

GIST OF N.C.E.R.T

DRAINAGE SYSTEM

A river drains the water collected from a specific area, which is called its 'catchment area'.

The flow of water through well-defined channels is known as 'drainage' and the network of such channels is called a 'drainage system'. The drainage pattern of an area is the outcome of the geological time period, nature and structure of rocks, topography, slope, amount of water flowing and the periodically of the flow.

An 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: (i) the Arabian Sea drainage; and (ii) the Bay of Bengal drainage. They are separated from each other through the Delhi ridge, the Aravalis and the Sahyadris (water divide is shown by a line in Figure. 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. It 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.

The Narmada and Tapi are two large rivers which are exceptions. 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. Although it has the problem of including the Chambal, the Betwa, the Son, etc. which are much older in age and origin than other rivers that have their origin in the Himalayas, it is the most accepted basis of classification.

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.

Important Drainage Patterns

- (i) The drainage pattern resembling the branches of a tree is known as "dendritic" the examples of which are the rivers of northern plain.
- (ii) When the rivers originate from a hill and flow in all directions, the drainage pattern is known as 'radial'. The rivers originating from the Amarkantak range present a good example of it.
- (iii) When the primary tributaries of rivers flow parallel to each other and secondary tributaries join them at right angles, the pattern is known as 'trellis'.
- (iv) When the rivers discharge their waters from all directions in a lake or depression, the pattern is known as 'centripetal'.

The Himalayan Drainage

The Himalayan drainage system has evolved through a long geological history. It mainly includes the Ganga, the Indus and the Brahmaputra rivers basins. Since these are fed both by melting of snow and precipitation, rivers of this system are perennial. 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. 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. 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 in the plains. The course 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 Shivalik 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 Shivalik 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 Himalayan, 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:

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 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 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 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. 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. 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. 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 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. 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.

The Ganga System

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 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 Bnadrinath. The Alaknanda consists of the Dhaul and the Vishnu Ganga which meet at Joshimath or Vishnu Prayag. The other tributaries of Alaknanda such as the Pindar join it at Karna Prayag while Mandakini or Kali Ganga meets it at Rudra Prayag. The Ganga enters the plains at Haridwar. From here, 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. It is shared by Uttaranchal (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. 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, 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). It joins the Ganga at Prayag (Allahabad). 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 water feeds the western and eastern Yamuna and the Agra canals for irrigation purposes.

The Chambal rises near Mhow in the Malwa plateau of Madhya Pradesh 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. 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.

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, multipurpose project.

The Sarda or Saryu river rises in the Milan 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 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.

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. 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.

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 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 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.

The peninsular drainage system

The peninsular drainage system is older than the Himalayan one. This 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. Most of the major peninsular rivers except Narmada and Tapi flow from west to east. The Chambal, the Sind, the Betwa, the Ken, the Son, originating in the northern part of the peninsular 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 meanders and no perennial flow of water. The Narmada and the Tapi which flow through the rift valley are, however, exceptions. They meet in Arabian sea.

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. Generally, it has disturbed the symmetrical plan of the river on either side of the original watershed. (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. A brief account of the major peninsular river systems is given below:

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 lakhs sq. km. Some navigation is carried on in the lower course of this river. Fifty three per cent of the drainage basin of this rivers lies in Madhya Pradesh and Chhattisgarh, while 47 per cent lies in Orissa.

The Godavari is the largest peninsular river system. It is also called the Dakshin Ganga. It rises in the Nasik district of Maharashtra and discharges its water into the Bay of Bengal. Its tributaries run through the states of Maharashtra, Madhya Pradesh, Chhattisgarh, Orissa and Andhra Pradesh. 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 Penganga, the Indravati, the Pranhita, and the Manjra are its principal tributaries. 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 Rajamundri 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. The Koyna, the Tungbhadra and the Bhima are its major tributaries. 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. It originates from Multai in the Betul district of Madhya Pradesh. It is 724 km long and drains an area of 65,145 sq. km. 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 Aravali. It originates 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 Aravali 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.

<i>River</i>	<i>Catchment area sq. km</i>
Sabarmati	21,674
Mahi	34,842
Dhandhar	2,770
Kalinadi	5,179
Sharavati	2,029
Bharathapuzha	5,397
Periyar	5,243

Smaller Rivers flowing towards the West

The rivers flowing towards the Arabian sea have short courses. Find out the smaller rivers of Gujarat. The Shetrunji is one such river which rises near Dalkahwa in Amreli district. 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 is another important river in Karnataka flowing towards the west. The Sharavati originates in

Shimoga district of Karnataka and drains a catchment area of 2,209 sq. km.

Goa has two important rivers which can be mentioned here. One is Mandovi and the other is Juari.

<i>River</i>	<i>Catchment area sq. km</i>
Subarnarekha	19.296
Baitarni	12.789
Brahmani	39.033
Penner	55.213
Palar	17.870

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 Compare its catchment area with that of the Sharavati river of Karnataka.

The Periyar is the second largest river of Kerala. Its catchment area is 5,243 sq. km. You can see that there is a marginal difference in the catchment area of the Bhartapuzha and the Periyar rivers.

Another river of Kerala worth mentioning is the Pamba river which falls in the Vemobanad lake after traversing a course of 177 km.

<i>Sl. No.</i>	<i>Aspects</i>	<i>Himalayan Ruler</i>	<i>Peninsular Ruler</i>
1.	Place of origin	Himalayan mountain covered with glaciers	Peninsular plateau and central highland.
2.	Nature of flow	Perennial: receive water from glacier and rainfall	Seasonal: dependent on monsoon rainfall.
3.	Type of drainage	Antecedent and consequent leading to dendritic pattenin in plains	Super imposed, rejuvenated resulting in trellis, radial and rectangular patterns.
4.	Nature of river	Long course, flowing through the rugged mountains experiencing headword erosion and river capturing: In plains meandering and shifting of course.	Smaller, fixed course with well-adjusted valleys.
5.	Catchment area	Very large basins	Relatively smaller basin
6.	Age of the river	Young and youthful, active and deepening in the valleys	Old rivers with graded profile, and have almost reached their base levels.

Comparison between the Himalayan and the Peninsular River