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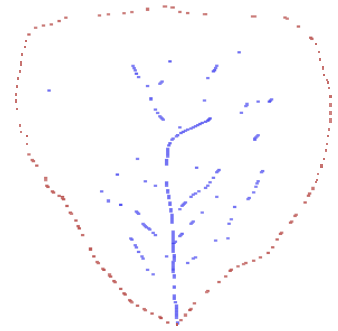
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**Introduction**

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 dashed line in the adjacent graphic shows a basin.



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.

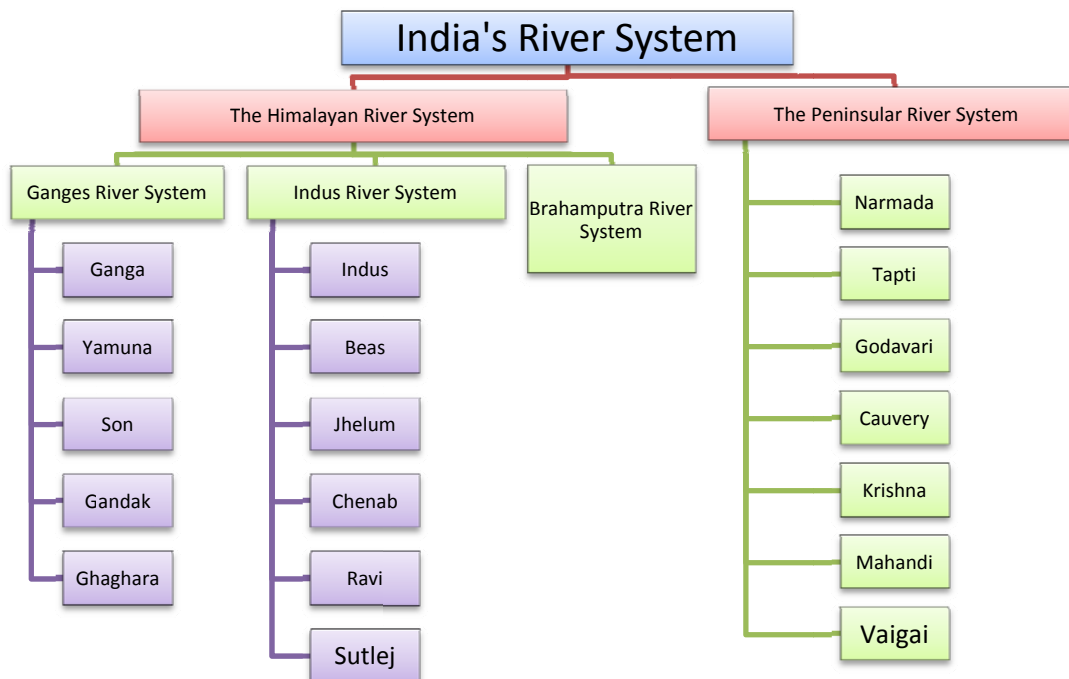
- ☞ Almost all of India's rivers are of **open basin** as more than **90%** of total surface water runoff would go to **Bay of Bengal**. Rest goes to Arabian Sea.
- ☞ There is just a small area in parts of **Ladakh**, northern parts of the **Aravalli range** and the arid parts of the **Thar Desert**, that have inland drainage.

**Sources of Indian Rivers**

All major rivers of India originate from one of the three main watersheds:

1. The Himalaya and the Karakoram ranges
2. Vindhya and Satpura ranges and Chhotanagpur plateau in central India
3. Sahyadri or Western Ghats in western India

The following graphic shows the major rivers in India's River System



The above graphic is a very simplified version of the complex river system of India. We discuss them one by one here:

**INDUS RIVER SYSTEM**

**Indus River**

Indus River originates in China and flows in Pakistan (93%) and India.

It originates in Tibetan plateau at **Bokhar Chu** (glacier) in northern slopes of **Mt. Kailas**, in the vicinity of **Lake Mansarovar** in Tibet, runs a course through the Ladakh of India and then enters Pakistan via the Northern Areas (Gilgit-Baltistan), flowing through the North in a southerly direction along the entire length of Pakistan, to merge into the Arabian Sea near Karachi.

The total length of the river is **3,180** kilometers, making it Pakistan's longest river and world's 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, Zanskar 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.

**Indus Water Treaty**

After the independence of India and Pakistan in 1947, the use of the waters of the Indus and its five eastern tributaries became a major dispute between India and Pakistan. The irrigation canals of the Sutlej valley and the Bari Doab were split - with the **canals lying primarily in Pakistan** and the headwork **dams in India** disrupting supply in some parts of Pakistan. The concern over India building large dams over various Punjab rivers that could undercut the supply flowing to Pakistan, as well as the possibility that India could divert rivers in the time of war, caused political consternation in Pakistan. India and Pakistan signed the Indus Waters Treaty in **1960**. The treaty, which was brokered by **World Bank**, gave **India control** of the three easternmost rivers of the Punjab, the **Sutlej**, the **Beas** and the **Ravi**, while Pakistan gained control of the three western rivers, the Jhelum, the Chenab and the Indus. India **retained the right** to use of the **western rivers** for **non irrigation** projects.

**Indus River Tributaries:**



-: About this document:-

**Beas River**

- » 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 **Hyphasis 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 rdng that marks the watershed of the Seas 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**

- » The river Jhelum rises from **northern slopes of Pir Panjal ranges at Verinag spring** (which is main source) 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.
- » Jhelum 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 Jhelum 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.

**Kishen Ganga Power Project**

- ✓ Kishan Ganga River is known as Neelum River in Pakistan and Pak-Occupied Kashmir. The river flows from India to Pakistan.
- ✓ India is building a 330 MW hydroelectric power project. This project was awarded to Hindustan Construction Company Ltd, with a timeline of 7 years. This project involves the diverting of the water of the river to Jhelum through a 27 kilometer tunnel.
- ✓ Pakistan is also building a 969 MW hydroelectric power project. This project has been awarded to a Chinese consortium.
- ✓ Pakistan says that India is violating the 1960 Indus Water Treaty by diverting the route of the river. India denies this. Pakistan has taken this issue to the United Nations.
- ✓ According to India, the treaty allows it to divert Kishanganga waters to the Bonar Madmati Nallah, another tributary of the Jhelum, which falls into the Wullar Lake before joining the Jhelum again.
- ✓ Pakistan has objected to this saying India's plans to divert waters will obstruct the flow of the river affecting its Neelum-Jhelum project downstream.
- ✓ Pakistan can take this issue in UN because the Indus Water treaty between India and Pakistan was signed in 1960 under the aegis of the United Nations. This **treaty provides an arbitration court**, which has to have seven members, including the chairman. India and Pakistan have named two international experts each to represent them.
- ✓ Since the issue could not be solved by the bilateral talks, it is under arbitration. On 30th October 2010, Judge Stephen M. Schwebel, former President of the International Court of Justice, has been appointed head of the Court of Arbitration being constituted to resolve the Kishanganga hydroelectric project dispute between India and Pakistan. Judge Schwebel is an expert on international law and dispute settlement.

Pakistan's bid to stall construction work at the Kishenganga power project in Jammu and Kashmir, was thwarted on January 14, 2010 when it was forced to withdraw a petition in this regard at the International Court of Arbitration. During the first hearing of the Kishenganga Arbitration Court in The Hague in The Netherlands, the Indian side put up a spirited argument for construction of the 330-MW project on Kishenganga, a tributary of the Jhelum river.

**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.**





**Fact Box: Baglihar Dam Project**

Baglihar Dam or Baglihar Hydroelectric Power Project of India is on Chenab River Doda, Jammu and Kashmir. This project was conceived in 1992, approved in 1996 and construction began in 1999. The project is estimated to cost USD \$1 billion. The first phase of the Baglihar Dam was completed in 2004. With the second phase completed, on 10 October 2008, Prime Minister Manmohan Singh of India dedicated the 450-MW Baglihar hydro electric power project to the nation.

**Baglihar Dam Controversy**

The Dam has been a controversial issue between India and Pakistan. When the construction of this dam began in 1999, Pakistan claimed that design parameters of Baglihar project violated the Indus Water Treaty of 1960. The Indus Water Treaty provided India with exclusive control over three eastern rivers, Near Beacon tunnel while granting Pakistan exclusive control to three western rivers, including Chenab River. However it contained provisions for India to establish river-run power projects with limited reservoir capacity and flow control needed for feasible power generation. Availing this provision India established several run-of-the-river projects, with Pakistan objecting to these. Also in the case of the Baglihar and Kishenganga Hydroelectric Plants, Pakistan claimed that some design parameters were too lax than were needed for feasible power generation and provided India with excessive ability to accelerate, decelerate or block flow of the river, thus giving India a strategic leverage in times of political tension or war.

There was no result of several rounds of talks between India and Pakistan. Issue was taken to World Bank, a broker and signatory of Indus Water Treaty. World Bank appointed a neutral expert Raymond Lafitte, a Swiss civil engineer, to adjudicate the difference.

The overall design of the Baglihar dam being built by India on the Chenab as a run-of-river plant was upheld by Prof. Raymond Lafitte, the Neutral Expert (NE) appointed by the World Bank to consider Pakistan's objections to the Baglihar project, in his decision delivered on 12-February, 2007 in Berne to the representatives of India and Pakistan.

The decision of the NE recognized India's right to utilize the waters of the Western Rivers more effectively, within the ambit of the Treaty, for power generation.

This was the first time since the signing of the Indus Waters Treaty 1960 that a Neutral Expert was appointed.

**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 Bangahal 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.

### Major Dams and Projects on Ravi

- » **Baira Suil Hydroelectric** Power Project of 198 MW capacity was the first project on Ravi River.
- » **Chamera-I** of 540 MW capacity commissioned in 1994,
- » **Ranjitsagar Multipurpose Project** (600 MW) completed in 1999 and the **Chamera-II** of 300 MW capacity in the upstream of Chamera-I commissioned in 2004. It is also known as **Thein dam** as it is located in Thein village.

### 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.

### Projects on Sutlej River

- » There are several major hydroelectric projects on the Sutlej, for example, the 1,000 MW **Bhakra Dam**, the 1,000 MW **Karcham-Wangtoo** and the 1,530 MW **Nathpa Jhakri Hydroelectric Dam**.
- » There has been a proposal to build a 214-kilometre (133 mi) long heavy freight canal, known as the **Sutlej-Yamuna Link (SYL)**, in India to connect the Sutlej and Yamuna rivers. However, the proposal met obstacles and was referred to the Supreme Court.

**THE GANGA 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.

**Understanding Course of Ganga : (Read carefully)**



- » 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.

**Gangotri & Gaumukh**

- » 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 Shivling; 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 **Panchprayag**. 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

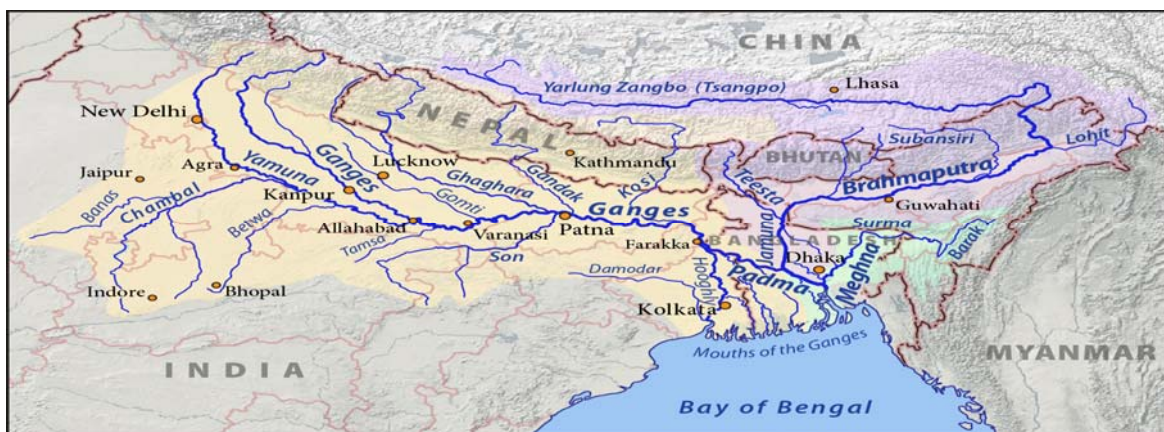
keeps flowing till Bahraich, by then it is known as **Saryu River**. Saryu River meets Ganga in the Bahraich of Uttar Pradesh.

**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 Gangaes 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.



-: About this document:-

## Tributaries of Ganga

### 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 southwest-northeast-running **Kaimur Range**.
- » The Son parallels the Kaimur hills, flowing east-northeast through **Uttar Pradesh, Jharkhand** 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

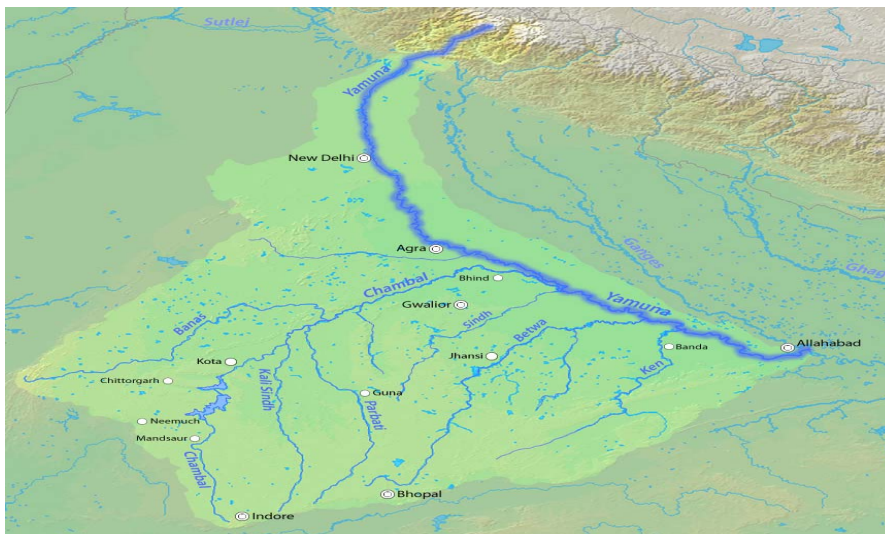
- » The Gomti originates from Gomat Taal which formally known as Fulhaar jheel, near Madho Tanda, Pilibhit, India.
- » It extends 900 km through Uttar Pradesh and meets the Ganga River near Saidpur, Kaithi in Ghazipur.

### Yamuna River

- » Please note that **India's Yamuna River is largest tributary of Ganga River, while Bangladesh's Jamuna River is largest distributary 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.
- » **Manikheda Dam** has been constructed across the Sindh River in Shivpuri district, Madhya Pradesh.

#### Hindon River

- »  Hindo 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.

#### Fact Box: Dams in Chambal Valley Project

- » **Gandhi Sagar Dam:** This is the first of the four Chambal Valley Projects, located on the **Rajasthan-Madhya Pradesh border.** It is a 64 metre high masonry gravity dam, with a live storage capacity of 6,920 Mm<sup>3</sup> and a catchment area of 22,584 km<sup>2</sup>, of which only 1,537 km<sup>2</sup> are in Rajasthan. The dam was completed in the year 1960. The hydro-power station is located at the dam site and comprises five generating units, four of 23 MW each and one 27 MW capacity. The water released after power generation is utilised for irrigation through Kota Barrage. Rajasthan has a 50% share in the power generation of this station.
- » **Rana Pratap Sagar Dam:** Rana Pratap Sagar dam is the second in the series of Chambal Valley Projects, located 52 km downstream of Gandhi Sagar dam across the river Chambal in **Rajasthan.** This dam was completed in the year 1970. It is a straight masonry gravity structure, 54 meters high. The power house is located on the left side of the spillway and consists of 4 units of 43 MW each, with firm power generation of 90 MW at 60% load factor. The total catchment area of this dam is 24,864 km<sup>2</sup>, of which only 956 km<sup>2</sup> are in Rajasthan. The free catchment area below Gandhi Sagar dam is 2,280 km<sup>2</sup>. The live storage capacity is 1,566 Mm<sup>3</sup>. Rajasthan State has a 50% share in the power generation of this station.
- » **Jawahar Sagar Dam:** Jawahar Sagar dam is the third dam in the series of Chambal Valley Projects, located 29 km upstream of **Kota city** and 26 km downstream of Rana Pratap Sagar dam, across the river Chambal. It is a concrete gravity dam, 45 meter high and 393 m long, generating 60 MW of power with an installed capacity of 3 units of 33 MW. The work was completed in 1972. The total catchment area of the dam is 27,195 Km<sup>2</sup>, of which only 1,496 km<sup>2</sup> are in Rajasthan. The free catchment area below Rana Pratap Sagar dam is 2,331 km<sup>2</sup>. Rajasthan has a 50% share in the power generation of this station.
- » **Kota Barrage:** Kota Barrage is the fourth in the series of Chambal Valley Projects, located about 0.8 km upstream of Kota City in Rajasthan. **Water released after power generation** at Gandhi Sagar, Rana Pratap Sagar and Jawahar Sagar Dams, is **diverted by Kota Barrage** for irrigation in **Rajasthan** and in **Madhya Pradesh** through canals on the left and the right sides of the river. The work on this



dam was completed in 1960. The total catchment area of Kota Barrage is 27,332 km<sup>2</sup>, of which the free catchment area below Jawahar Sagar Dam is just 137 km<sup>2</sup>. The live storage is 99 Mm<sup>3</sup>. It is an earthfill dam with a concrete spillway. The right and left main canals have a headworks discharge capacity of 188 and 42 m<sup>3</sup>/sec, respectively. The total length of the main canals, branches and distribution system is about 2,342 km, serving an area of 229 kha of CCA.50% of the water intercepted at Kota Barrage has been agreed to be diverted to MP for irrigation. (Source: Ministry of water resources, Rajasthan)

» **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 is only *Nad* (masculine name for a river), all others in India are *Nadi* (feminine).

It 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 its 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.

### 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 **Rangit 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**.