

1. Details of Module and its structure

Module Detail	
Subject Name	Geography
Course Name	Geography 02 (Class XI, Semester - 2)
Module Name/Title	Drainage – Part 2
Module Id	kegy_20302
Pre-requisites	Knowledge about the Himalayan Drainage
Objectives	<p>After going through this lesson, the learners will be able to understand the following:</p> <ul style="list-style-type: none">• Indian drainage system• Stages of rivers• Evolution of Himalayan rivers• River system of Himalayan rivers-<ul style="list-style-type: none">➤ The Indus and its tributaries➤ The Ganga and its tributaries➤ The Brahmaputra and its tributaries
Keywords	Anticidental river, Perennial, waterfalls, PANJNAD, DOAB

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1. Drainage Systems of India

Indian drainage system consists of a large number of small and big rivers. It is the outcome of the evolutionary process of the three major physiographic units and the nature and characteristics of precipitation.

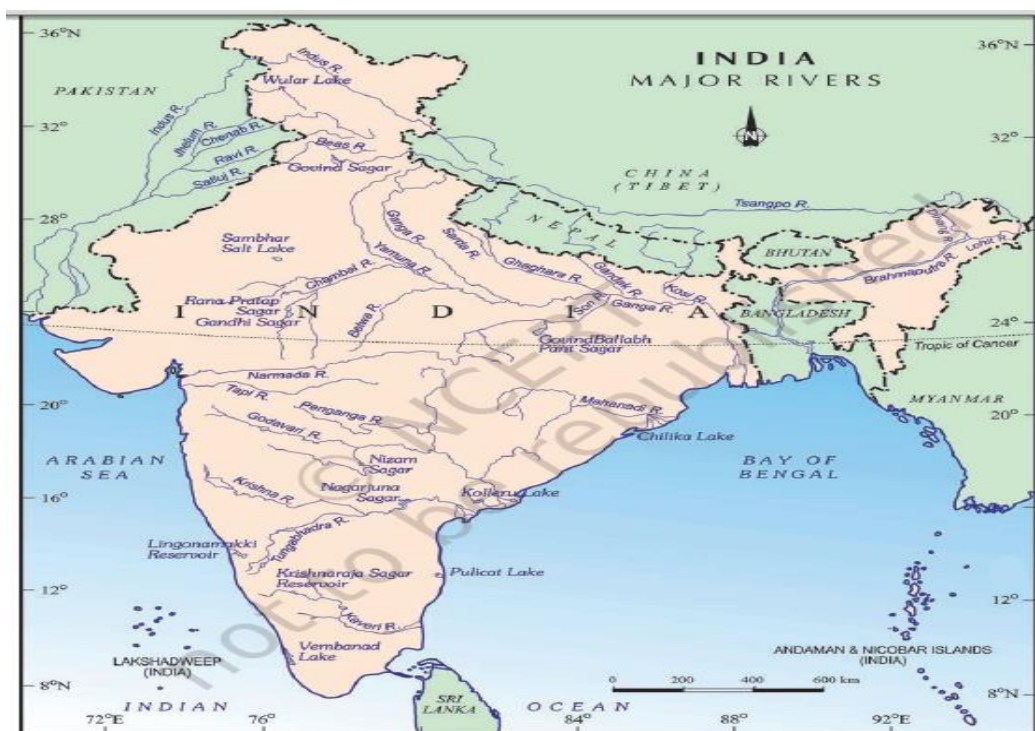


Fig. 1 Indian Rivers

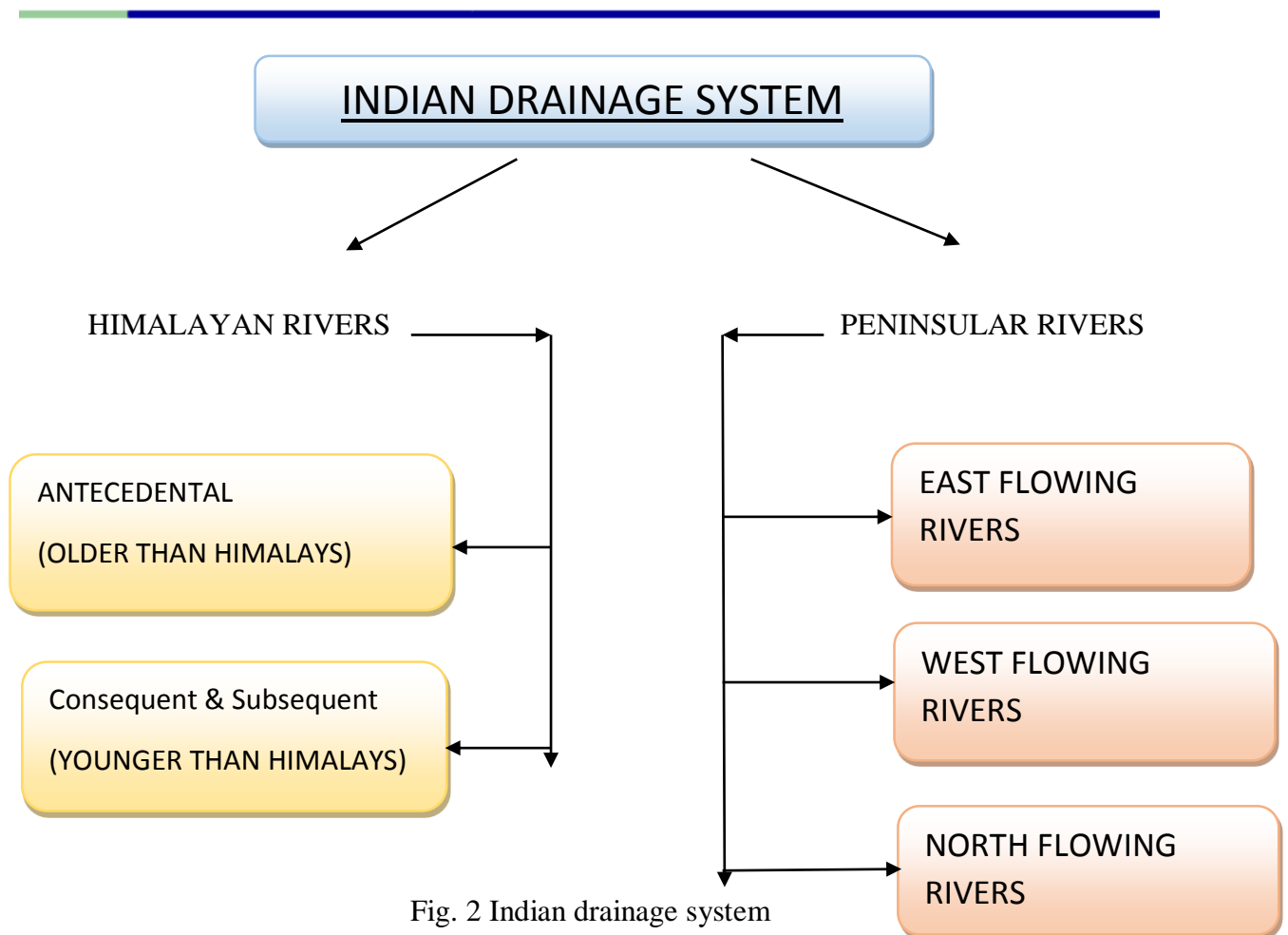


Fig. 2 Indian drainage system

The Himalayan Drainage

The Himalayan drainage system has evolved through a long geological history. It mainly includes the tributaries of Ganga, Indus and Brahmaputra rivers that have their origins in glaciers, lakes and springs in the Himalayas. Since these are fed both by melting of snow, precipitation and natural springs most of the rivers of this system are perennial. It is because of these qualities Himalayas are also called the towers of water. Rivers according to W. M. Davis go through the evolutionary stages like any organism: youth, mature and old stages and Himalayan rivers are not an exception to this normal cycle.

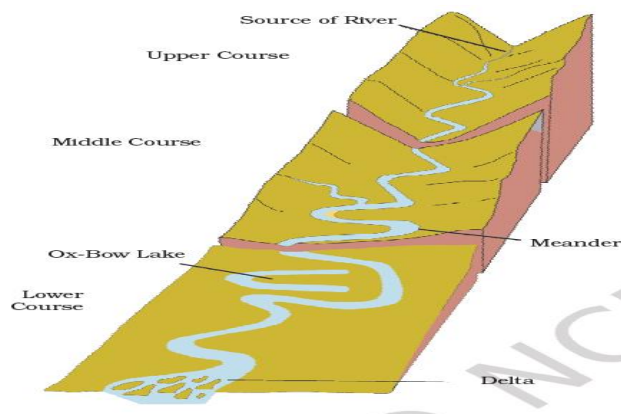


Fig.3- Stages of rivers

Himalayas being the young, high mountains with steep slope are subjected to the glacial and fluvial processes of erosion and deposition resulting into the formation of U shaped valleys, moraines, Vshaped valleys, rapids, waterfalls, and gorges in their youth stage while flowing through mountainous. While entering the plains, these rivers and streams form depositional features like flat valleys, ox-bow lakes, flood plains, braided channels, ravine islands and deltas near the river mouth. In the Himalayan reaches, the course of these rivers is highly tortuous, but over the plains they display a strong meandering tendency and shift their courses frequently.



Fig. 4- Waterfall



Fig. 5-Meanders

source-<https://pixabay.com/photos/waterfall-river-water-waters-721273/>

source -<https://en.wikipedia.org/wiki/Meander#/media/File:Rio-cauto-cuba.JPG>



Fig.6- Flood plain



Fig.7- V-shape valley, Interlocking spur

Source-[https://commons.wikimedia.org/wiki/File: Paran%C3%A1_River_Floodplain.jpg](https://commons.wikimedia.org/wiki/File:Paran%C3%A1_River_Floodplain.jpg)

Source-https://upload.wikimedia.org/wikipedia/commons/7/7f/Interlocking_spurs%2C_Ashes_Hollow.jpg



Fig.8 -Delta

Source - https://commons.wikimedia.org/wiki/File:Sundarbans_web_ESA362980.jpg

Evolution of the Himalayan Drainage

There is difference of opinion about the evolution of the Himalayan rivers. However, geologists believe that a mighty river called Shiwalik or Indo-Brahma traversed the entire longitudinal extent of the Himalaya from Assam to Punjab and onwards to Sind, and finally discharged into the Gulf of Sind near lower Punjab during the Miocene period some 5-24 million years ago. The remarkable continuity of the Shiwalik and its lacustrine origin and alluvial deposits consisting of sands, silt, clay, boulders and conglomerates present in the Shiwalik formation support this viewpoint.

It is opined that in due course of time Indo– Brahma river was dismembered into three main drainage systems:

- i. The Indus and its five tributaries in the western part;
- ii. The Ganga and its Himalayan tributaries in the central part; and
- iii. The stretch of the Brahmaputra in Assam and its Himalayan tributaries in the eastern part.

The dismemberment was probably due to the Pleistocene upheaval in the western Himalayas, including the uplift of the Potwar Plateau (North -Eastern Pakistan) which acted as the water divide between the Indus and Ganga drainage systems. Likewise, the down thrusting of the Malda gap area between the

Rajmahal hills and the Meghalaya plateau during the mid-pleistocene period, diverted the Ganga and the Brahmaputra systems to flow towards the Bay of Bengal.

The River Systems of the Himalayan Drainage

The Himalayan drainage consists of several river systems but the following are the major river systems:

The Indus System

It is one of the largest river basins of the world, covering an area of 11,65,000 sq. km (in India it covers 321, 289 sq. km) and a total length of 2,880 km (in India 1,114 km). The Indus also known as the Sindhu, is the westernmost of the Himalayan rivers in India. It originates from a glacier near Bokhar Chu (31°15' N latitude and 81°40' E longitude) in the Tibetan region at an altitude of 4,164 m in

the Kailash Mountain range. In Tibet, it is known as '*Singi Khamban*'; or Lion's mouth. After flowing in the northwest direction between the Ladakh and Zaskar ranges, it passes through Ladakh and Baltistan. It cuts across the Ladakh range, forming a spectacular gorge near Gilgit in Jammu and Kashmir. It enters into Pakistan near Chilas in the Dardistan region. (Dardistan is a term coined by Gottlieb Willam Leitner for northern Pakistan, Kashmir and parts of north eastern Afghanistan. It is inhabited by Dards speaking Dardic language. It includes Chitral, the upper reaches of the Panjkora river, the Kohistan (highland of Swat, and the upper portions of the Gilgit Agency).



Fig. 10-Tributaries of Indus

Source-https://commons.wikimedia.org/wiki/File:Indus_river_basin.jpg

Tributaries of Indus River

- The Indus receives a number of Himalayan tributaries such as the Shyok, the Gilgit, the Zaskar, the Hunza, the Nubra, the Shigar, the Gasting and the Dras. It finally emerges out of the hills near Attock where it receives the Kabul river on its right bank.
- The other important tributaries joining the right bank of the Indus are **the Khurram, the Tochi, the Gomal, the Viboa and the Sangar**. They all originate in the Sulaiman ranges.



Fig 11- Panjnad

Source: https://en.wikipedia.org/wiki/Panjnad_River#/media/File:Panjnad.png

The river flows southward and receives 'Panjnad' a little above Mithankot. Panjnad is a river at the extreme end of Bahawalpur district in Punjab, Pakistan. The Panjnad is formed by successive confluence or merger of the five rivers of Punjab, namely the Satluj, the Beas, the Ravi, the Chenab and the Jhelum. Jhelum and Ravi join Chenab, Beas joins Sutlej, and then Sutlej and Chenab join to form Panjnad 10 miles north of Uch Sharif in Muzaffar Garh district. The combined stream runs southwest for approximately 45 miles and joins the Indus River at Mithankot. The Indus continues and It finally discharges into the Arabian Sea, east of Karachi.

The Indus flows in India through Jammu and Kashmir and Ladakh district.

- **The Jhelum**, an important tributary of the Indus, rises from a spring at Verinag situated at the foot of the Pir Panjal in the south-eastern part of the valley of Kashmir. It flows through Srinagar and the Wular lake before entering Pakistan through a deep narrow gorge. It joins the Chenab near Jhang in Pakistan.

- **The Chenab** is the largest tributary of the Indus. It is formed by two streams, the Chandra and the Bhaga, which join at Tandi near Keylong in Himachal Pradesh. Hence, it is also known as Chandrabhaga.
The river flows for 1,180 km before entering into Pakistan.
- **The Ravi** is another important tributary of the Indus. It rises west of the Rohtang pass in the Kullu hills of Himachal Pradesh and flows through the Chamba valley of the state. Before entering Pakistan and joining the Chenab near Sarai Sidhu, it drains the area lying between the southeastern part of the Pir Panjal and the Dhauladhar ranges.
- **The Beas** is another important tributary of the Indus, originating from the Beas Kund near the Rohtang Pass at an elevation of 4,000 m above the mean sea level. The river flows through the Kullu valley and forms gorges at Kati and Largi in the Dhauladhar range. It enters the Punjab plains where it meets the Satluj near Harike.
- **The Satluj** originates in the 'Raksas tal' near Mansarovar at an altitude of 4,555 m in Tibet where it is known as Langchen Khambab. It flows almost parallel to the Indus for about 400 km before entering India, and comes out of a gorge at Rupar. It passes through the Shipki La on the Himalayan ranges and enters the Punjab plains. It is an antecedent river. It is a very important tributary as it feeds the canal system of the Bhakra Nangal project.

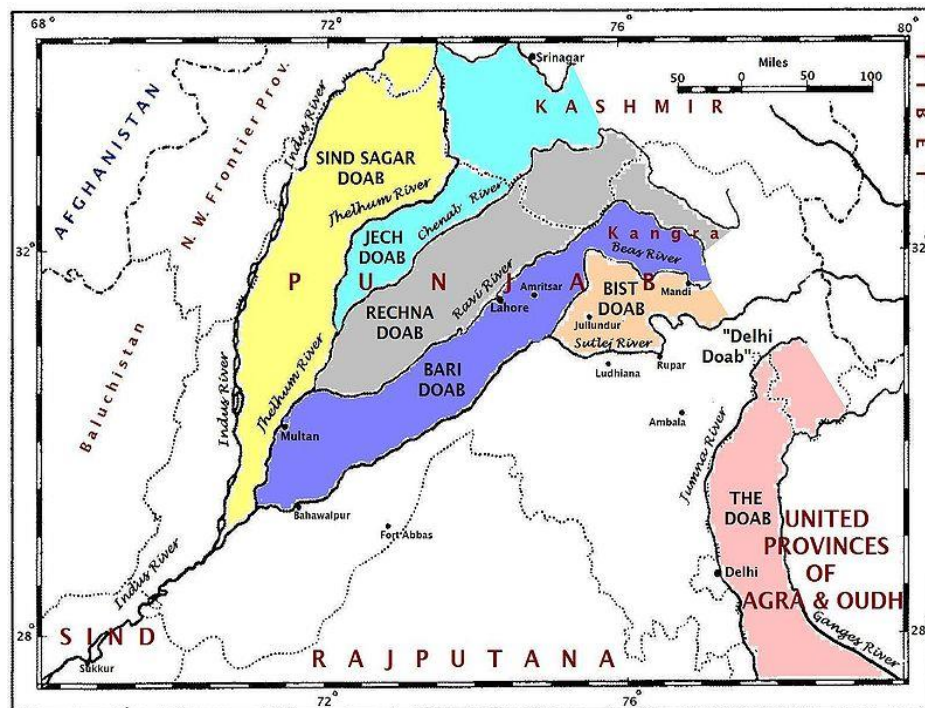


Fig. 12- Doab in Punjab (Before Partition)

Source-

<https://pnb.m.wikipedia.org/wiki/%D9%81%D8%A7%D8%A6%D9%84:Punjabdoabs1.jpg>

The Ganga System

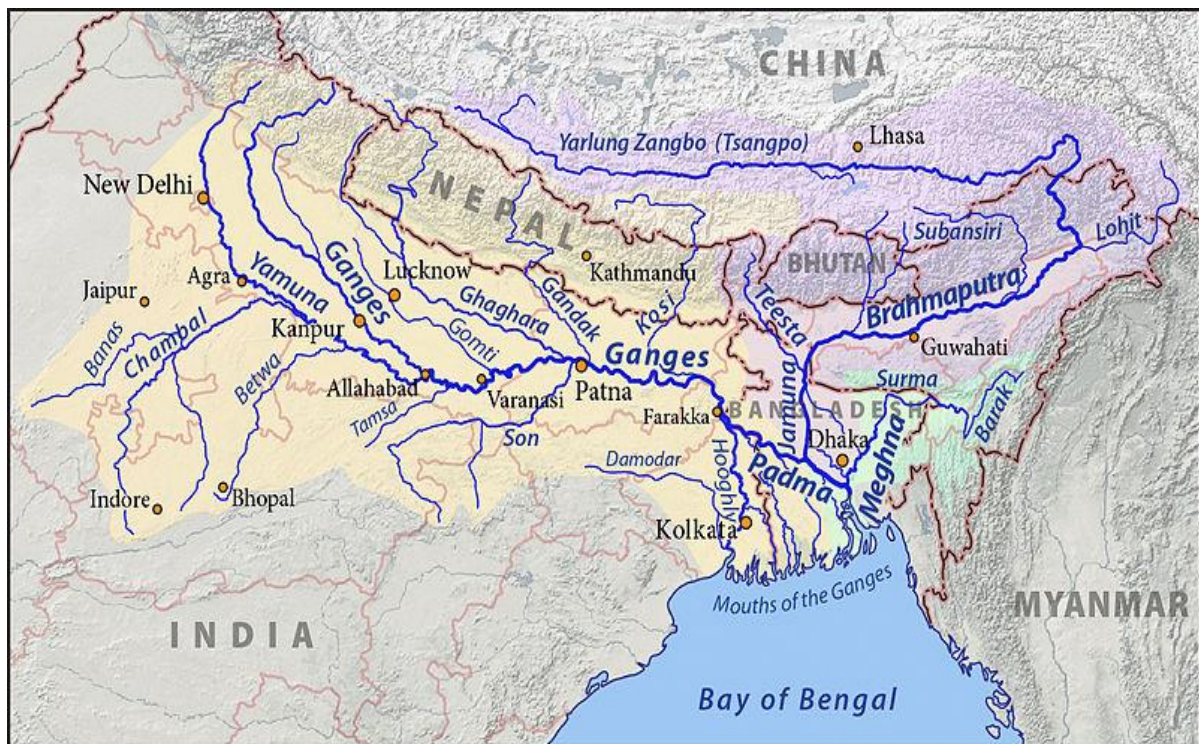


Fig.13 Ganga and Brahmaputra river

Source: https://commons.wikimedia.org/wiki/File:Ganges-Brahmaputra-Meghna_basins.jpg

Origin and Course of river Ganga

The Ganga is the most important river of India both from the point of view of its basin and cultural significance. It rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttarakhand. Here, it is known as the Bhagirathi. It cuts through the Central and the Lesser Himalayas in narrow gorges. Although many small streams comprise the headwaters of the Ganges, the six longest and their five confluences are considered sacred.

The six headstreams are the Alaknanda, Dhauliganga, Nandakini, Pindar, Mandakini, and Bhagirathi rivers. The five confluences, known as the Panch Prayag, are all along the Alaknanda. They are, in downstream order, Vishnuprayag, where the Dhauliganga joins the Alaknanda; Nandprayag, where the Nandakini joins; Karnaprayag, where the Pindar joins; Rudraprayag, where the Mandakini joins; and finally, Devprayag where the Bhagirathi joins the Alaknanda to form The Ganges.



Fig.14 -Devprayag (confluence of Bhagirathi and Alaknanda)

Source-<https://commons.wikimedia.org/wiki/File:Devprayaga.jpg>

The **Alaknanda** has its source in the Satopanth glacier above Badrinath. The Alaknanda consists of the Dhauti and the Vishnu Ganga which meet at Joshimath or Vishnu Prayag. The other tributaries of Alaknanda such as the Pindar joins it at Karna Prayag while Mandakini or Kali Ganga meets it at Rudra Prayag. After flowing 249 km, through its narrow Himalayan valley, the Ganges emerges from the mountains at Rishikesh then debouched onto the Gangetic Plain at the pilgrimage town of Haridwar. At Haridwar, a dam diverts some of its waters into the Ganges Canal, which irrigates the Doab region of Uttar Pradesh, whereas the river, whose course has been roughly southwest until this point, now begins to flow southeast through the plains of northern India before splitting into two distributaries, namely the Bhagirathi and the Padma. .

Tributaries of Ganga

The Ganges river follows an 800 km arching course passing through the cities of Kannauj, Farukhabad, and Kanpur. Along the way it is joined by the Ramganga. The **Yamuna**, the western most and the longest tributary of the Ganga, has its source in the Yamunotri glacier on the western slopes of Banderpunch range (6,316 km). The river Yamuna

joins the Ganga at the Triveni Sangam at Prayagraj at Prayag (Allahabad), a holy confluence in Hinduism. At their confluence the Yamuna is larger than the Ganges.

It is joined by the Chambal, the Sind, the Betwa and the Ken on its right bank which originates from the Peninsular plateau while the Hindan, the Rind, the Sengar, the Varuna, etc. join it on its left bank. Much of its water feeds the western and eastern Yamuna and the Agra canals for irrigation purposes.

Now flowing east, the river meets the Tamsa River (also called *Tons*), which flows north from the Kaimur Range. After the Tamsa the Gomti River joins, flowing south from the Himalayas. Then the Ghaghara River (Karnali River), also flowing south from the Himalayas of Nepal, joins. The Ghaghara (Karnali), is the largest tributary of the Ganges. After the Ghaghara (Karnali) confluence the Ganges is joined from the south by the Son River. The Gandaki River, then the Kosi River, join from the north flowing from Nepal, contributing about 1,654 m³/s (58,400 cu ft/s) and 2,166 m³/s (76,500 cu ft/s), respectively. The Kosi is the third largest tributary of the Ganges, after the Ghaghara (Karnali) and Yamuna. The Kosi merges into the Ganges near Kursela in Bihar.

Along the way between Allahabad and Malda, West Bengal, the Ganges river passes the towns of Chunar, Mirzapur, Varanasi, Ghazipur, Patna, Hajipur, Chapra, Bhagalpur, Ballia, Buxar, Simaria, Sultanganj, and Saidpur. At Bhagalpur, the river begins to flow south-southeast and at Pakur, it begins its attrition with the branching away of its first distributary, the Bhāgirathi-Hooghly, which goes on to become the Hooghly River. Just before the border with Bangladesh the Farakka Barrage controls the flow of Ganges, diverting some of the water into a feeder canal linked to the Hooghly for the purpose of keeping it relatively silt-free. The Hooghly River is formed by the confluence of the Bhagirathi River and Jalangi River at Nabadwip, and Hooghly has a number of tributaries of its own. The largest is the Damodar River, which is 541 km (336 mi) long, with a drainage basin of 25,820 km² (9,970 sq mi).^[16] The Hooghly River empties into the Bay of Bengal near Sagar Island. Between Malda and the Bay of Bengal, the Hooghly river passes the towns and cities of Murshidabad, Nabadwip, Kolkata and Howrah.

After entering Bangladesh, the main branch of the Ganges river is known as the Padma. The Padma is joined by the Jamuna River, the largest distributary of the Brahmaputra. Further downstream, the Padma joins the Meghna River, the second largest distributary of the Brahmaputra, and takes on the Meghna's name as it enters the Meghna Estuary, which empties into the Bay of Bengal. Here it forms the 1,430 by 3,000 km (890 by 1,860 mi) Bengal Fan, the world's largest submarine fan, which alone accounts for 10–20% of the global burial of organic carbon. The Ganges Delta, formed mainly by the large, sediment-laden flows of the

Ganges and Brahmaputra rivers, is the world's largest delta, at about 59,000 km² (23,000 sq mi). It stretches 322 km (200 mi) along the Bay of Bengal.

Only the Amazon and Congo rivers have a greater average discharge than the combined flow of the Ganges, the Brahmaputra, and the Surma-Meghna river system. In full flood only the Amazon is larger.

- The Ganga river has a length of 2,525 km.
- It is shared by Uttarakhand (110 km) and Uttar Pradesh (1,450 km), Bihar (445 km) and West Bengal (520 km).
- The Ganga basin covers about 8.6 lakh sq. km area in India alone.
- The Ganga river system is the largest in India having a number of perennial and non-perennial rivers originating in the Himalayas in the north and the Peninsula in the south, respectively.
- Drainage pattern of Ganga are good examples of Antecedent drainage, Subsequent Rivers, Angular drainage patterns. The factors controlling the pattern of drainage in a region include the topography, structural control, slope and tectonic activities, nature of rocks, a supply of water and above all the geological history of that region.
- The **Son** is its major right bank tributary.
- The important left bank tributaries are the Ramganga, the Gomati, the Ghaghara, the Gandak, the Kosi and the Mahananda. The river finally discharges itself into the Bay of Bengal near the Sagar Island.
- The **Yamuna** also known as the **Jumna** or **Jamna**, is the second largest tributary river of the Ganges(Ganga) and the longest tributary in India. Originating from the Yamunotri Glacier at a height of 6,387 metres (20,955 ft) on the southwestern slopes of Banderpooch peaks of the Lower Himalaya in Uttarakhand, it travels a total length of 1,376 kilometres (855 mi) and has a drainage system of 366,223 square kilometres (141,399 sq mi), 40.2% of the entire Ganges Basin. It merges with the Ganges at Triveni Sangam, Prayagraj, which is a site of the Kumbh Mela, a Hindu festival held every 12 years.

It crosses several states: Haryana and Uttar Pradesh, passing by Uttarakhand and later Delhi, and meeting its tributaries on the way, including Tons, Chambal, its longest tributary which has its own large basin, followed by Sindh, the Betwa, and Ken

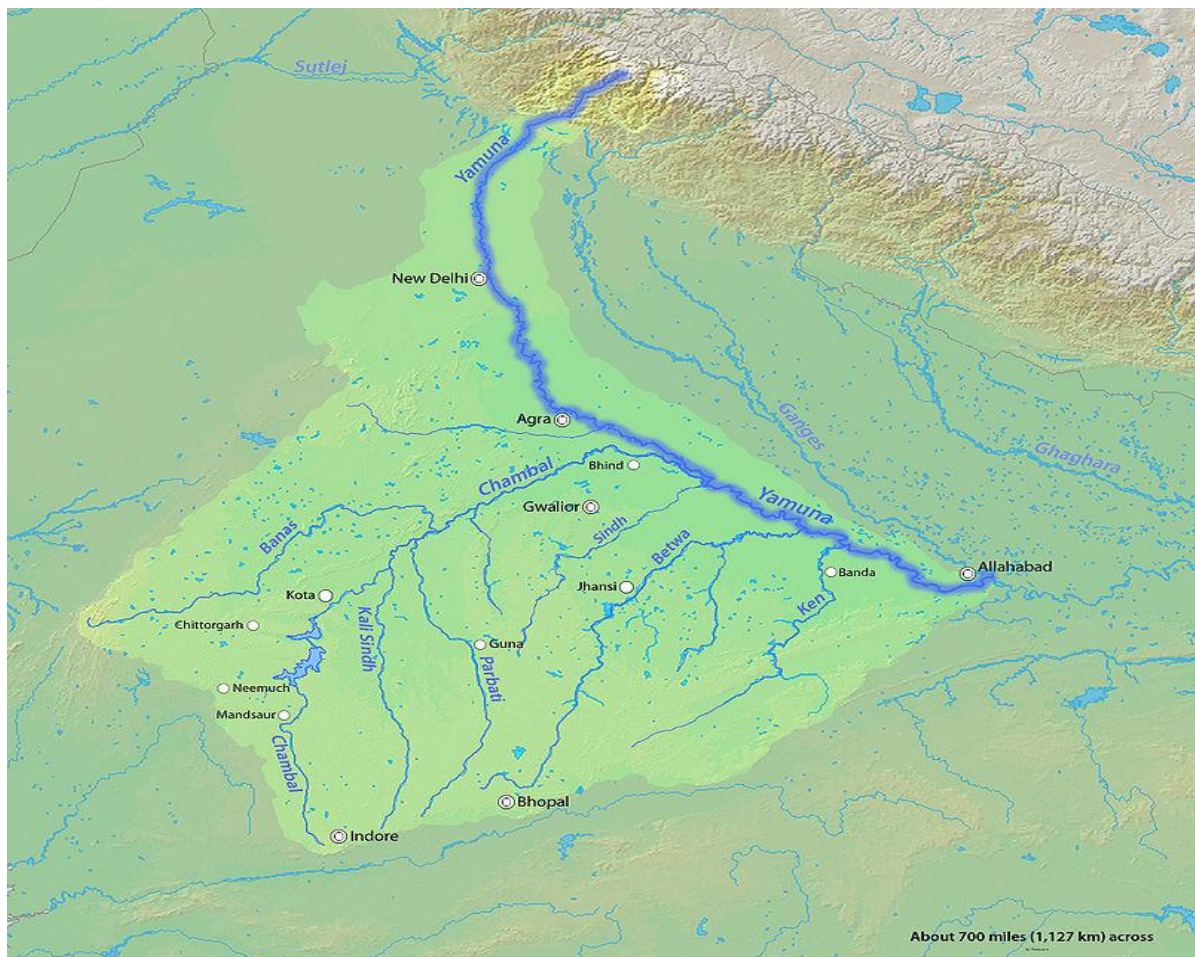


Fig.15- Course of Yamuna River

Source- <https://en.wikipedia.org/wiki/Yamuna#/media/File:Yamunarivermap.jpg>

- The Chambal rises near Mhow in the Malwa plateau of Madhya Pradesh and flows northwards through a gorge up wards of Kota in Rajasthan, where the Gandhisagar dam has been constructed. From Kota, it traverses down to Bundi, Sawai Madhopur and Dholpur, and finally joins the Yamuna. The Chambal is famous for its badland topography called the Chambal ravines.
- The Tons, Yamana's largest tributary, drains a large portion of the upper catchment area and holds more water than the main stream. It rises from the Hari-ki-dun valley and merges after Kalsi near Dehradun.
- **Hindon River**, a tributary of Yamuna river, is a river in India that originates in the Saharanpur District, from Upper [Shivalik](#) in Lower Himalayan Range
- The Ken River originates near the village Ahirgawan on the north-west slopes of [Barner Range](#) in Katni district and travels a distance of 427 km, before merging with the Yamuna at Chilla village, district Banda in Uttar Pradesh.
- The Sindh originates on the Malwa Plateau in Vidisha district, and flows north-northeast through

[thehttps://commons.wikimedia.org/wiki/File:Sundarbans_web_ESA362980.jpg](https://commons.wikimedia.org/wiki/File:Sundarbans_web_ESA362980.jpg)

districts of Guna, Ashoknagar, Shivpuri, Datia, Gwalior and Bhind in Madhya Pradesh to join the Yamuna River in Jalaun district, Uttar Pradesh, just after the confluence of the Chambal River with the Yamuna River.

- The **Betwa** or **Betravati** is a river in Northern India, and a tributary of the Yamuna. It rises in the Vindhya Range (Raisen) just north of Hoshangabad in Madhya Pradesh and flows north-east through Madhya Pradesh and Orchha to Uttar Pradesh.
- The Gandak comprises two streams, namely Kaligandak and Trishulganga. It rises in the Nepal Himalayas between the Dhaulagiri and Mount Everest and drains the central part of Nepal. It enters the Ganga plain in Champaran district of Bihar and joins the Ganga at Sonpur near Patna.
- The Ghaghara originates in the glaciers of Mapchachungo. After collecting the waters of its tributaries – Tila, Seti and Beri, it comes out of the mountain, cutting a deep gorge at Shishapani.
- The river Sarda (Kali or Kali Ganga) joins it in the plain before it finally meets the Ganga at Chhapra.
- The Kosi is an antecedent river with its source to the north of Mount Everest in Tibet, where its main stream Arun rises. After crossing the Central Himalayas in Nepal, it is joined by the Son Kosi from the West and the Tamur Kosi from the east. It forms Sapt Kosi after uniting with the river Arun. River Kosi, also known as the ‘sorrow of Bihar’, has been notorious for frequently changing its course. The Kosi brings huge quantity of sediments from its upper reaches and deposits it in the plains. The course gets blocked, and consequently, the river changes its course. Why does the Kosi river bring such huge quantity of sediments from the upper reaches?
- The Ramganga is comparatively a small river rising in the Garhwal hills near Gairsain. It changes its course to the southwest direction after crossing the Shiwalik and enters into the plains of Uttar Pradesh near Najibabad. Finally, it joins the Ganga near Kannauj.
- The Damodar occupies the eastern margins of the Chotanagpur Plateau where it flows through a rift valley and finally joins the Hugli. The Barakar is its main tributary. Once known as the ‘sorrow of Bengal’, the Damodar has been now tamed by the Damodar Valley corporation, a multipurpose project.
- The Sarda or Saryu river rises in the Milam glacier in the Nepal Himalayas where it is known as the Goriganga. Along the Indo-Nepal border, it is called Kali or Chauk, where it joins the Ghaghara.

- The Mahananda is another important tributary of the Ganga rising in the Darjiling hills. It joins the Ganga as its last left bank tributary in West Bengal.
- The Son is a large south bank tributary of the Ganga, originating in the Amarkantak plateau. After forming a series of waterfalls at the edge of the plateau, it reaches Arrah, west of Patna, to join the Ganga.

‘Namami Gange Programme’, is an Integrated Conservation Mission, approved as “Flagship Programme” by the Union Government in June 2014 with the twin objectives of effective abatement of pollution, conservation and rejuvenation of the National River Ganga. Main pillars of the Namami Gange Programme are:

- Sewerage Treatment Infrastructure
- River-Front Development
- River-Surface Cleaning
- Bio-Diversity
- Afforestation
- Public Awareness
- Industrial Effluent Monitoring
- Ganga Gram

The Brahmaputra System

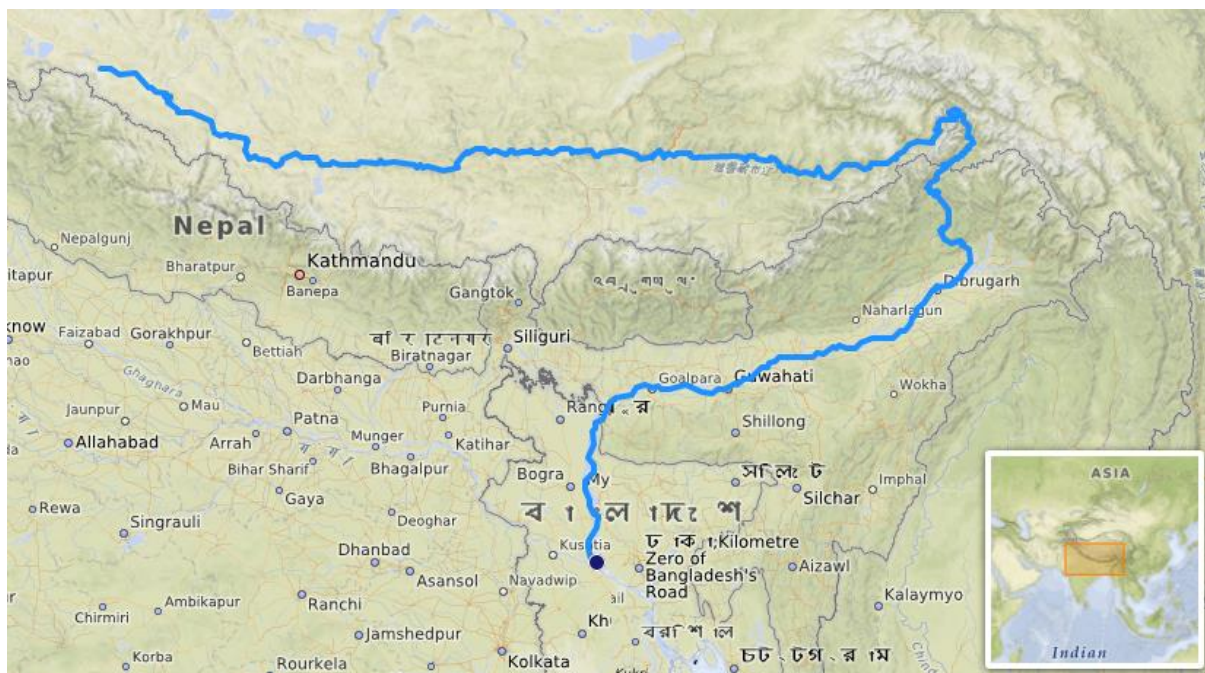


Fig 16- Origin of Brahmaputra River in China

Source-https://en.wikipedia.org/wiki/Brahmaputra_River#/media/File:Brahmapoutre.png

Origin and Course of Brahmaputra River

The Brahmaputra, one of the largest rivers of the world, has its origin in the Chemayungdung glacier of the Kailash range near the Mansarovar lake located on the northern side of the Himalayas in Burang County of Tibet as the Yarlung Tsangpo River,. From here, it traverses eastward longitudinally for a distance of nearly 1,200 km in a dry and flat region of southern Tibet, where it is known as the Tsangpo, which means 'the purifier.' and then into Arunachal Pradesh (India). It flows southwest through the Assam Valley as Brahmaputra and south through Bangladesh as the Jamuna (not to be mistaken with Yamuna of India). In the vast Ganges Delta, it merges with the Padma, the popular name of the river Ganges in Bangladesh, and finally, after merging with Padma, it becomes the Meghna and from here, it flows as Meghna river before emptying into the Bay of Bengal.

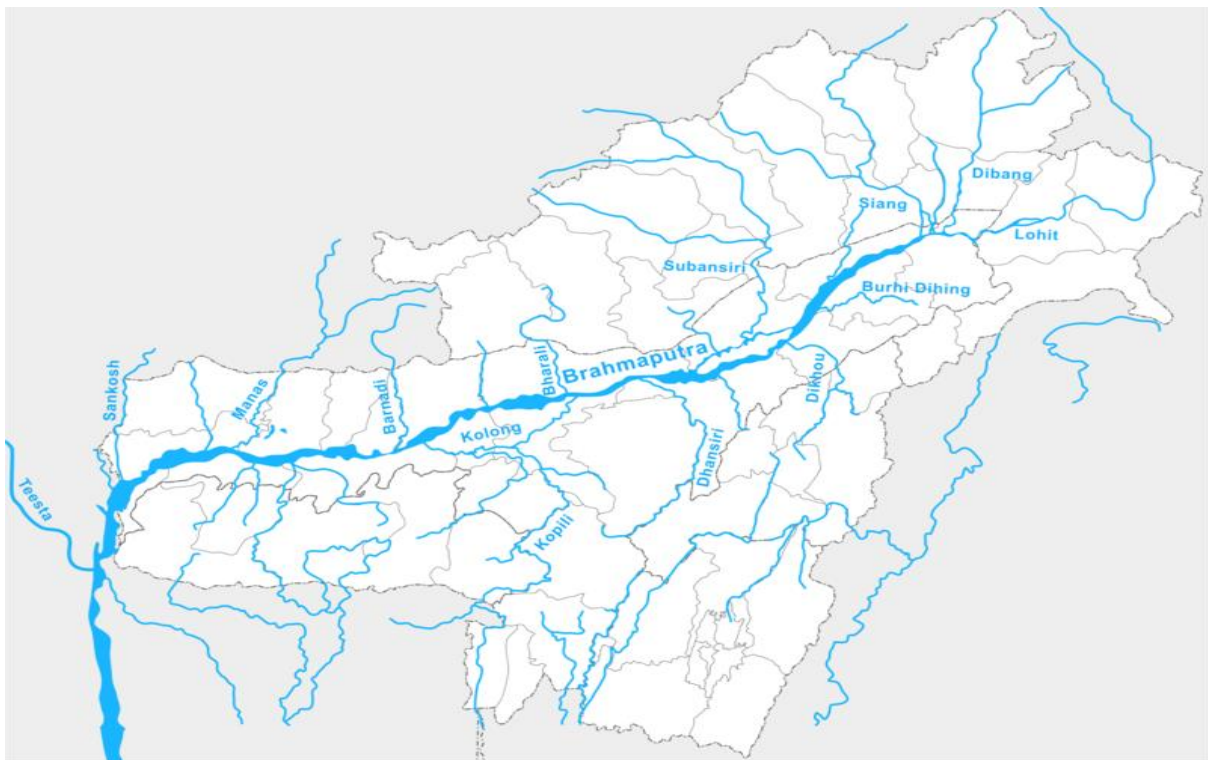


Fig.17 -Tributaries of Brahmaputra River

Source-https://en.wikipedia.org/wiki/Brahmaputra_River#/media/File:Brahmaputra-river-basin.png

Tributaries of Brahmaputra River

- The Rango Tsangpo is the major right bank tributary of this river in Tibet. It emerges as a turbulent and dynamic river after carving out a deep gorge in the Central Himalayas near Namcha Barwa (7,755 m). The river emerges from the foothills under the name of Siang or Dihang. It enters India west of Sadiya town in Arunachal Pradesh. Flowing

southwest, it receives its main left bank tributaries, viz., Dibang or Sikang and Lohit; thereafter, it is known as the Brahmaputra.



Fig. 18- Course of Brahmaputra river on India and Bangladesh

Source-<https://commons.wikimedia.org/wiki/File:Westbengalimap.png>

The Brahmaputra receives numerous tributaries in its 750 km long journey through the Assam valley.

- Its major left bank tributaries are the Burhi Dihing and Dhansari (South) whereas the important right bank tributaries are the Subansiri, Kameng, Manas and Sankosh. The Subansiri which has its origin in Tibet, is an antecedent river.
- The Brahmaputra enters into Bangladesh near Dhubri and flows southward. In Bangladesh, the Tista joins it on its right bank from where the river is known as the Jamuna. It finally merges with the river Padma, which falls in the Bay of Bengal. The Brahmaputra is well-known for floods, channel shifting and bank erosion. This is due to the fact that most of its tributaries are large, and bring large quantity of sediments owing to heavy rainfall in its catchment area.