

Basic concepts of drainage

Question: What are 'drainage systems' and the geographical factors affecting a drainage system?

Answer: 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 or depends upon:

- the geological time period
 - nature and structure of rocks
 - topography
 - slope
 - amount of water flowing and the periodicity of the flow
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- **Catchment Area:** A river drains the water collected from a specific area, which is called its 'catchment area'.
 - **Drainage basin:** An area drained by a river and its tributaries is called a drainage basin.
 - **Watershed:** The boundary line separating one drainage basin from the other is known as the watershed.
 - **Water divide:** The geographical boundary separating two drainage systems is called water divide.
 - **River Regime:** The pattern of flow of water in a river channel over a year is known as its regime.

Note: 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.

Important Drainage Patterns

1. **Dendritic pattern:** The drainage pattern resembling the branches of a tree is known as "dendritic" the examples of which are the rivers of northern plain. It is the most common form of drainage system. In a dendritic system, there are many contributing streams (analogous to the twigs of a tree), which are then joined together into the tributaries of the main river (the branches and the trunk of the tree, respectively). They develop where the river channel follows the slope of the terrain.
2. **Parallel drainage pattern:** A parallel drainage system is a pattern of rivers caused by steep slopes with some relief. Because of the steep slopes, the streams are swift and straight, with very few tributaries, and all flow in the same direction. This system forms on uniformly sloping surfaces, for example, rivers flowing southeast from the Aberdare Mountains in Kenya.
3. **Radial Pattern:** 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.
4. **Trellis Pattern:** 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'. The geometry of a trellis drainage system is similar to that of a common garden trellis used to grow vines. As the river flows along a strike valley, smaller tributaries feed into it from the steep slopes on the sides of mountains. These tributaries enter the main river at approximately 90 degree angles, causing a trellis-like appearance of the drainage system. Trellis drainage is characteristic of folded mountains.
5. **Centripetal Pattern:** When the rivers discharge their waters from all directions in a lake or depression, the pattern is known as 'centripetal'.

Consequent and Subsequent rivers

- A river system that follows a normal downhill pattern along a pre-existing land surface is said to be consequent (the consequence of original slope). This pattern can be altered by mountain uplift,

erosion around resistant rock units, etc. When altered, this is called subsequent (subsequent to the original pattern).

- Occasionally a river may erode its bed into the path of another and capture it. This is called stream capture or piracy. When this happens, the downstream portion of the captured river dries up and is said to be beheaded.

Antecedent and Superimposed Rivers

- The case of rivers cutting right through mountain ranges is especially intriguing. **Two models** have been given serious consideration. The **first**, called '**antecedent**', postulates that the river has stayed more or less in its original position as slow uplift of the region has taken place.
- As long as uplift is slower than the erosional capability of a river, the river can maintain its normal position and grade (slope) across uplifting regions.
- Its position being antecedent to uplift, the sequence is appropriately referred to as antecedent drainage.
- The river Arun, which crosses the Himalayas a few dozen km east of Mount Everest through deep and almost impassable gorges, is considered to be antecedent. The **second** model to explain rivers cutting through mountain ranges are called '**superposed**', a contraction of **superimposed**.
- In this model the pattern of a river from a higher level is superimposed on the present topography. The mountain ranges are assumed to have already been there but buried in sediments and the rivers flow on the surface of the sediments that cover these ranges.
- The sedimentary layers over and around the mountain ranges are then eroded with time and the river cuts down through them including the buried ranges. With either model one ends up with the same final result. This makes it more difficult to tell which really occurred.

INDIAN DRAINAGE SYSTEM:

Indian drainage system may be divided on various bases.

A. On the basis of discharge of water (orientations to the sea), it may be grouped into:

1. The Arabian Sea drainage
2. The Bay of Bengal drainage.

They are separated from each other through the Delhi ridge, the Aravalis 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.

B. 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.

- C. On the basis of the mode of origin, nature and characteristics, the Indian drainage may also be classified into:
- i. The Himalayan drainage
 - ii. 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.

THE HIMALAYAN DRAINAGE

- The Himalayan drainage system has evolved through a long geological history.
- It mainly includes the Ganga, the Indus and the Brahmaputra river basins. Since these are fed both by melting of snow and precipitation, rivers of this system are perennial.
- The various geographical features made by the Himalayan rivers are:
 - In upper reaches (Youthful stage): Gorges, V-shaped valleys, rapids, waterfalls, truncated spurs etc.
 - In plane areas or middle part (Mature stage): While entering the plains, they form depositional features like flat valleys, ox-bow lakes, flood plains, braided channels, and deltas near the river mouth. Over the plains they display a strong meandering tendency and shift their courses frequently.

The major river systems of Himalayan drainage are

1. The Indus system
2. The Ganga system
3. The Brahmaputra system

Note: Discuss their life from their birth to death i.e. from source to mouth. Major features if they make, their importance etc.

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 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 meanders and non-perennial flow of water. The Narmada and the Tapi which flow through the rift valley are, however, exceptions.

Note: Regarding evolution of Himalayan drainage and Peninsular drainage system: A story could be told to make it interesting.

Comparison between the Himalayan River system and Peninsular River system:

Sl. No.	Aspects	Himalayan River	Peninsular River
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 pattern in plains	Super imposed, rejuvenated resulting in trellis, radial and rectangular patterns
4.	Nature of river	Long course, flowing through the rugged mountains experiencing headward 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

Smaller Rivers Flowing Towards the West

River	Origin
Shetrunji	Amreli district
Bhadra	Rajkot district
Dhadhar	Panchmahal district
Vaitarna	Nasik district
Kalinadi	Belgaum district
Sharavati	Shimoga district

Other important west flowing rivers are: Sabarmati, Mahi, Periyar, Bharatpuzha, Dhandhar etc.

Small rivers flowing towards the East:

River	Catchment area sq. km
Subarnarekha	19,296
Baitami	12,789
Brahmani	39,033
Penner	55,213
Palar	17,870

Note: Locate all these rivers in Atlas.