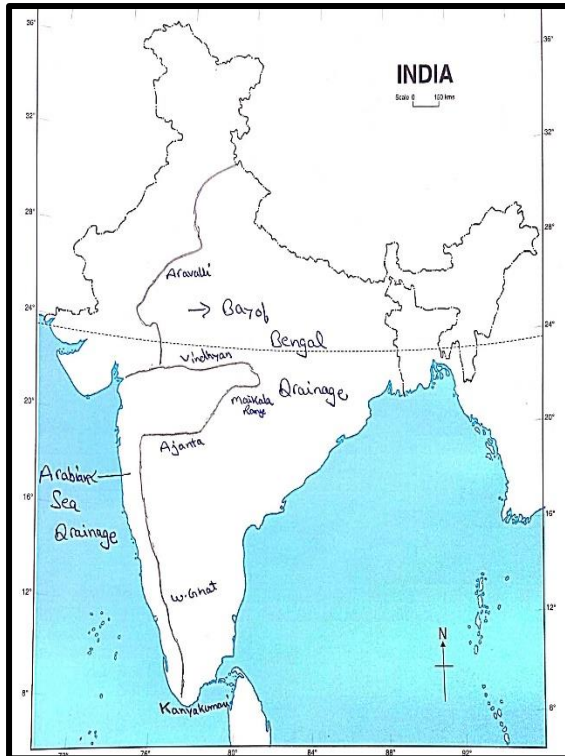


LECTURE 10 – INDIAN GEOGRAPHY: DRAINAGE SYSTEM OF INDIA

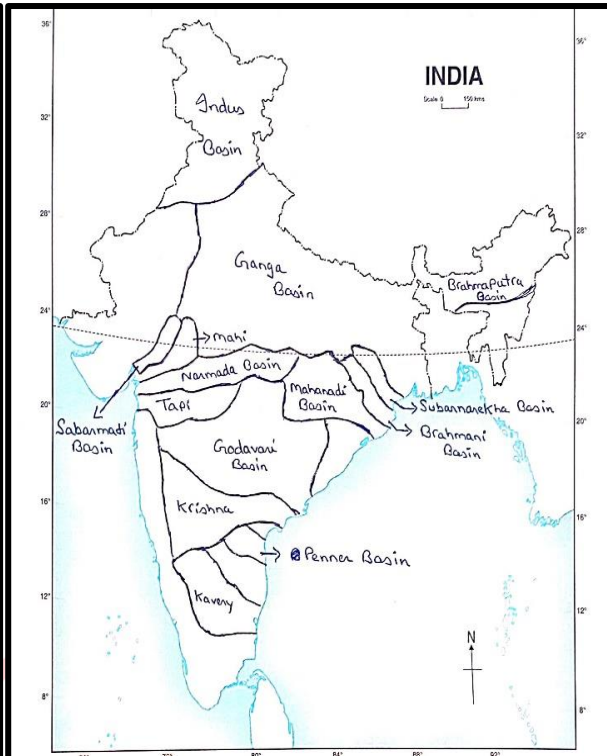
CLASSIFICATION OF DRAINAGE SYSTEM	FEATURES
Size of the Catchment Area	<p>Major River Basins</p> <ul style="list-style-type: none"> ➤ Rivers with catchment area of 20,000 sq km or above ➤ India has 14 such rivers basins and are in high rainfall areas ➤ Accounts for 85% of total run – off all rivers in the India <p>Medium River Basins</p> <ul style="list-style-type: none"> ➤ Rivers with catchment area between 2000 and 20,000 sq km ➤ India has 44 such rivers and are in medium rainfall areas <p>Minor River Basins</p> <ul style="list-style-type: none"> ➤ Rivers with catchment area less than 2000 sq km ➤ There are 55 such basins and are in areas of dry weather or along the West Coast
Origin	<ul style="list-style-type: none"> ➤ Himalayan Rivers: Rivers which originate in the Himalayas ➤ Peninsular Rivers: Rivers which originate in the Peninsular Plateaus
Orientation to the Sea	<p>Bay of Bengal drainage</p> <ul style="list-style-type: none"> ➤ Rivers which fall into Bay of Bengal ➤ 77% of the drainage area of India has orientation towards Bay of Bengal <p>Note – 90% of the water carried by Indian rivers fall into Bay of Bengal</p> <p>Arabian Sea drainage</p> <ul style="list-style-type: none"> ➤ Rivers which fall into Arabian Sea ➤ 23% of the drainage area of India has orientation towards Arabian Sea <hr/> <p>Why we most rivers have orientation towards Bay of Bengal?</p> <p>Because of the location of 2736 km long watershed which separates Bay of Bengal and Arabian Sea Drainage systems.</p>
Rivers with Largest Basins in India	Ganga > Indus > Godavari > Krishna > Brahmaputra > Narmada
Longest Rivers in India (Length in India only)	Ganga > Godavari > Krishna > Yamuna > Narmada > Indus > Brahmaputra
Longest Rivers in India (Total Length wise)	Indus > Brahmaputra > Ganga > Godavari
Rivers with largest Annual Water Yield in	Brahmaputra > Ganga > Godavari > Indus

India

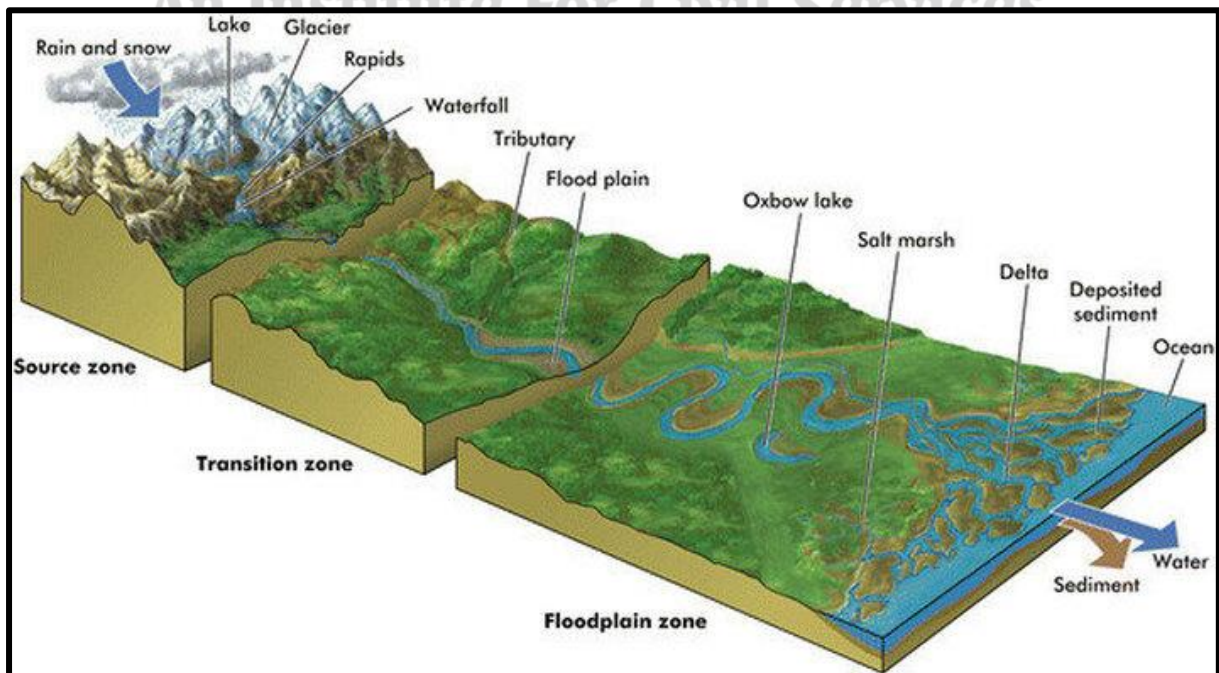
WATERSHED



14 MAJOR BASINS



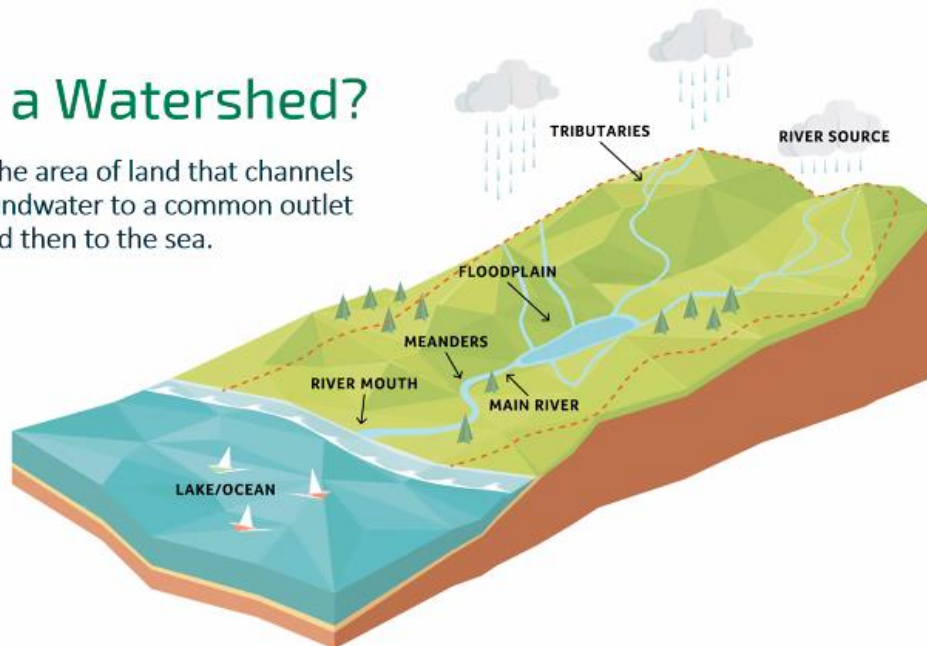
River System



Catchment Area and Watershed

What is a Watershed?

A watershed is the area of land that channels rainfall and groundwater to a common outlet such as a gut and then to the sea.



Designs or patterns which a river and its tributaries form together.

Drainage Patterns:

Network of such channels.

Drainage System:

Flow of water through well-defined channels.

Drainage:

Occurs in the lower course of a river.

Due to gentle gradient and less kinetic energy.

Lateral Erosion

Leads to U-shaped valleys due to more horizontal erosion.

Occurs in the upper course of a river.

Due to steep gradient and high kinetic energy.

Vertical Erosion:

Creates V-shaped valleys.

Basic Terminology

River Rejuvenation

Increase in the erosive power of a river.

River Regime:

Seasonal fluctuation in the volume of water in the river.

Discharge:

Volume of water flowing in a river over time.

Erosion:

Process of wearing away river beds and banks by a river.

Base Level of Erosion:

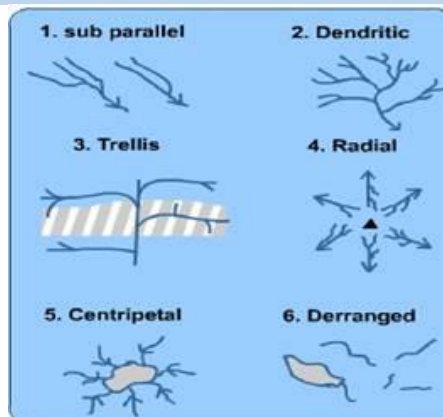
Lowest level to which vertical erosion is possible.

For large rivers: Sea is the base level.

For small rivers: Large rivers or lakes act as the base level.

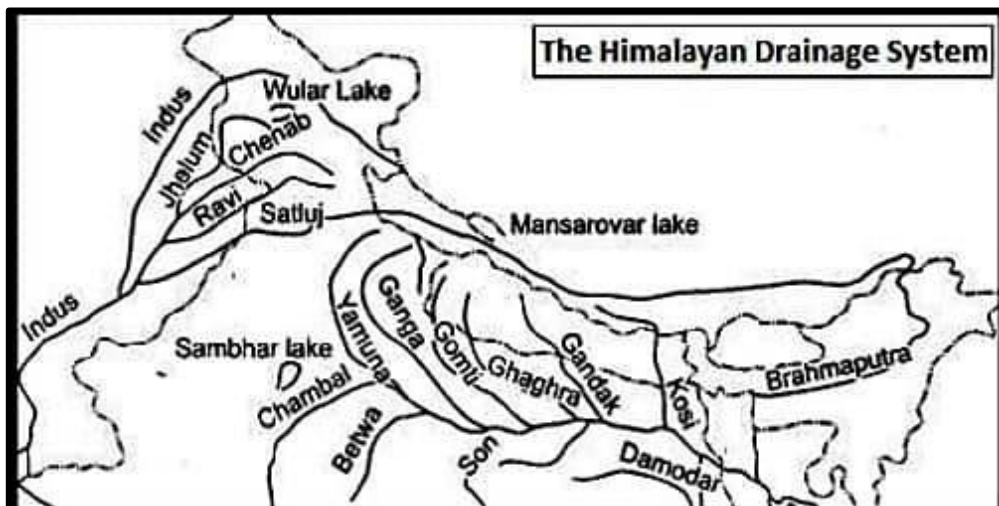
Presented with xmind

Drainage Patterns



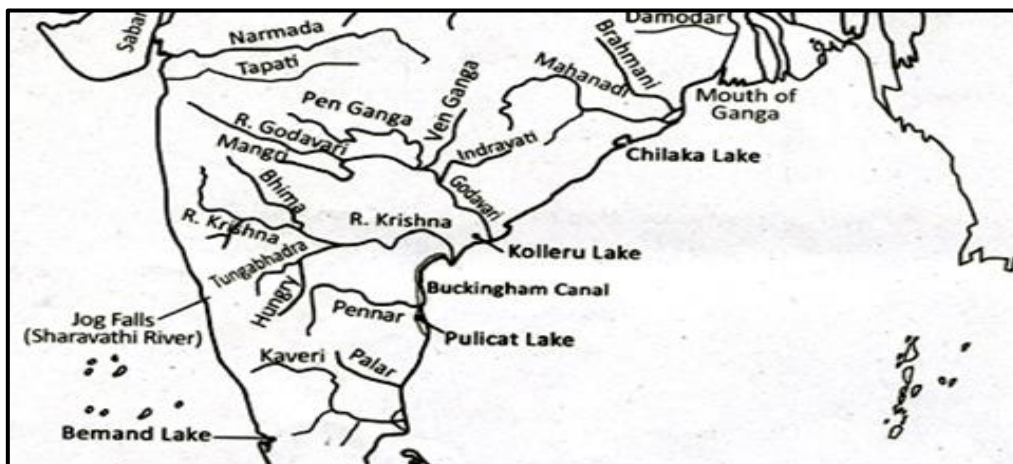
TYPES OF DRAINAGE PATTERNS	MEANING
Discordant	<p>Antecedent</p> <ul style="list-style-type: none"> ➤ Rivers which were present before the uplifting in the region & thus maintain their course ➤ Example – Sutlej, Indus <p>Super-Imposed</p> <ul style="list-style-type: none"> ➤ When a river follows the pattern which has no conformity with underlying rock structure ➤ Example – Damodar, Chambal, Banas
Concordant	<p>Consequent</p> <ul style="list-style-type: none"> ➤ Rivers which follow the slope of initial topography <p>Subsequent</p> <ul style="list-style-type: none"> ➤ Which develops after master consequent stream <p>Obsequent</p> <ul style="list-style-type: none"> ➤ Which follows the opposite direction of master consequent stream
Others	<p>Dendritic</p> <ul style="list-style-type: none"> ➤ Resemble branch of a tree ➤ Develops when river follows slope of the terrain ➤ Example – North Indian Plain Rivers <p>Radial</p> <ul style="list-style-type: none"> ➤ When streams from a higher region flows in different direction. ➤ Example – Amarkantak Plateau (Narmada River, Son River, Johila River) <p>Centripetal</p> <ul style="list-style-type: none"> ➤ When river discharge water in a common central region ➤ Example – Loktak Lake, Sambhar Lake <p>Trellis</p> <ul style="list-style-type: none"> ➤ When primary tributaries flow parallel to each other and secondary tributaries join them at right angles

Himalayan Rivers and Peninsula Rivers

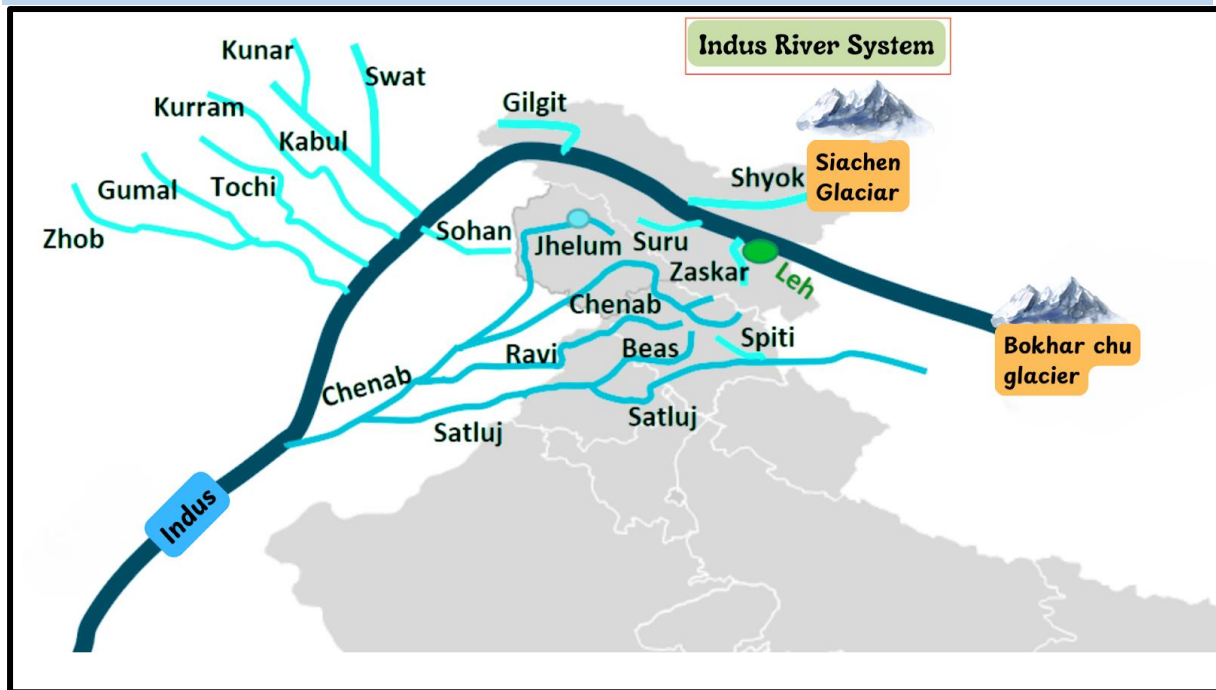


DIMENSIONS	HIMALAYAN RIVERS	PENINSULAR RIVERS
Origin	➤ In Himalayas	➤ In Peninsular Plateaus
Basins and Catchment Areas	➤ Large	➤ Small
Valleys	➤ Deep, I – Shaped valleys or V shaped Valleys and deep gorges	➤ Shallow and Broad Valleys
Drainage	➤ Antecedent (Older than Himalayas) – Indus, Brahmaputra, Sutlej Rivers ➤ Non – Antecedent like Ganga, Yamuna	➤ Consequent – follows the general direction of the slope
Nature	➤ Perennial – water flows throughout the year as they receive water from both monsoon and snow melt	➤ Seasonal / Non - Perennial – As they receive waters mainly during rainy season
Stage	➤ Youthful	➤ Mature
Velocity and Carrying Capacity of Rivers	➤ High	➤ Low
Erosion	➤ Vertical Erosion is Prominent	➤ Almost reached their base level thus vertical erosion is negligible
Meanders	➤ Yes	➤ Little scope of Meandering as these rivers flows over hard – rock surface which has non – alluvial character
River Course	➤ Curvy, Long and there is shifting of course	➤ More or Less Straight, Small and Fixed Course
Deltas and Estuaries	➤ Forms large deltas	➤ Some form deltas and some form estuaries

Peninsular Rivers



Indus River



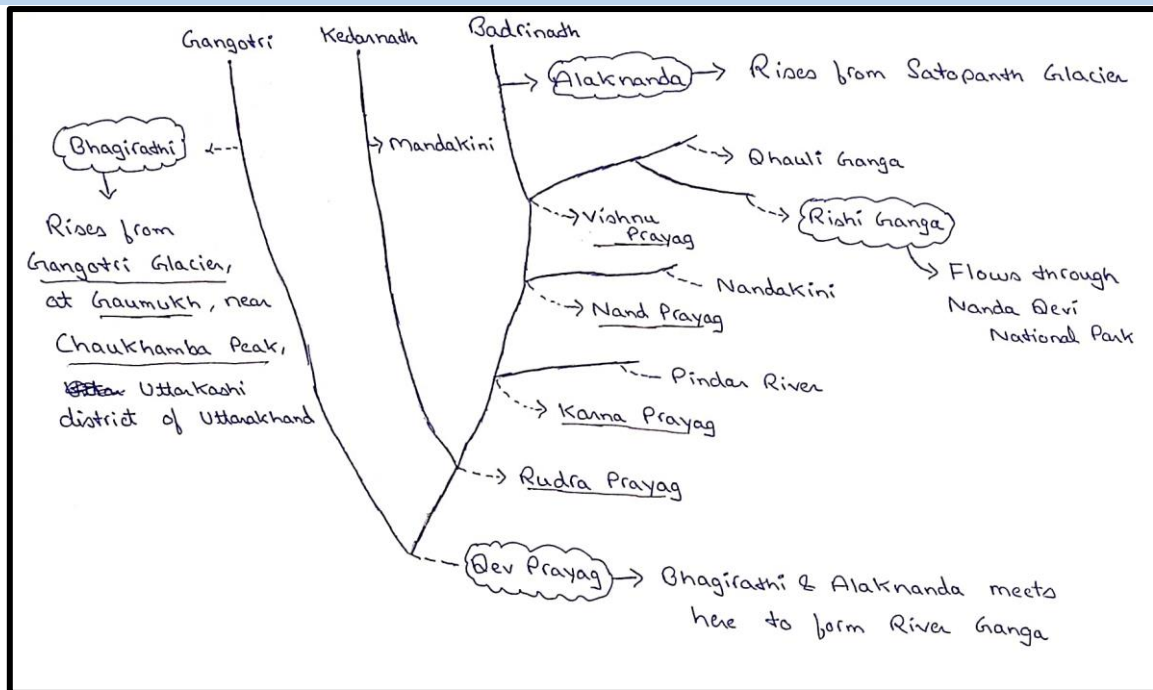
Source	➤ Bokhar Chu Glacier , Mansarovar Lake, Kailash Range, Tibet
Different Name	➤ Singee Khabab or Lion's Mouth in Tibet
Enters India	➤ In Ladakh Region at a place called Demchok
River Course	<ul style="list-style-type: none"> ➤ After entering India, it flows in North – West direction between Ladakh and Zaskar Range ➤ Then, around Nanga Parbat it takes sharp Southerly turn ➤ Thereafter, it reaches Attock where it ends its mountainous journey and flows through Potwar Plain and crosses Salt Range ➤ Just above Mithankot, it receives Pachnad ➤ River forms big delta south of Karachi before meeting Arabian Sea

Important Tributaries of Indus

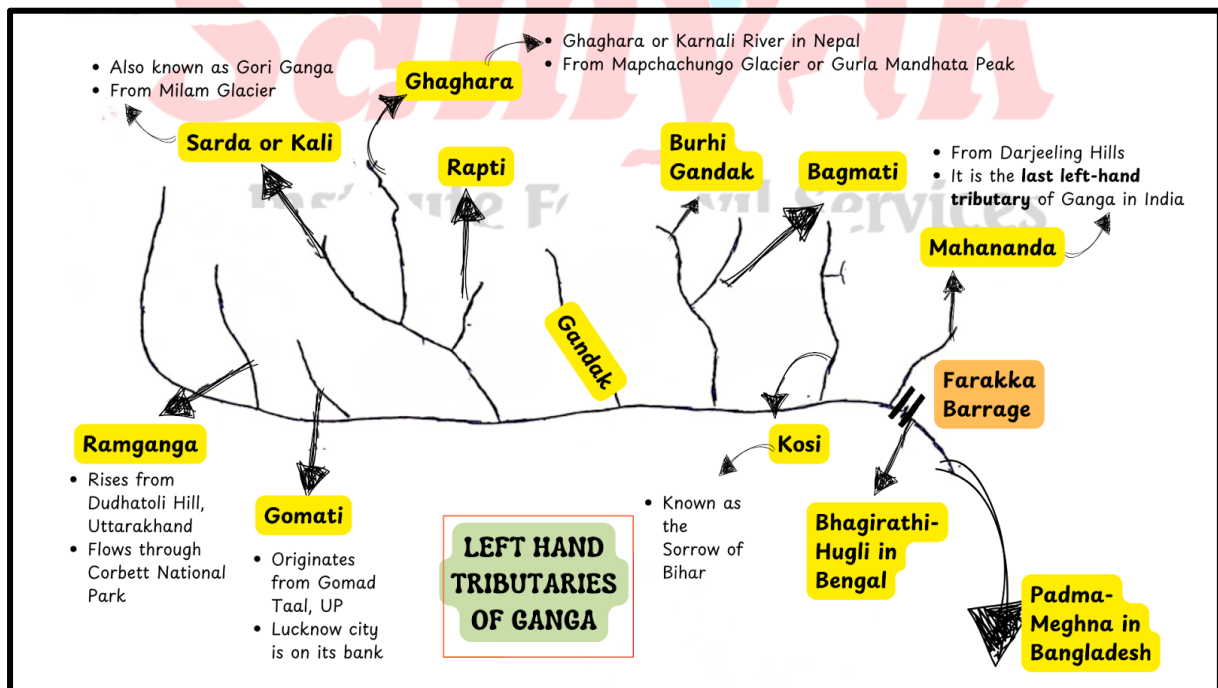
TRIBUTARIES	SOURCE	IMPORTANT FEATURES
Zaskar	In Zaskar Region	➤ First Tributary of River Indus in India
Suru	Deosai Mountain	<ul style="list-style-type: none"> ➤ Flows in opposite direction of Indus – Obsequent Tributary ➤ Dras is tributary of Suru River ➤ Kargil lies on its bank ➤ Dams <ul style="list-style-type: none"> ➡ Chutak Dam
Kishen Ganga	Drass	<ul style="list-style-type: none"> ➤ Tributary of Jhelum ➤ Also known as Neelam River due to its sky cold water or due to the precious stone “ruby (Neelam)” that is found in this area.
Jhelum	Verinag, Pir Panjal	<ul style="list-style-type: none"> ➤ Flows through Kashmir Valley and Wular Lake ➤ Tributary of Chenab and meets Chenab at Jhang or Trimmu, Pakistan

		<ul style="list-style-type: none"> ➤ It forms boundary between India and Pakistan ➤ Dams <ul style="list-style-type: none"> ☞ Uri Dam – Jammu & Kashmir
Chenab	Bara Lacha Pass, Lahul – Spiti of Zaskar Range	<ul style="list-style-type: none"> ➤ Formed by the confluence of two streams – Chandra and Bhaga at Tandi ➤ Longest Tributary of Indus ➤ Dams <ul style="list-style-type: none"> ☞ Baglihar Dam – Jammu & Kashmir ☞ Dulhasti Dam – Jammu & Kashmir ☞ Rattle Hydroelectric project – Jammu & Kashmir
Ravi	Kullu Hills, Near Rohtang Pass, Dhauladhar Range	<ul style="list-style-type: none"> ➤ Flows through Chamba valley of Himachal Pradesh ➤ Dams <ul style="list-style-type: none"> ☞ Thein Dam / Ranjit Sagar Dam - Punjab ☞ Ujh Multi – purpose project on Ujh River – tributary of Ravi River ☞ Shahpurkandi Dam – Punjab ☞ Bassi Dam – Himachal Pradesh
Beas	Beas Kund, Near Rohtang Pass	<ul style="list-style-type: none"> ➤ Manali lies on its banks ➤ Lies entirely within Indian Territory ➤ Dams <ul style="list-style-type: none"> ☞ Pandoh Dam – Himachal Pradesh ☞ Pong Dam – Himachal Pradesh
Sutlej	Mansarovar – Rakas Lake, Tibet	<ul style="list-style-type: none"> ➤ Also known as <ul style="list-style-type: none"> ☞ Red River ☞ Langchen Khambab ➤ Enters India via Shipki La Pass in Himachal Pradesh ➤ Forms boundary between India – Pakistan ➤ Joins Chenab to form Panchnad ➤ Dams <ul style="list-style-type: none"> ☞ Kol Dam – Himachal Pradesh ☞ Nathpa Jhakri Project – Himachal Pradesh ☞ Bhakra Dam – Himachal Pradesh

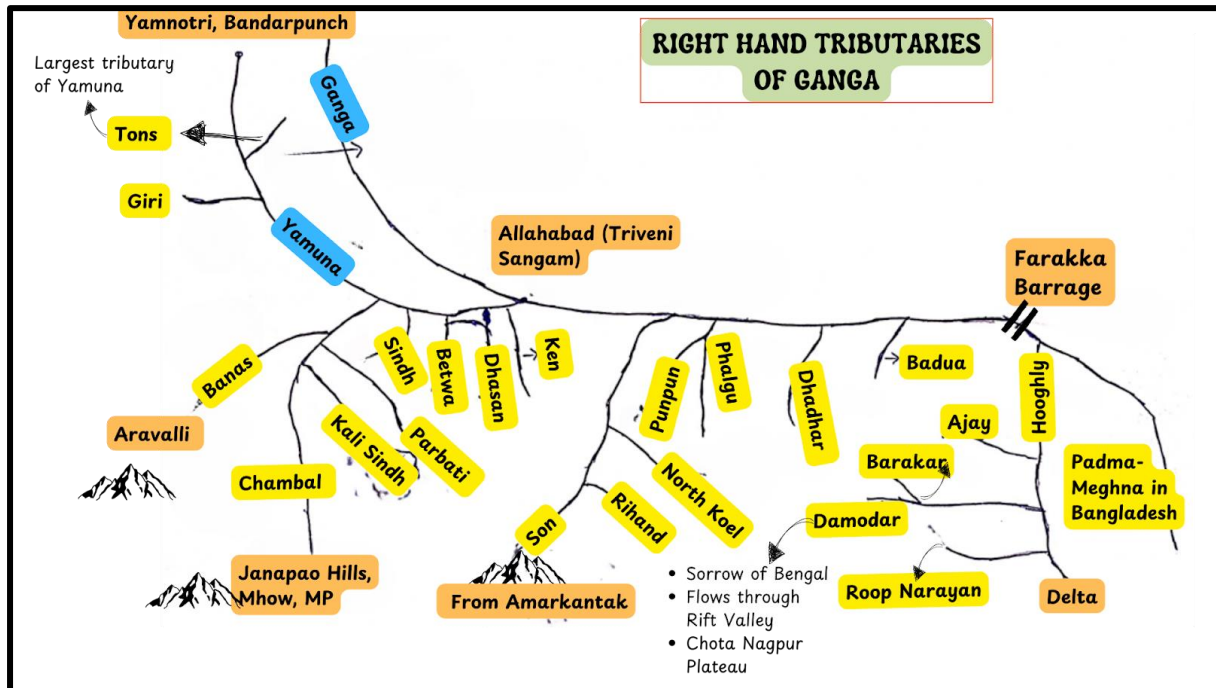
River Ganga



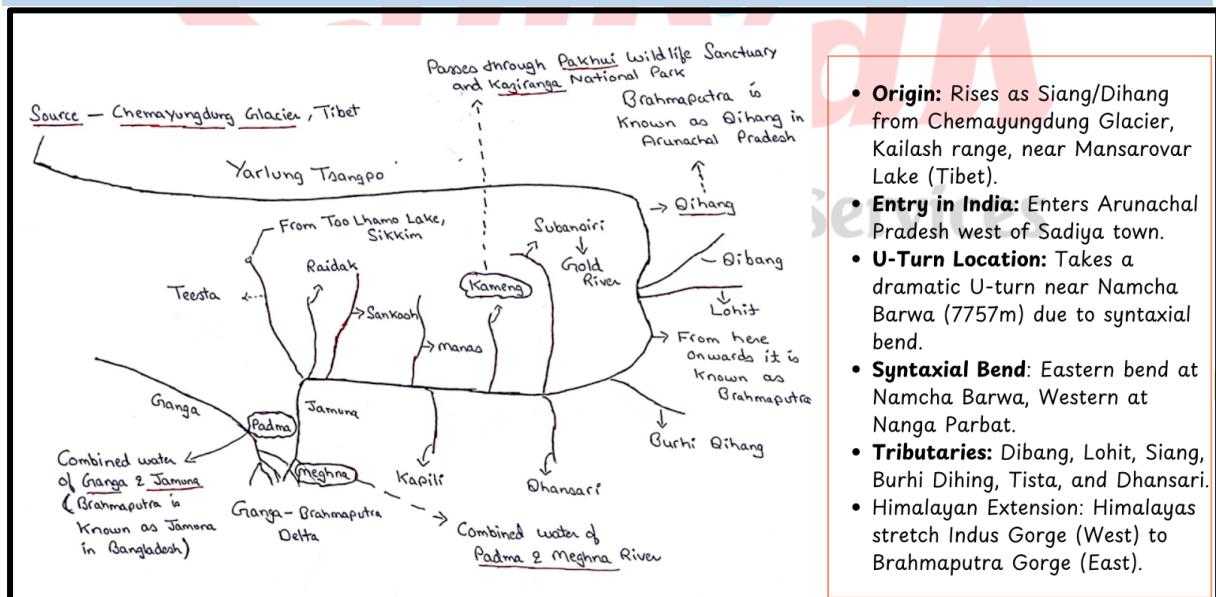
Left Hand Tributaries of River Ganga

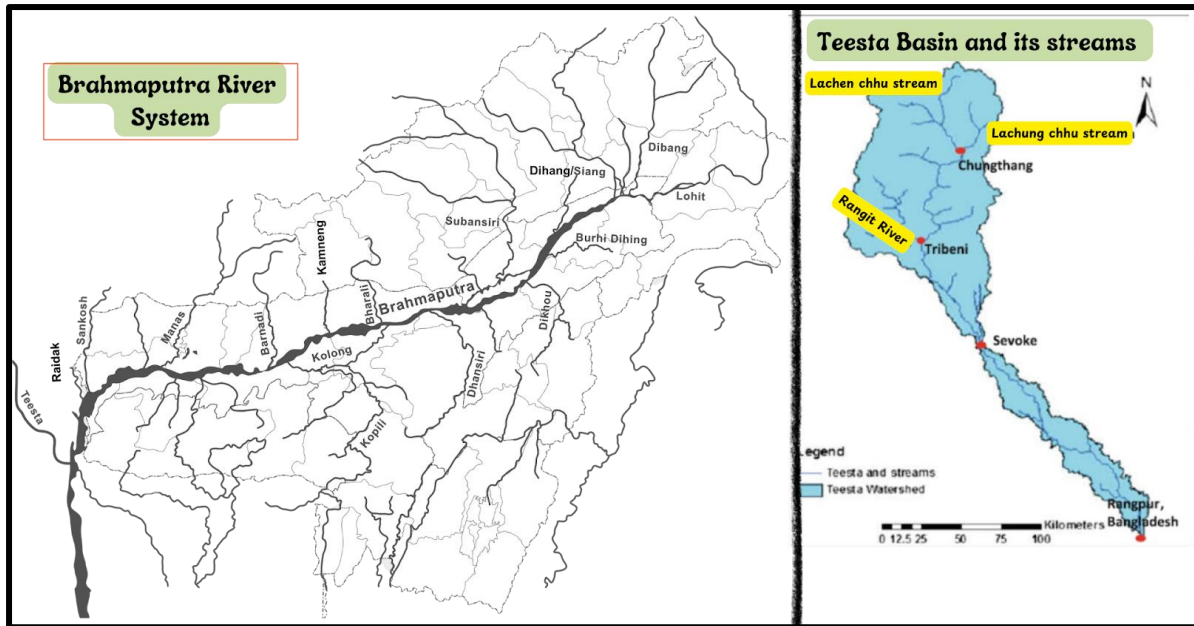


Right Hand Tributaries of River Ganga

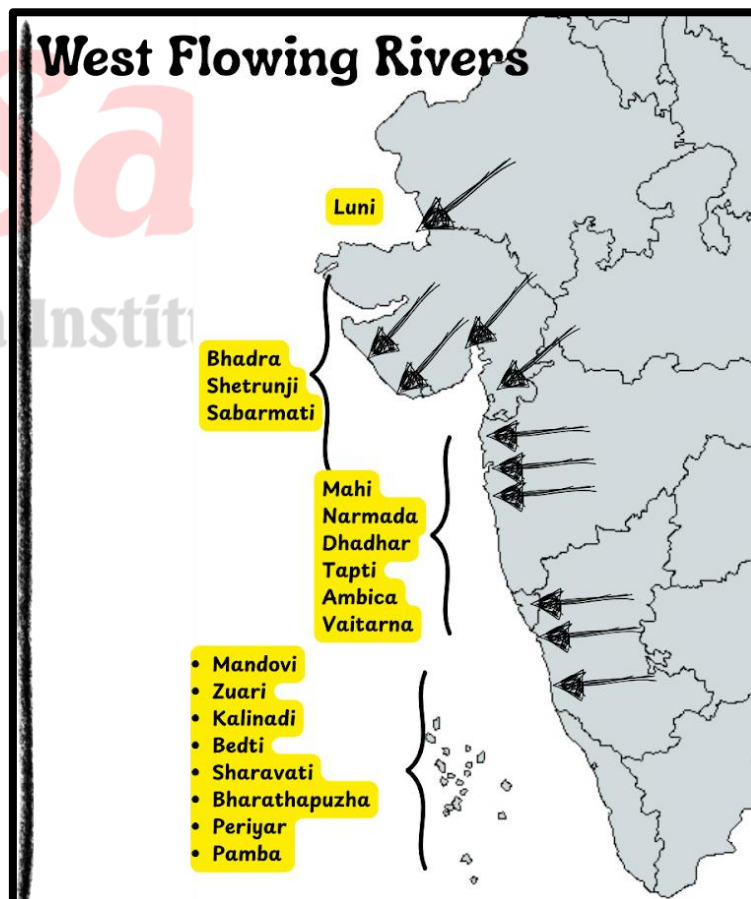


River Brahmaputra

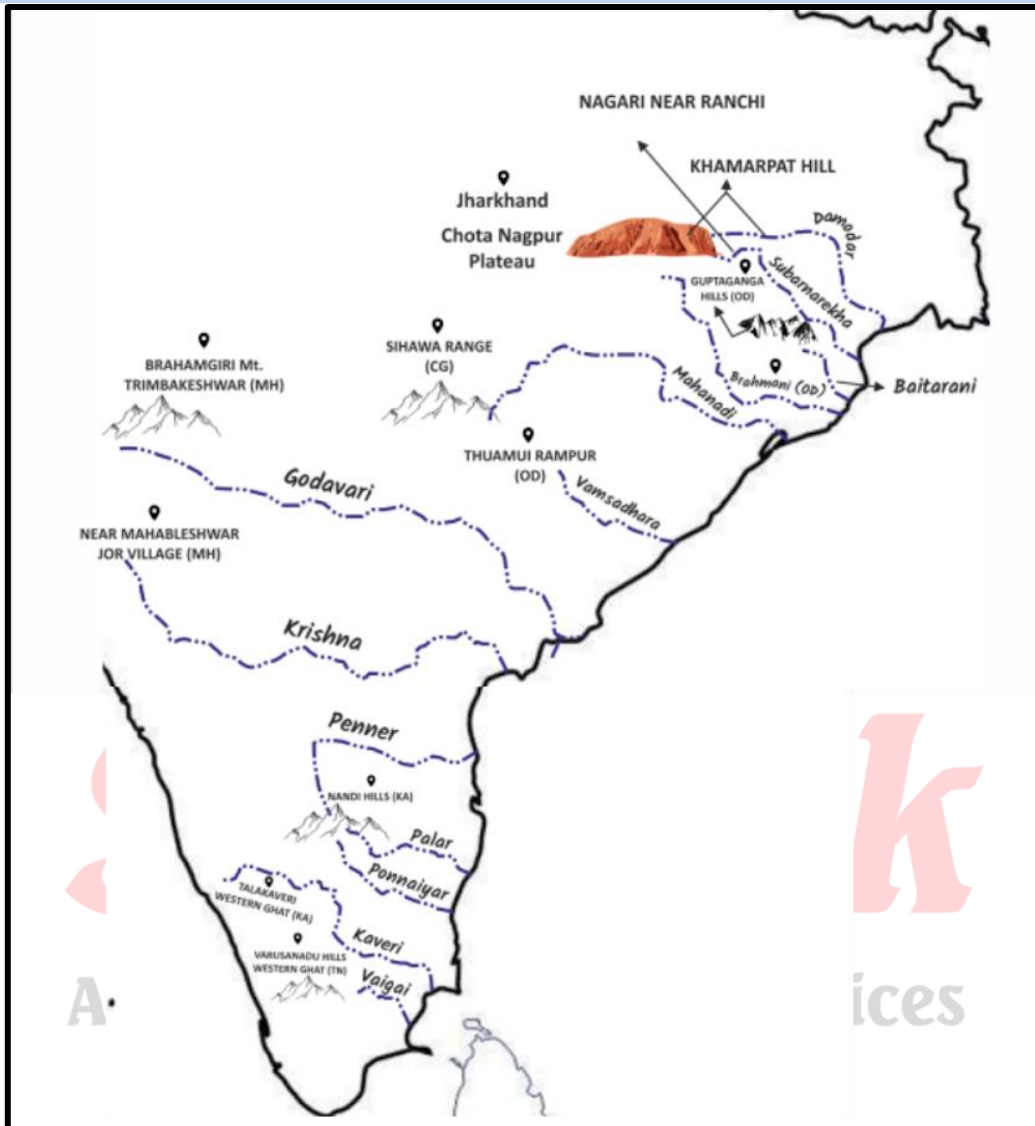




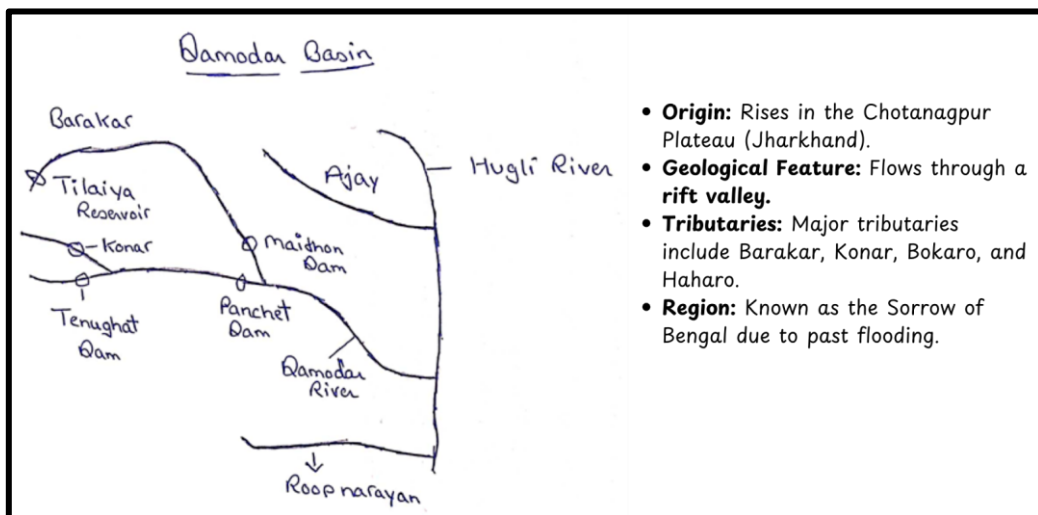
West flowing rivers



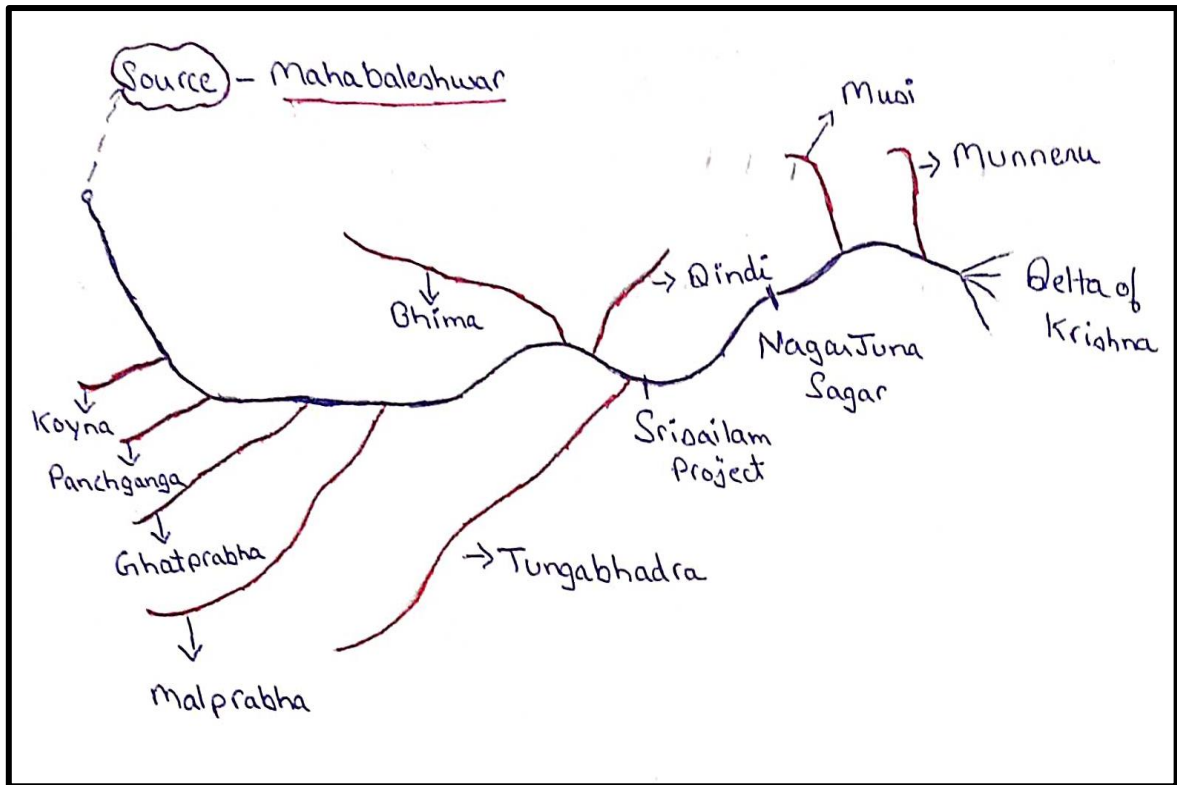
East Flowing Rivers



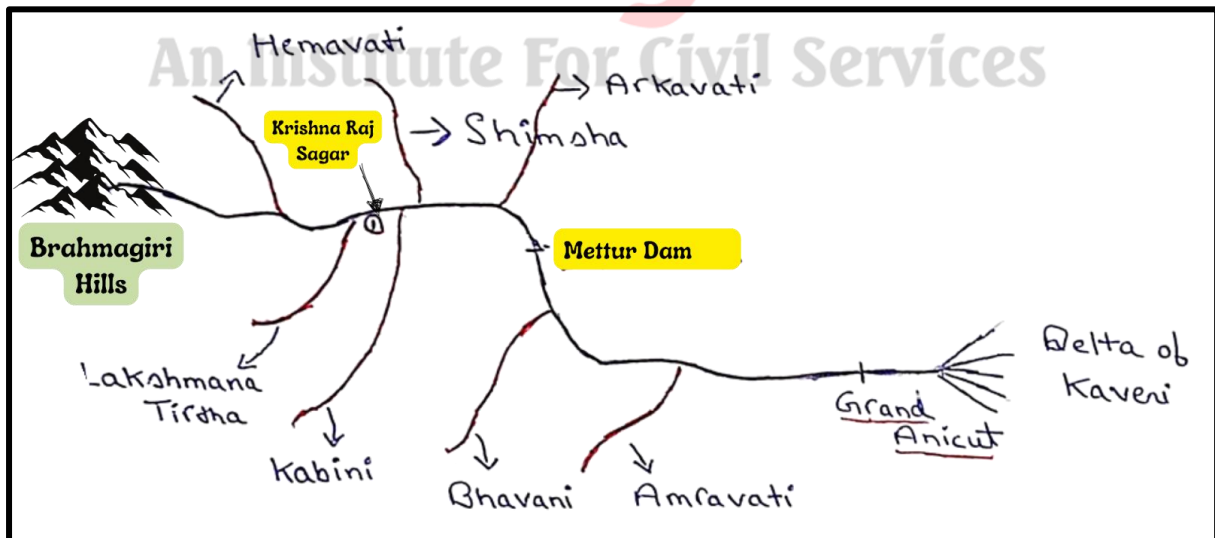
River Damodar



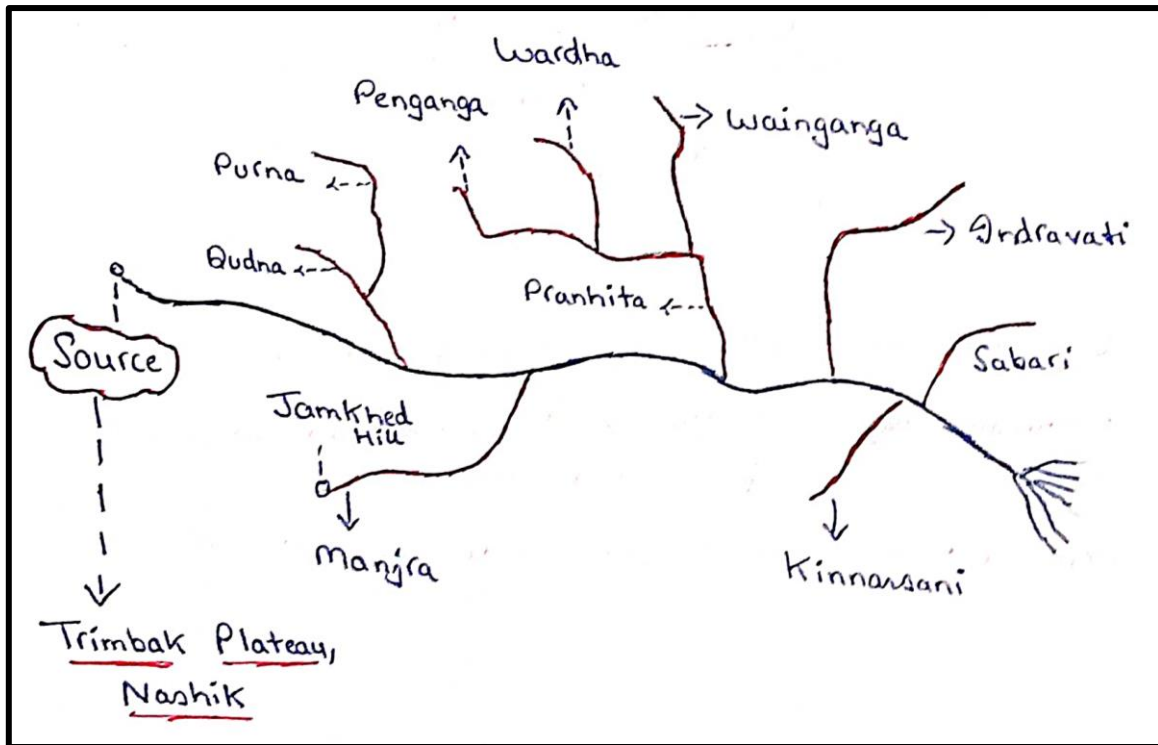
River Krishna



River Kaveri

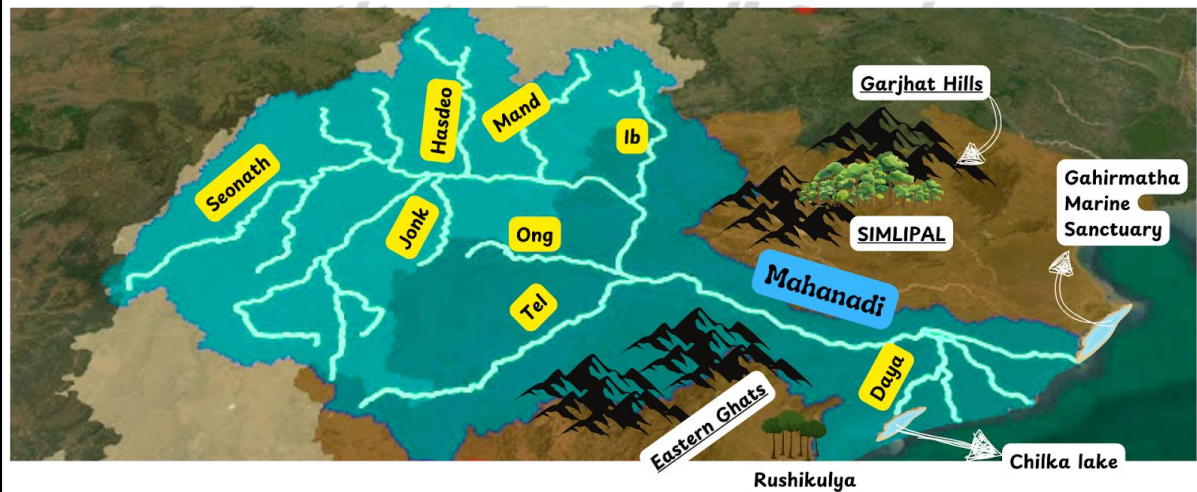


River Godavari



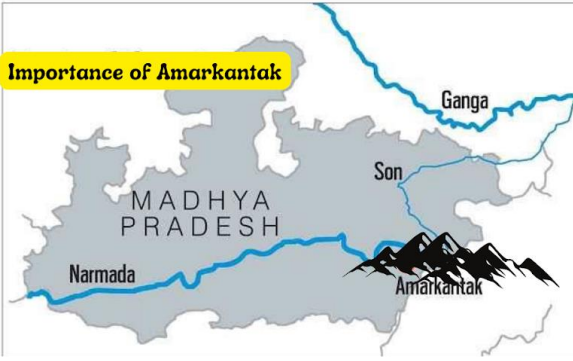
River Mahanadi

Mahanadi River System

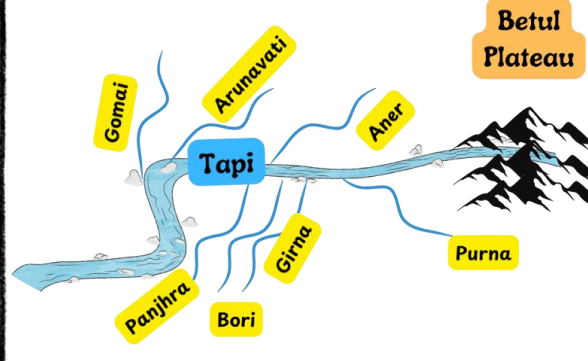


Importance of Amarkantak

Importance of Amarkantak



- Located in Anuppur district of Madhya Pradesh near the Chhattisgarh border.
- Lies at the confluence of the Vindhya and Satpura mountain ranges.
- Origin point of the Narmada, Son, and Johilla rivers.



- Located in the Deccan Plateau region; Flows through a rift valley,
- **Basin States:** Covers parts of Madhya Pradesh, Maharashtra, and Gujarat.
- **Outflow:** Empties into the Gulf of Khambat.
- **Basin Boundaries:** Bounded by Satpura Range (North), Mahadev Hills (East), Ajanta & Satmala Hills (South), and Arabian Sea (West).

Dams and Reservoirs

STATE	DAMS AND RIVERS	RESERVOIRS
Andhra Pradesh	River Krishna <ul style="list-style-type: none"> ✓ Srisailem Dam ✓ Nagarjuna Sagar (World's largest masonry dam) River Godavari <ul style="list-style-type: none"> ✓ Polavaram ✓ Jalaput Dam Penna River <ul style="list-style-type: none"> ✓ Somasila Dam 	Gosthani River <ul style="list-style-type: none"> ✓ Tatipudi Reservoir Manneru River <ul style="list-style-type: none"> ✓ Gandipalem Reservoir
Arunachal Pradesh	River Subansari <ul style="list-style-type: none"> ✓ Subansari Dam River Ranganadi <ul style="list-style-type: none"> ✓ Ranganadi Dam 	
Bihar	Nagi River <ul style="list-style-type: none"> ✓ Nagi Dam 	
Chhattisgarh	River Mahanadi <ul style="list-style-type: none"> ✓ Gangrel Dam ✓ Dudhawa Dam River Hasdeo <ul style="list-style-type: none"> ✓ Minimata Dam ✓ Bango Dam 	
Gujarat	River Tapi <ul style="list-style-type: none"> ✓ Ukai Dam 	

	River Narmada ✓ Sardar Sarovar Mahi River ✓ Kandan Dam Banas River ✓ Dantiwada Dam	
Punjab	River Sutlej ✓ Nangal Dam River Ravi ✓ Thein(Ranjit Sagar) Dam Damsal River ✓ Damsal Dam	
Himachal Pradesh	River Sutlej ✓ Bhakra Dam ✓ Nathpa Jhakri Dam River Beas ✓ Pandoh Dam ✓ Maharana Pratap Sagar River Ravi ✓ Chamera Dam	River Sutlej ✓ Gobind Sagar Pong Dam Lake ✓ Maharana Pratap Sagar
Jammu Kashmir	River Chenab ✓ Baghliar Dam ✓ Salal ✓ Dulhasti River Cholal Cho ✓ Cholal Dam River Jhelum ✓ Uri Dam River Indus ✓ Dumkhar Hydroelectric	Suru River ✓ Chutak Hydroelectric Project
Jharkhand	River Damodar ✓ Panchet ✓ Tenughat River Barakar ✓ Maithon Dam ✓ Tilaiya River Konar ✓ Konar Dam Damodar valley multipurpose project four dams: Tilaiya and Maithon (on the Barakar River), Konar (Konar River), and Panchet (Damodar River)	
Karnataka	River Krishna ✓ Almatti Dam ✓ Krishnarajsagar	

	<ul style="list-style-type: none"> ✓ shivsamudram Ghataprabha River <ul style="list-style-type: none"> ✓ Hidkal Dam Sharavati River <ul style="list-style-type: none"> ✓ Linganamakki Dam 	
Kerala	Periyar River <ul style="list-style-type: none"> ✓ Idduki Dam ✓ Mulaperiyar Dam 	
Madhya Pradesh	River Son <ul style="list-style-type: none"> ✓ Banesagar Dam River Narmada <ul style="list-style-type: none"> ✓ Indira Sagar Dam ✓ Omkareshwar Dam ✓ Bargi Dam River Chambal <ul style="list-style-type: none"> ✓ Gandhi Sagar Dam River Sindh <ul style="list-style-type: none"> ✓ Madikheda Dam River Tawa <ul style="list-style-type: none"> ✓ Tawa Dam 	
Maharastra	River Godavari <ul style="list-style-type: none"> ✓ Jayakwadi(Paithan) Dam River Koyna <ul style="list-style-type: none"> ✓ Koyna Dam River Penganga <ul style="list-style-type: none"> ✓ Isapur Dam River Pench <ul style="list-style-type: none"> ✓ Totladoh 	
Odisha	Mahanadi River <ul style="list-style-type: none"> ✓ Hirakud (Longest in India) Brahmni River <ul style="list-style-type: none"> ✓ Rengali Dam River Sankha <ul style="list-style-type: none"> ✓ Mandira Dam 	Sileru River <ul style="list-style-type: none"> ✓ Balimela Reservoir
Rajasthan	River Banas <ul style="list-style-type: none"> ✓ Bisalpur Dam River Chambal <ul style="list-style-type: none"> ✓ Jawahar Sagar ✓ Rana Pratap Sagar River Mahi <ul style="list-style-type: none"> ✓ Mahi Bajaj Sagar Dam 	
Tamil Nadu	Kaveri River <ul style="list-style-type: none"> ✓ Mettur Dam ✓ Kallanai Dam (Oldest in India) Vagai River <ul style="list-style-type: none"> ✓ Vagai Dam 	Kaveri River <ul style="list-style-type: none"> ✓ Stanley Reservoir Periya Odai River <ul style="list-style-type: none"> ✓ Willingdon Reservoir Others- <ul style="list-style-type: none"> ✓ Bhavani Sagar

	River Bhavani ✓ Bhavani Sagar Dam	Reservoir ✓ Pambar Reservoir ✓ Periyar Reservoir ✓ Parambikulam Reservoir
Telangana	Manjira River ✓ Nizam Sagar Dam ✓ Singur Dam River Godavari ✓ Ramagundam Dam ✓ Sriram Sagar Dam	Krishna River ✓ Dindi Reservoir Osman Sagar ✓ Himayat Sagar Reservoir Godavari River ✓ Sriram Sagar Reservoir
Uttar Pradesh	River Betwa ✓ Matatila Dam ✓ Rajghat Dam ✓ Parichha Dam Rihand River ✓ Rihand Dam	Rihand River ➤ Govind Vallabh Pant Sagar
Uttarakhand	River Bhagirathi ✓ Tehri Dam (Highest in India) ✓ Koteswar Dam River Yamuna ✓ Lakhwar Dam Deoha River ✓ Nanak Sagar	
West Bengal	River Damodar ✓ Panchet Dam ✓ Durgapur Barrage River Ganga ✓ Farakka Barrage	

Lakes in India

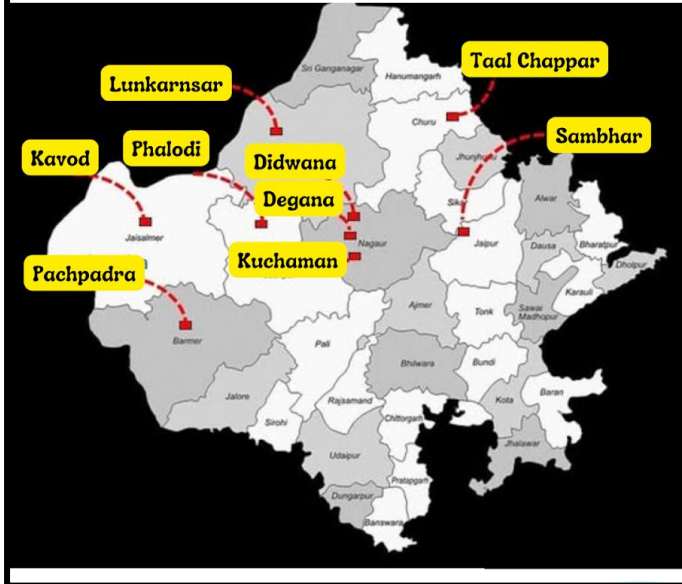
STATE	LAKES
Andhra Pradesh	➤ Pulicat Lake ➤ Second-largest brackish-water lake or lagoon ➤ Located on the border of Tamil Nadu and Andhra Pradesh. ➤ Sriharikota Island – Satish Dhawan Space Center ➤ Kolleru Lake
Assam	➤ Deepor Beel ➤ Chandubi lake ➤ Haflong Lake ➤ Son Beel ➤ Tectonically Formed
Bihar	➤ Kanwar Lake

	➤ Asia's largest freshwater oxbow lake
Gujarat	<ul style="list-style-type: none"> ➤ Hamirsar Lake ➤ Kankaria Lake
Haryana	➤ Brahma Sarovar
Himachal Pradesh	<ul style="list-style-type: none"> ➤ Chandra Tal ➤ Maharana Pratap Sagar ➤ Gobind Sagar Lake
Jammu Kashmir	Dal lake <ul style="list-style-type: none"> ➤ Biggest tulip garden in Asia. Wular Lake <ul style="list-style-type: none"> ➤ India's largest freshwater lake ➤ Tectonic Lake
Karnataka	<ul style="list-style-type: none"> ➤ Agara Lake ➤ Ulsoor Lake
Kerala	<ul style="list-style-type: none"> ➤ Sasthamkotta Lake ➤ Periyar Lake ➤ Vembanand Lake <ul style="list-style-type: none"> ➤ Longest Lake in India ➤ Nehru Trophy Boat Race ➤ Kuttanad ➤ Ashtamudi
Ladakh	<ul style="list-style-type: none"> ➤ Pangong Lake ➤ Tsomoriri Note – Both are Saltwater Lake
Madhya Pradesh	➤ Bhojtal
Maharashtra	<ul style="list-style-type: none"> ➤ Shivsagar ➤ Lonar Lake <ul style="list-style-type: none"> ➤ created by impact of Meteor – Crater Lake ➤ Its colour changed to pink recently due to presence of algae and a low water level.
Manipur	➤ Loktak lake
Meghalaya	<ul style="list-style-type: none"> ➤ Umiam Lake ➤ Barapani Lake
Mizoram	➤ Tam Dil
Odisha	<ul style="list-style-type: none"> ➤ Chilka Lake <ul style="list-style-type: none"> ➤ The largest coastal lagoon in the nation and the second largest in the world ➤ Has Nalaban Island – bird sanctuary
Punjab	<ul style="list-style-type: none"> ➤ Harike ➤ kanjili
Rajasthan	<ul style="list-style-type: none"> ➤ Sambhar <ul style="list-style-type: none"> ➤ Largest Inland salt lake in India ➤ Pushkar Lake ➤ Nakki Lake <ul style="list-style-type: none"> ➤ Mahatma Gandhi's ashes were scattered into this Lake, and Gandhi Ghat was built.

	<ul style="list-style-type: none"> ➤ Jaisamand lake (Dhebar) – Artificial Lake ➤ India's Second Largest Artificial Lake
Sikkim	<ul style="list-style-type: none"> ➤ Tsomgo / Changu Lake ➤ Glacial Lake ➤ Cholamu Lake ➤ Highest Lake in India
Telangana	<ul style="list-style-type: none"> ➤ Hussain Sagar ➤ 16-meter-tall, 350-ton monolithic Buddha statue atop the "Rock of Gibraltar" placed in the middle of the lake
Tamil Nadu	<ul style="list-style-type: none"> ➤ Chembarambakkam ➤ Kaliveli ➤ Kodaikanal
Uttar Pradesh	<ul style="list-style-type: none"> ➤ Belasagar ➤ Govind Vallabh Pant Sagar ➤ Largest Artificial Lake in India
Uttarakhand	<ul style="list-style-type: none"> ➤ Bhimtal ➤ Largest Lake in Kumaon Region ➤ Nainital ➤ Crescent Shape
ARTIFICIAL LAKES / MAN – MADE LAKES IN INDIA	
Telangana	<ul style="list-style-type: none"> ➤ Himayat sagar ➤ Pakhal Lake ➤ Hussain Sagar
Uttar Pradesh	<ul style="list-style-type: none"> ➤ Govind Vallabh Pant (Largest Man – Made Lake in India)
Tamil Nadu	<ul style="list-style-type: none"> ➤ Chembarambakkam Lake ➤ Kodaikanal
Haryana	<ul style="list-style-type: none"> ➤ Badhkal Lake
Gujarat	<ul style="list-style-type: none"> ➤ Narayan Sarovar ➤ Kankaria Lake ➤ Hamirsar Lake
Andhra Pradesh	<ul style="list-style-type: none"> ➤ Nagarjuna Sagar
Rajasthan	<ul style="list-style-type: none"> ➤ Jaisamand Lake
Madhya Pradesh	<ul style="list-style-type: none"> ➤ Bhojtal
Himachal Pradesh	<ul style="list-style-type: none"> ➤ Gobind sagar

LAKES IN NEWS

Saline Lakes in Rajasthan



DownToEarth

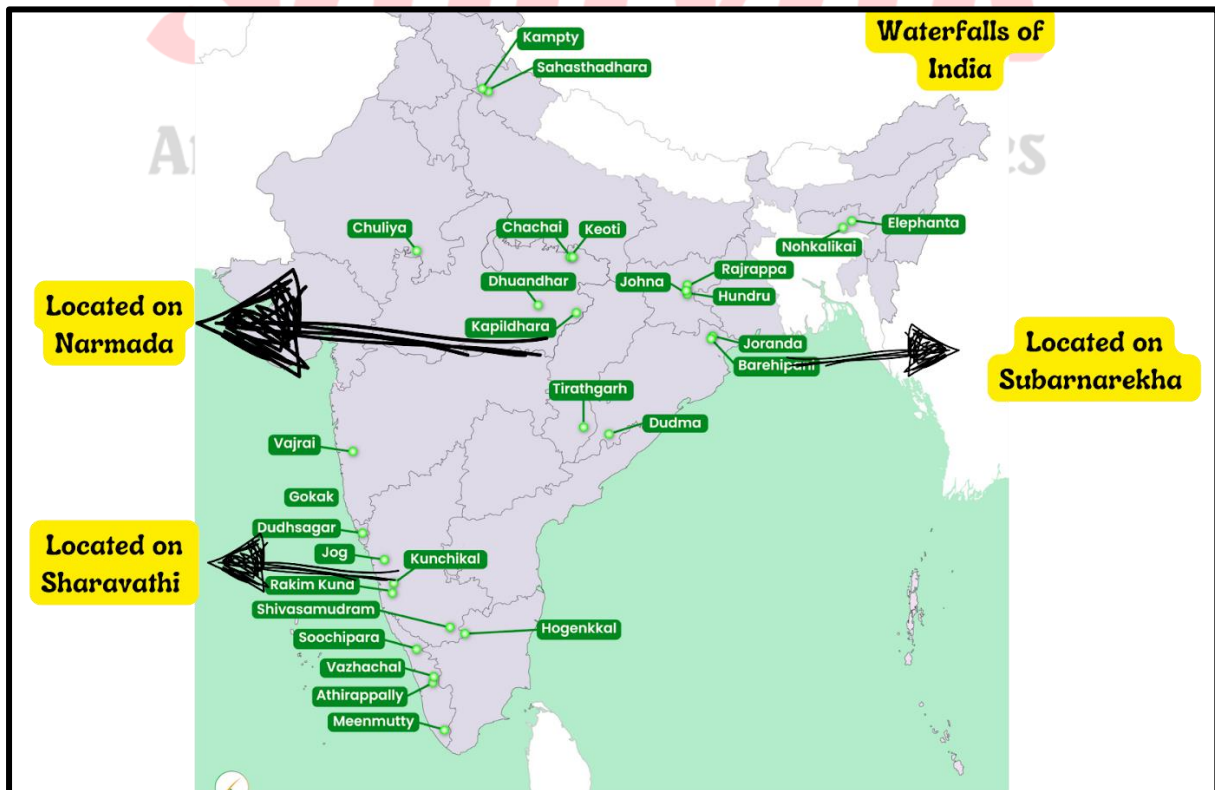
Wildlife & Biodiversity

Extreme weather may have triggered avian botulism, leading to 600 bird deaths in Rajasthan

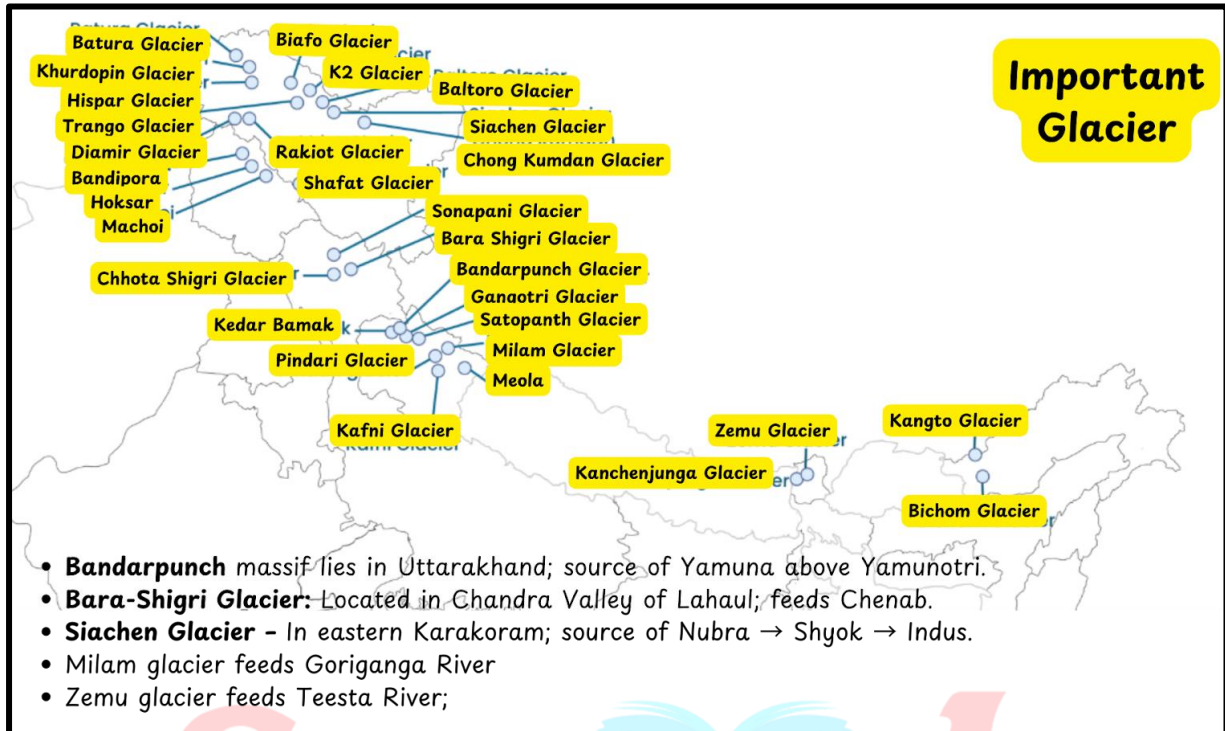
High temperatures and a drop in salinity in Sambhar lake may have created conditions for the deadly bacterial outbreak

- Over 600 migratory birds died at Sambhar Lake in Rajasthan due to suspected avian botulism.
- Deaths began on October 26, 2024, and lasted for about two weeks.
- Avian botulism is caused by a toxin from *Clostridium botulinum*, leading to bird paralysis and death.
- The toxin thrives in wetland sediments, in both invertebrates and vertebrates.
- High temperatures, low oxygen, and organic nutrients trigger bacterial outbreaks.
- No cure exists; affected birds must be immediately removed and disposed of.

Waterfalls of India



Important Glacier



Important cities located on river banks

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City	River	City	River
Agra	Yamuna	Kanpur	Ganga
Ahmedabad	Sabarmati	Kolkata	Hooghly
Allahabad (Prayagraj)	Ganga and Yamuna (Confluence)	Kota	Chambal
Ayodhya	Saryu	Lucknow	Gomti
Badrinath	Alaknanda	Ludhiana	Sutlej
Bareilly	Ramganga	Mathura	Yamuna
Cuttack	Mahanadi	Nashik	Godavari
Delhi	Yamuna	Panaji	Mandovi
Dibrugarh	Brahmaputra	Patna	Ganga
Firozpur	Sutlej	Sambalpur	Mahanadi
Guwahati	Brahmaputra	Srinagar	Jhelum
Haridwar	Ganga	Surat	Tapti
Hyderabad	Musi	Tiruchirapalli	Cauvery
Jabalpur	Narmada	Ujjain	Kshipra
Jamshedpur	Subarnarekha	Varanasi	Ganga
Jaunpur	Gomti	Vijayawada	Krishna