

**INDIAN RIVER SYSTEMS**

A river drains the water collected from a specific area, which is called its 'catchment area' and the area drained by a river and its tributaries is called a drainage basin.

- The boundary line separating one drainage basin from the other is known as the watershed.
- The catchments of large rivers are called river basins while those of small rivulets and rills are often referred to as watersheds.
- There is, however, a slight difference between a river basin and a watershed. Watersheds are small in area while the basins cover larger areas.
- Indian drainage system may be divided on various bases. On the basis of discharge of water (orientations to the sea), it may be grouped into the Arabian Sea drainage and the Bay of Bengal drainage.
- They are separated from each other through the Delhi ridge, the Aravallis and the Sahyadris.
- Nearly 77 per cent of the drainage area consisting of the Ganga, the Brahmaputra, the Mahanadi, the Krishna, etc. is oriented towards the Bay of Bengal while 23 per cent comprising the Indus, the Narmada, the Tapi, the Mahi and the Periyar systems discharge their waters in the Arabian Sea.
- On the basis of the size of the watershed, the drainage basins of India are grouped into three categories:
  - (i) Major river basins with more than 20,000 sq. km of catchment area that includes 14 drainage basins such as the Ganga, the Brahmaputra, the Krishna, the Tapi, the Narmada, the Mahi, the Pennar, the Sabarmati, the Barak, etc.
  - (ii) Medium river basins with catchment area between 2,000-20,000 sq. km incorporating 44 river basins such as the Kalindi, the Periyar, the Meghna, etc.
  - (iii) Minor river basins with catchment area of less than 2,000 sq. km include fairly good number of rivers flowing in the area of low rainfall.
- Large rivers flowing on the peninsular plateau have their origin in the Western Ghats and discharge their waters in the Bay of Bengal.

- The Narmada and Tapi are two large rivers which are exceptions as they along with many small rivers discharge their waters in the Arabian Sea.
- On the basis of the mode of origin, nature and characteristics, the Indian drainage may also be classified into the Himalayan drainage and the peninsular drainage.

## **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.

### **(i) THE HIMALAYAN DRAINAGE**

- It mainly includes the Ganga, the Indus and the Brahmaputra river basins and these rivers pass through the giant gorges carved out by the erosional activity carried on simultaneously with the uplift of the Himalayas.
- Besides deep gorges, these rivers also form V-shaped valleys, rapids and waterfalls in their mountainous course.
- While entering the plains, they form depositional features like flat valleys, ox-bow lakes, flood plains, braided channels, and deltas near the river mouth.
- 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 and gets blocked, and consequently, the river changes its course.

### **EVOLUTION OF THE HIMALAYAN DRAINAGE**

- There are differences 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 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 (Delhi Ridge), 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:
  - (a) 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 is 321, 289 sq. km) and a total length of 2,880 km (in India 1,114 km).
    - The Indus is the westernmost of the Himalayan rivers in India originating 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.
    - After flowing in the northwest direction between the Ladakh and Zaskar ranges, it passes through Ladakh and Baltistan and cuts across the Ladakh range, forming a spectacular gorge near Gilgit in Jammu and Kashmir. It enters into Pakistan near Chillar in the Dardistan region.
    - 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 river flows southward and receives 'Panjnad' a little above Mithankot. The Panjnad is the name given to the five rivers of Punjab, namely the Satluj, the Beas, the Ravi, the Chenab and the Jhelum.
- It finally discharges into the Arabian Sea, east of Karachi but the Indus flows in India only through the Leh district in Jammu and Kashmir.
- 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 and flows through Srinagar and the Wular Lake before entering Pakistan through a deep narrow gorge. It joins the Chenab near Jhang in Pakistan.
- The Ravi is another important tributary of the Indus rising west of the Rohtang pass in the Kullu hills of Himachal Pradesh and flows through the Chamba valley of the state.
- 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 Dhaoladhar range. It enters the Punjab plains where it meets the Satluj near Harike.
- The Satluj originates in the Rakas Lake 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 and passes through the Shipki La on the Himalayan ranges and enters the Punjab plains.
- It is a very important tributary as it feeds the canal system of the Bhakra Nangal project.

**(b) The Ganga System**

- The Ganga, the most important river of India, rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttaranchal. Here, it is known as the Bhagirathi.
- It cuts through the Central and the Lesser Himalayas in narrow gorges.
- At Devprayag, the Bhagirathi meets the Alaknanda; hereafter, it is known as the Ganga.

The Alaknanda has its source in the Satopanth glacier above Badrinath.

- The Alaknanda consists of the Dhauliganga and the Vishnu Ganga which meet at Joshimath or Vishnu Prayag.
- The Ganga enters the plains at Haridwar from where; it flows first to the south, then to the south-east and east before splitting into two distributaries, namely the Bhagirathi and the Hugli.
- The river has a length of 2,525 km and is shared by Uttaranchal (110 km), Uttar Pradesh (1,450 km), Bihar (445 km) and West Bengal (520 km).
- 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.
- The Son is its major right bank tributary and the important left bank tributaries are the Ramganga, the Gomati, the Ghaghara, the Gandak, the Kosi and the Mahanada.
- The river finally discharges itself into the Bay of Bengal near the Sagar Island.
- The Yamuna, the western most and the longest tributary of the Ganga, has its source in the Yamunotri glacier.
- It joins the Ganga at Prayag (Allahabad) and 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.
- 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 Gandak comprises two streams, namely Kaligandak and Trishulganga rising in the Nepal Himalayas between the Dhaulagiri and Mount Everest and drains the central part of Nepal and 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.
- The Ramganga is comparatively a small river rising in the Garhwal hills near Gairsain changing 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.
- Known as the ‘sorrow of Bengal’, the Damodar has been now tamed by the Damodar Valley Corporation, a multipurpose project.
- The Mahananda is another important tributary of the Ganga rising in the Darjeeling 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.

**(c) The Brahmaputra System**

- 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.
- 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.’
- The Rango Tsangpo is the major right bank tributary of this river in Tibet and emerges as a turbulent and dynamic river after carving out a deep gorge in the Central Himalayas near Namcha Barwa (7,755 m).

- It enters India west of Sadiya town in Arunachal Pradesh and flowing southwest, it receives its main left bank tributaries, viz., Dibang or Sikang and Lohit; thereafter, it is known as the Brahmaputra.
- The Brahmaputra receives numerous tributaries in its 750 km long journey through the Assam valley.
- Its major left bank tributaries are the Burhi Dihing, Dhansari (South) and Kalang whereas the important right bank tributaries are the Subansiri, Kameng, Manas and Sankosh.
- 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 Yamuna.
- 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.

## **(ii) THE PENINSULAR DRAINAGE SYSTEM**

- The Peninsular drainage system is older than the Himalayan one which is evident from the broad, largely-graded shallow valleys, and the maturity of the rivers.
- The Western Ghats running close to the western coast act as the water divide between the major Peninsular Rivers, discharging their water in the Bay of Bengal and as small rivulets joining the Arabian Sea.
- The Chambal, the Sind, the Betwa, the Ken, the Son, originating in the northern part of the Peninsula belong to the Ganga river system.
- The other major river systems of the peninsular drainage are – the Mahanadi the Godavari, the Krishna and the Kaveri.
- Peninsular rivers are characterized by fixed course, absence of rapids and non-perennial flow of water with the exception of Kaveri.

## THE EVOLUTION OF PENINSULAR DRAINAGE SYSTEM

- Three major geological events in the distant past have shaped the present drainage systems of Peninsular India:
  - (i) Subsidence of the western flank of the Peninsula leading to its submergence below the sea during the early tertiary period.
  - (ii) Upheaval of the Himalayas when the northern flank of the peninsular block was subjected to subsidence and the consequent trough faulting. The Narmada and The Tapi flow in trough faults and fill the original cracks with their detritus materials. Hence, there is a lack of alluvial and deltaic deposits in these rivers.
  - (iii) Slight tilting of the peninsular block from northwest to the southeastern direction gave orientation to the entire drainage system towards the Bay of Bengal during the same period.

### River Systems of the Peninsular Drainage

- There are a large number of river systems in the peninsular drainage.
- The Mahanadi rises near Sihawa in Raipur district of Chhattisgarh and runs through Orissa to discharge its water into the Bay of Bengal.
- It is 851 km long and its catchment area spreads over 1.42 lakh sq. km and fifty three per cent of the drainage basin of this river lies in Madhya Pradesh and Chhattisgarh, while 47 per cent lies in Orissa.
- The Godavari is the largest peninsular river system that rises in the Nasik district of Maharashtra and discharges its water into the Bay of Bengal.
- It is 1,465 km long with a catchment area spreading over 3.13 lakh sq. km 49 per cent of this, lies in Maharashtra, 20 per cent in Madhya Pradesh and Chhattisgarh, and the rest in Andhra Pradesh.
- The Godavari is subjected to heavy floods in its lower reaches to the south of Polavaram, where it forms a picturesque gorge. It is navigable only in the deltaic stretch. The river after Rajahmundry splits into several branches forming a large delta.

- The Krishna is the second largest east-flowing Peninsular River which rises near Mahabaleshwar in Sahyadri.
- Its total length is 1,401 km and of the total catchment area of the Krishna, 27 per cent lies in Maharashtra, 44 per cent in Karnataka and 29 per cent in Andhra Pradesh.
- The Kaveri rises in Brahmagiri hills (1,341m) of Kogadu district in Karnataka. Its length is 800 km and it drains an area of 81,155 sq. km.
- Since the upper catchment area receives rainfall during the southwest monsoon season (summer) and the lower part during the northeast monsoon season (winter), the river carries water throughout the year with comparatively less fluctuation than the other Peninsular rivers.
- About 3 per cent of the Kaveri basin falls in Kerala, 41 per cent in Karnataka and 56 per cent in Tamil Nadu. Its important tributaries are the Kabini, the Bhavani and the Amravati.
- The Narmada originates on the western flank of the Amarkantak plateau at a height of about 1,057 m.
- Flowing in a rift valley between the Satpura in the south and the Vindhyan range in the north, it forms a picturesque gorge in marble rocks and Dhuandhar waterfall near Jabalpur.
- After flowing a distance of about 1,312 km, it meets the Arabian Sea south of Bharuch, forming a broad 27 km long estuary. Its catchment area is about 98,796 sq. km. The Sardar Sarovar Project has been constructed on this river.
- The Tapi is the other important westward flowing river that originates from Multai in the Betul district of Madhya Pradesh.
- It is 724 km long and drains an area of 65,145 sq. km and nearly 79 per cent of its basin lies in Maharashtra, 15 per cent in Madhya Pradesh and the remaining 6 per cent in Gujarat.
- Luni is the largest river system of Rajasthan, west of Aravalli originating near Pushkar in two branches, i.e. the Saraswati and the Sabarmati, which join with each other at Govindgarh. From here, the river comes out of Aravalli and is known as Luni.
- It flows towards the west till Telwara and then takes a southwest direction to join the

Rann of Kuchchh. The entire river system is ephemeral.

### **Smaller Rivers Flowing Towards the West**

- The Shetrunji in Gujarat is one such river which rises near Dalkahwa in Amreli district and flows towards the Arabian Sea.
- The Bhadra originates near Aniali village in Rajkot district. The Dhadhar rises near Ghantar village in Panchmahal district. Sabarmati and Mahi are the two famous rivers of Gujarat.
- The Vaitarna rises from the Trimbak hills in Nasik district at an elevation of 670 m. The Kalinadi rises from Belgaum district and falls in the Karwar Bay.
- The source of Bedti river lies in Hubli Dharwar and traverses a course of 161 km.
- The Sharavati originating in Shimoga district of Karnataka and drains a catchment area of 2,209 sq. km, is another important river in Karnataka flowing towards the west.
- Goa has two important rivers - Mandovi and the other is Juari.
- Kerala has a narrow coastline. The longest river of Kerala, Bharathapuzha rises near Annamalai hills. It is also known as Ponnani. It drains an area of 5,397 sq. km.
- The Periyar is the second largest river of Kerala. Its catchment area is 5,243 sq. km.
- Another river of Kerala worth mentioning is the Pamba river which falls in the Vemobanad lake after traversing a course of 177 km.

### **Small Rivers Flowing towards the East**

- There are a large number of rivers flowing towards the east along with their tributaries.
- There are small rivers which join the Bay of Bengal, though small, these are important in their own right.
- The Subarnrekha, the Baitarni, the Brahmani, the Vamsadhara, the Penner, the Palar and the Vaigai are important rivers.

### **(iii) RIVER REGIMES**

- The pattern of flow of water in a river channel over a year is known as its regime.

- The north Indian rivers originating from the Himalayas are perennial as they are fed by glaciers through snow melt and also receive rainfall water during rainy season.
- The rivers of South India do not originate from glaciers and their flow pattern witnesses fluctuations but the flow increases considerably during monsoon rains.
- Thus, the regime of the rivers of South India is controlled by rainfall which also varies from one part of the peninsular plateau to the other.
- The discharge is the volume of water flowing in a river measured over time measured either in cusecs (cubic feet per second) or cumecs (cubic metres per second).
- The Ganga has its minimum flow during the January-June period and the maximum flow either in August or in September.
- There are striking differences in the river regimes in the eastern and the western parts of the Ganga Basin.
- The Ganga maintains a sizeable flow in the early part of summer due to snow melt before the monsoon rains begin.
- The mean maximum discharge of the Ganga at Farakka is about 55,000 cusecs while the mean minimum is only 1,300 cusecs.
- The two Peninsular rivers display interesting differences in their regimes compared to the Himalayan rivers.
- The Narmada has a very low volume of discharge from January to July but it suddenly rises in August when the maximum flow is attained.
- The flow of water in the Narmada, as recorded at Garudeshwar, shows that the maximum flow is of the order of 2,300 cusecs, while the minimum flow is only 15 cusecs.
- The Godavari has the minimum discharge in May, and the maximum in July-August.
- After August, there is a sharp fall in water flow although the volume of flow in October and November is higher than that in any of the months from January to May.
- The mean maximum discharge of the Godavari at Polavaram is 3,200 cusecs while the mean minimum flow is only 50 cusecs. These figures give an idea of the regime of the river.

**EXTENT OF USABILITY OF RIVER WATER**

- The rivers of India carry huge volumes of water per year but it is unevenly distributed both in time and space.
- There are perennial rivers carrying water throughout the year while the non-perennial rivers have very little water during the dry season.
- During the rainy season, much of the water is wasted in floods and flows down to the sea.
- Similarly, when there is a flood in one part of the country, the other area suffers from drought.