ChronicleIAS

Class IXth NEW NCERT
Chapter-3

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3

DRAINAGE

The term ***drainage*** describes the river system of an area. Look at the physical map. You will notice that small streams flowing from different directions come together to form the main river, which ultimately drains into a large water body such as a lake or a sea or an ocean. The area drained by a single river system is called a ***drainage basin***. A closer observation on a map will indicate that any elevated area, such as a mountain or an upland, separates two drainage basins. Such an upland is known as a ***water divide*** (Figure 3.1).

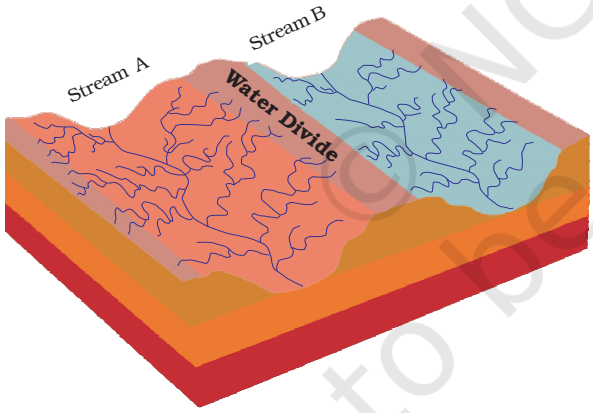

Figure 3.1 : Water Divide

Do You Know?

The world's largest drainage basin is of the Amazon river

Find out

- Which river has the largest basin in India?

DRAINAGE SYSTEMS IN INDIA

The drainage systems of India are mainly controlled by the broad relief features of the subcontinent. Accordingly, the Indian rivers are divided into two major groups:

- the Himalayan rivers; and
- the Peninsular rivers.

Apart from originating from the two major physiographic regions of India, the Himalayan and the Peninsular rivers are different from each other in many ways. Most of the Himalayan rivers are **perennial**. It means that they have water throughout the year. These rivers receive water from rain as well as from melted snow from the lofty mountains. The two major Himalayan rivers, the Indus and the Brahmaputra originate from the north of the mountain ranges. They have cut through the mountains making gorges. The Himalayan rivers have long courses from their source to the sea.

Figure 3.2 : A Gorge

They perform intensive erosional activity in their upper courses and carry huge loads of silt and sand. In the middle and the lower courses, these rivers form meanders, oxbow lakes, and many other depositional features in their floodplains. They also have well-developed deltas (Figure 3.3).

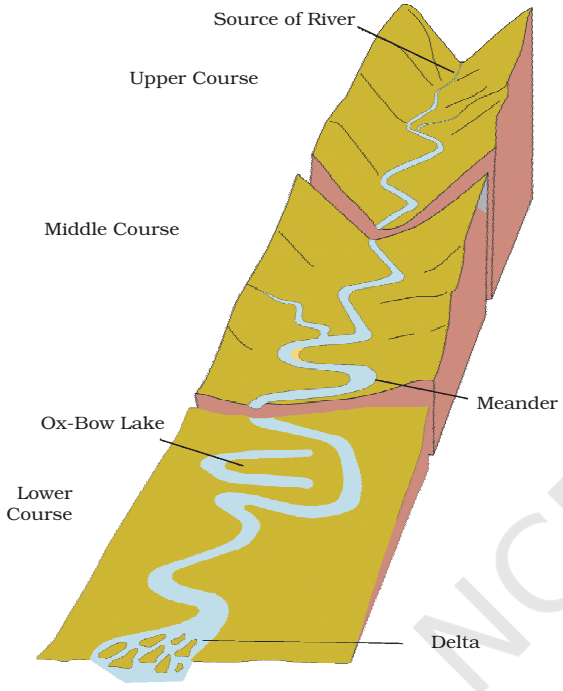

Figure 3.3 : Some Features Made by Rivers

A large number of the Peninsular rivers are seasonal, as their flow is dependent on rainfall. During the dry season, even the large rivers have reduced flow of water in their channels. The Peninsular rivers have shorter and shallower courses as compared to their Himalayan counterparts. However, some of them originate in the central highlands and flow towards the west. Can you identify two such large rivers? Most of the rivers of peninsular India originate in the Western Ghats and flow towards the Bay of Bengal.

The Himalayan Rivers

The major Himalayan rivers are the Indus, the Ganga and the Brahmaputra. These rivers are long, and are joined by many large and important tributaries. A river alongwith its tributaries may be called a **river system**.

The Indus River System

The river Indus rises in Tibet, near Lake Mansarowar. Flowing west, it enters India in the Ladakh. It forms a picturesque gorge in this part. Several tributaries, the Zaskar, the Nubra, the Shyok and the Hunza, join it in the Kashmir region. The Indus flows through Baltistan and Gilgit and emerges from the mountains at Attock. The Satluj, the Beas, the Ravi, the Chenab and the Jhelum join together to enter the Indus near Mithankot in Pakistan. Beyond this, the Indus flows southwards eventually reaching the Arabian Sea, east of Karachi. The Indus plain has a very gentle slope. With a total length of 2900 km, the Indus is one of the longest rivers of the world. A little over a third of the Indus basin is located in India Ladakh, Jammu and Kashmir, Himachal Pradesh and Punjab and the rest is in Pakistan.

Do You Know?

- According to the regulations of the **Indus Water Treaty (1960)**, India can use only 20 per cent of the total water carried by the Indus river system. This water is used for irrigation in Punjab, Haryana and the southern and the western parts of Rajasthan.

The Ganga River System

The headwaters of the Ganga, called the 'Bhagirathi' is fed by the Gangotri Glacier and joined by the Alaknanda at Devaprayag in Uttarakhand. At Haridwar, the Ganga emerges from the mountains on to the plains.

Figure 3.4 : Major Rivers and Lakes

Figure 3.5 : Confluence of Bhagirathi and Alaknanda at Devaprayag

The Ganga is joined by many tributaries from the Himalayas, a few of them being major rivers, such as the Yamuna, the Ghaghara, the Gandak and the Kosi. The river Yamuna rises from the Yamunotri Glacier in the Himalayas. It flows parallel to the Ganga and as a right bank tributary meets the Ganga at Allahabad. The Ghaghara, the Gandak and the Kosi rise in the Nepal Himalaya. They are the rivers, which flood parts of the northern plains every year, causing widespread damage to life and property, whereas, they enrich the soil for agricultural use.

The main tributaries, which come from the peninsular uplands, are the Chambal, the Betwa and the Son. These rise from semi-arid areas, have shorter courses and do not carry much water in them. Find out where and how they ultimately join the Ganga.

Do You Know?

• The *Namami Gange Programme* is an Integrated Conservation Mission approved as a 'flagship programme' by the Union Government in June 2014 to accomplish the twin objectives of effective abatement of pollution, conservation and rejuvenation of the national river, Ganga. You may explore about this project at http://nmcg.nic.in/NamamiGanga.sspx#

Enlarged with the waters from its right and left bank tributaries, the Ganga flows eastwards till Farakka in West Bengal. This is the northernmost point of the Ganga delta. The river bifurcates here; the Bhagirathi-Hooghly (a distributary) flows southwards through the deltaic plains to the Bay of Bengal. The mainstream, flows southwards into Bangladesh and is joined by the Brahmaputra. Further downstream, it is known as the Meghna. This mighty river, with waters from the Ganga and the Brahmaputra, flows into the Bay of Bengal. The delta formed by these rivers is known as the *Sundarban Delta*.

Do You Know?

• The Sundarban Delta derived its name from the Sundari tree, which grows well in marshland.

• It is the world's largest and fastest growing delta. It is also the home of Royal Bengal tiger.

The length of the Ganga is over 2500 km. Look at Figure 3.4; can you identify the type of drainage pattern formed by the Ganga river system? Ambala is located on the water divide between the Indus and the Ganga river systems. The plains from Ambala to the Sunderban stretch over nearly 1800 km, but the fall in its slope is hardly 300 metres. In other words, there is a fall of just one metre for every 6 km. Therefore, the river develops large meanders.

The Brahmaputra River System

The Brahmaputra rises in Tibet east of Mansarowar lake very close to the sources of the Indus and the Satluj. It is slightly longer than the Indus, and most of its course lies outside India. It flows eastwards parallel to the Himalayas. On reaching the Namcha Barwa (7757 m), it takes a 'U' turn and enters India in Arunachal Pradesh through a gorge. Here, it is called the Dihang and it is joined by the Dibang, the Lohit, and many other tributaries to form the Brahmaputra in Assam.

Do You Know?

• Brahmaputra is known as the Tsang Po in Tibet and Jamuna in Bangladesh.

In Tibet, the river carries a smaller volume of water and less silt as it is a cold and a dry area. In India, it passes through a region of high rainfall. Here the river carries a large volume of water and considerable amount of silt. The Brahmaputra has a braided channel in its entire length in Assam and forms many riverine islands. Do you remember the name of the world's largest riverine island formed by the Brahmaputra?

Every year during the rainy season, the river overflows its banks, causing widespread devastation due to floods in Assam and Bangladesh. Unlike other north Indian rivers, the Brahmaputra is marked by huge deposits of silt on its bed causing the riverbed to rise. The river also shifts its channel frequently.

The Peninsular Rivers

The main water divide in Peninsular India is formed by the Western Ghats, which runs from north to south close to the western coast. Most of the major rivers of the Peninsula, such as the Mahanadi, the Godavari, the Krishna and the Kaveri flow eastwards and drain into the Bay of Bengal. These rivers make deltas at their mouths. There are numerous small streams flowing west of the Western Ghats. The Narmada and the Tapi are the only long rivers, which flow west and make esturies. The drainage basins of the peninsular rivers are comparatively smaller in size.

The Narmada Basin

The Narmada rises in the Amarkantak hills in Madhya Pradesh. It flows towards the west in a rift valley formed due to faulting. On its way to the sea, the Narmada creates many picturesque locations. The 'Marble rocks', near Jabalpur, where the Narmada flows through a deep gorge, and the 'Dhuadhar falls, where the river plunges over steep rocks, are some of the notable ones.

Do You Know?

- The Narmada river conservation mission has been undertaken by the government of Madhya Pradesh by a scheme named *Namami Devi Narmade*. You may visit their website. http://www.namamidevinarmade.mp.gov.in to learn more about it.

All tributaries of the Narmada are very short and most of these join the main stream at right angles. The Narmada basin covers parts of Madhya Pradesh and Gujarat.

The Tapi Basin

The Tapi rises in the Satpura ranges, in the Betul district of Madhya Pradesh. It also flows in a rift valley parallel to the Narmada but it is much shorter in length. Its basin covers parts of Madhya Pradesh, Gujarat and Maharashtra.

The coastal plains between Western Ghats and the Arabian Sea are very narrow. Hence, the coastal rivers are short. The main west flowing rivers are Sabarmati, Mahi, Bharathpuzha and Periyar. Find out the states in which these rivers drain the water.

The Godavari Basin

The Godavari is the largest Peninsular river. It rises from the slopes of the Western Ghats in the Nasik district of Maharashtra. Its length is about 1500 km. It drains into the Bay of Bengal. Its drainage basin is also the largest among the peninsular rivers. The basin covers parts of Maharashtra (about 50 per cent of the basin area lies in Maharashtra), Madhya Pradesh, Odisha and Andhra Pradesh. The Godavari is joined by a number of tributaries, such as the Purna, the Wardha, the Pranhita, the Manjra, the Wainganga and the Penganga. The last three tributaries are very large. Because of its length and the area it covers, it is also known as the *Dakshin Ganga*.

The Mahanadi Basin

The Mahanadi rises in the highlands of Chhattisgarh. It flows through Odisha to reach

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the Bay of Bengal. The length of the river is about 860 km. Its drainage basin is shared by Maharashtra, Chhattisgarh, Jharkhand, and Odisha.

The Krishna Basin

Rising from a spring near Mahabaleshwar, the Krishna flows for about 1400 km and reaches the Bay of Bengal. The Tungabhadra, the Koyana, the Ghatprabha, the Musi and the Bhima are some of its tributaries. Its drainage basin is shared by Maharasthra, Karnataka and Andhra Pradesh.

The Kaveri Basin

The Kaveri rises in the Brahmagri range of the Western Ghats and it reaches the Bay of Bengal in south of Cuddalore in Tamil Nadu. The total length of the river is about 760 km. Its main tributaries are Amravati, Bhavani, Hemavati and Kabini. Its basin drains parts of Karnataka, Kerala and Tamil Nadu.

Do You Know?

- The river Kaveri makes the second biggest waterfall in India, known as Shivasamudram Falls. The hydroelectric power generated from the falls is supplied to Mysuru, Bengaluru and the Kolar Gold Field.

Find out

- The name of the biggest waterfall in India.

Besides these major rivers, there are some smaller rivers flowing towards the east. The Damoder, the Brahmani, the Baitarni and the Subarnrekha are some notable examples. Locate them in your atlas.

Do You Know?

- 71 per cent of the world's surface is covered with water, but 97 per cent of that is salt water.
- Of the 3 per cent that is available as freshwater, three quarters of it is trapped as ice.

Lakes

You may be familiar with the valley of Kashmir and the famous Dal Lake, the house boats and *shikaras*, which attract thousands of tourists every year. Similarly, you may have visited some other tourist spot near a lake and enjoyed boating, swimming and other water games. Imagine that if Srinagar, Nainital and other tourists places did not have a lake would they have been as attractive as they are today? Have you ever tried to know the importance of lakes in making a place attractive to tourists? Apart from attraction for tourists, lakes are also useful to human beings in many ways.

Find out

- Lakes of large extent are called seas, like the Caspian, the Dead and the Aral seas.

India has many lakes. These differ from each other in size and other characteristics. Most lakes are permanent; some contain water only during the rainy season, like the lakes in the basins of inland drainage of semi-arid regions. There are some lakes which are the result of the action of glaciers and ice sheets, while others have been formed by wind, river action and human activities.

A meandering river across a floodplain forms ***cut-offs*** that later develops into ***ox-bow*** lakes. Spits and bars form lagoons in the coastal areas, e.g. the Chilika lake, the Pulicat lake and the Kolleru lake. Lakes in the region of inland drainage are sometimes seasonal; for example, the Sambhar lake in Rajasthan, which is a salt water lake. Its water is used for producing salt.

Most of the freshwater lakes are in the Himalayan region. They are of glacial origin. In other words, they formed when glaciers dug out a basin, which was later filled with snowmelt. The Wular lake in Jammu and Kashmir, in contrast, is the result of tectonic activity. It is the largest freshwater lake in India. The Dal lake, Bhimtal, Nainital, Loktak and Barapani are some other important freshwater lakes.

Figure 3.6 : Loktak Lake

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Apart from natural lakes, the damming of the rivers for the generation of hydel power has also led to the formation of lakes, such as Guru Gobind Sagar (Bhakra Nangal Project).

Activity

Make a list of natural and artificial lakes with the help of the atlas.

Lakes are of great value to human beings. A lake helps to regulate the flow of a river. During heavy rains, it prevents flooding and during the dry season, it helps to maintain an even flow of water. Lakes can also be used for developing hydel power. They moderate the climate of the surroundings; maintain the aquatic ecosystem, enhance natural beauty, help develop tourism and provide recreation.

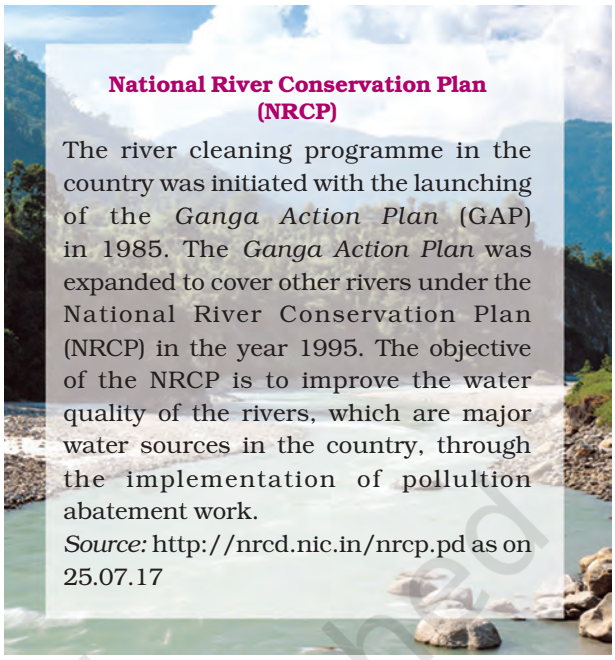
Role of Rivers in the Economy

Rivers have been of fundamental importance throughout the human history. Water from rivers is a basic natural resource, essential for various human activities. Therefore, riverbanks have attracted settlers from ancient times. These settlements have now become big cities. Make a list of cities in your state which are located on the bank of a river.

Using rivers for irrigation, navigation, hydro-power generation is of special significance — particularly to a country like India, where agriculture is the major source of livelihood of the majority of its population.

River Pollution

The growing domestic, municipal, industrial and agricultural demand for water from rivers naturally affects the quality of water. As a result, more and more water is being drained out of the rivers reducing their volume. On the other hand, a heavy load of untreated sewage and industrial effluents are emptied into the rivers. This affects not only the quality of water but also the self-cleansing capacity of the river. For example, given the adequate streamflow, the Ganga water is able to dilute and assimilate pollution loads within 20 km of large cities. But the increasing urbanisation and industrialisation do not allow it to happen and the pollution level of many rivers has been rising. Concern over rising pollution in our rivers led to the launching of various action plans to clean the rivers. Have you heard about such action plans? How does our health get affected by polluted river water? Think about "life of human beings without fresh water". Arrange a debate on this topic in the class.



National River Conservation Plan (NRCP)

The river cleaning programme in the country was initiated with the launching of the *Ganga Action Plan* (GAP) in 1985. The *Ganga Action Plan* was expanded to cover other rivers under the National River Conservation Plan (NRCP) in the year 1995. The objective of the NRCP is to improve the water quality of the rivers, which are major water sources in the country, through the implementation of pollution abatement work.

Source: http://nrcd.nic.in/nrcp.pd as on 25.07.17

Exercise

1. Choose the right answer from the four alternatives given below.
   (i) *In which of the following states is the Wular lake located?*
   (a) Rajasthan (c) Punjab
   (b) Uttar Pradesh (d) Jammu and Kashmir

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(ii) The river Narmada has its source at

(a) Satpura (c) Amarkantak

(b) Brahmagiri (d) Slopes of the Western Ghats

(iii) Which one of the following lakes is a salt water lake?

(a) Sambhar (c) Wular

(b) Dal (d) Gobind Sagar

(iv) Which one of the following is the longest river of the Peninsular India?

(a) Narmada (c) Godavari

(b) Krishna (d) Mahanadi

(v) Which one amongst the following rivers flows through a rift valley?

(a) Mahanadi (c) Krishna

(b) Tungabhadra (d) Tapi

2. Answer the following questions briefly.

(i) What is meant by a water divide? Give an example.

(ii) Which is the largest river basin in India?

(iii) Where do the rivers Indus and Ganga have their origin?

(iv) Name the two headstreams of the Ganga. Where do they meet to form the Ganga?

(v) Why does the Brahmaputra in its Tibetan part have less silt, despite a longer course?

(vi) Which two Peninsular rivers flow through trough?

(vii) State some economic benefits of rivers and lakes.

3. Below are given names of a few lakes of India. Group them under two categories – natural and created by human beings.

(a) Wular (b) Dal

(c) Nainital (d) Bhimtal

(e) Gobind Sagar (f) Loktak

(g) Barapani (h) Chilika

(i) Sambhar (j) Rana Pratap Sagar

(k) Nizam Sagar (l) Pulicat

(m) Nagarjuna Sagar (n) Hirakund

4. Discuss the significant difference between the Himalayan and the Peninsular rivers.

5. Compare the east flowing and the west flowing rivers of the Peninsular plateau.

6. Why are rivers important for the country's economy?

Map Skills

(i) On an outline map of India mark and label the following rivers: Ganga, Satluj, Damodar, Krishna, Narmada, Tapi, Mahanadi, and Brahmaputra.

(ii) On an outline map of India mark and label the following lakes: Chilika, Sambhar, Wular, Pulicat, Kolleru.

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Project/Activity

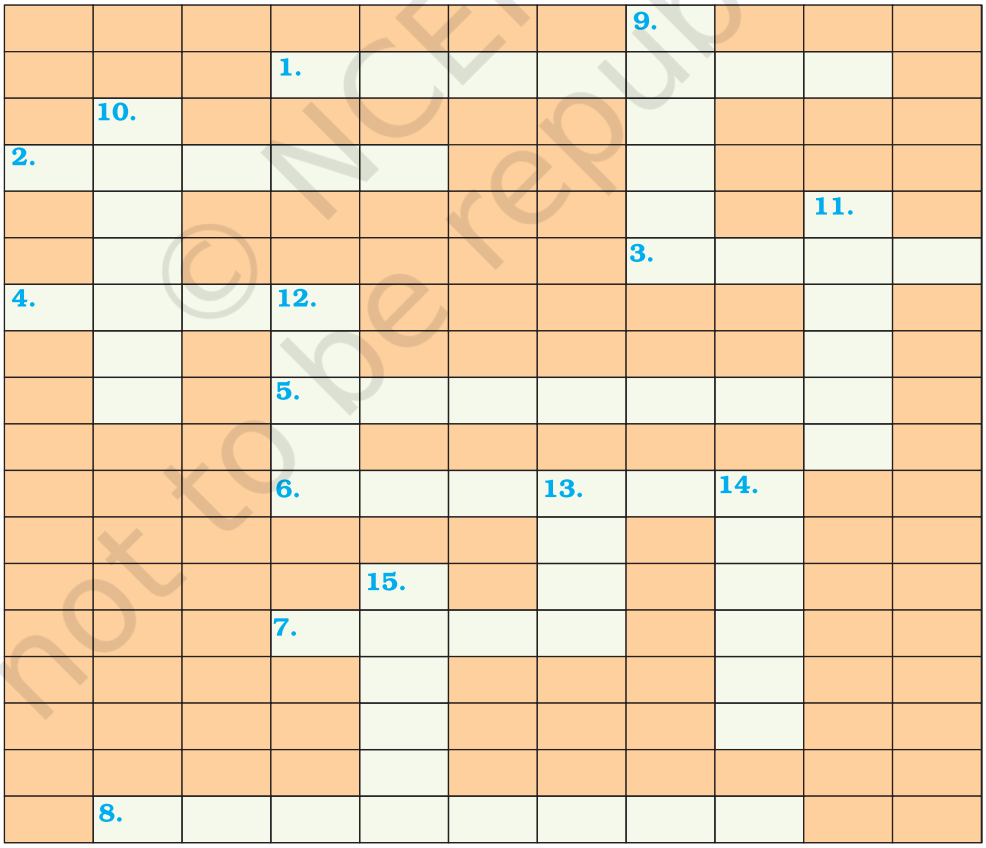
Solve this crossword puzzle with the help of given clues.

Across

1. Nagarjuna Sagar is a river valley project. Name the river?
2. The longest river of India.
3. The river which originates from a place known as Beas Kund.
4. The river which rises in the Betul district of MP and flows westwards.
5. The river which was known as the "Sorrow" of West Bengal.
6. The river on which the reservoir for Indira Gandhi Canal has been built.
7. The river whose source lies near Rohtang Pass.
8. The longest river of Peninsular India?

Down

9. A tributary of Indus originating from Himachal Pradesh.
10. The river flowing through fault, drains into the Arabian Sea.
11. A river of south India, which receives rainwater both in summer and winter.
12. A river which flows through Ladakh, Gilgit and Pakistan.
13. An important river of the Indian desert.
14. The river which joins Chenab in Pakistan.
15. A river which rises at Yamunotri glacier.



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CHAPTER

3

DRAINAGE SYSTEM

You have observed water flowing through the rivers, *nalas* and even channels during rainy season which drain the excess water. Had these channels not been there, large-scale flooding would have occurred. Wherever channels are ill-defined or choked, flooding is a common phenomenon.

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 periodicity of the flow.

Do you have a river near your village or city? Have you ever been there for boating or bathing? Is it perennial (always with water) or ephemeral (water during rainy season, and dry, otherwise)? Do you know that rivers flow in the same direction? You have studied about slopes in the other two textbooks of geography (NCERT, 2006) in this class . Can you, then, explain the reason for water flowing from one direction to the other? Why do the rivers originating from the Himalayas in the northern India and the Western Ghat in the southern India flow towards the east and discharge their waters in the Bay of Bengal?

Figure 3.1 : A River in the Mountainous Region

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

An area drained by a river and its tributaries is called a drainage basin. The boundary line

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 know as 'centripetal'.

Find out some of the patterns in the topo sheet given in Chapter 5 of *Practical Work in Geography– Part I (NCERT, 2006).*

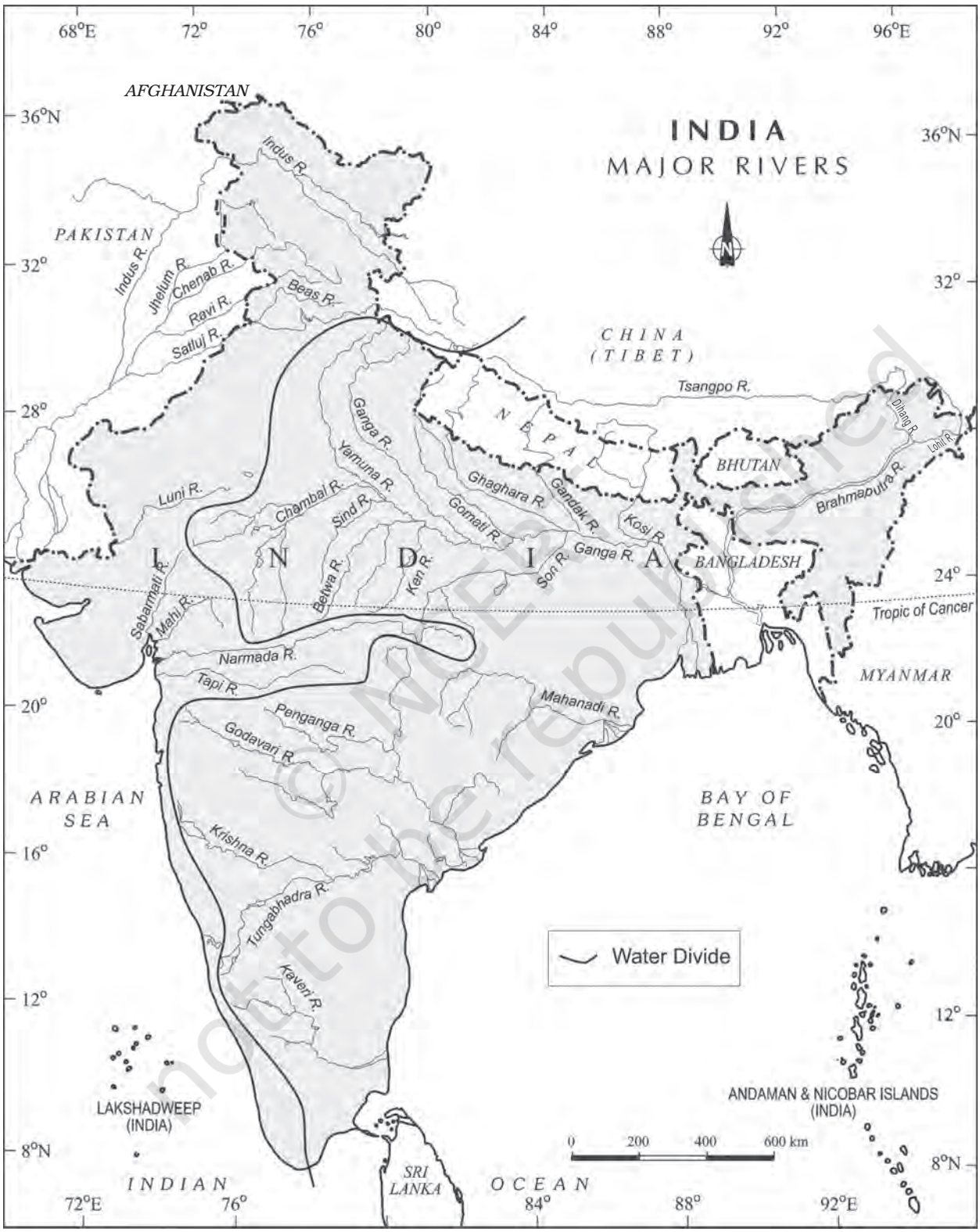

Figure 3.2 : Major Rivers of India

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.

River basins and watersheds are marked by unity. What happens in one part of the basin or watershed directly affects the other parts and the unit as a whole. That is why, they are accepted as the most appropriate micro, meso or macro planning regions.

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 3.1). 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. (Appendix III). (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.

If you look at the Figure 3.1 you can see that many rivers have their sources in the Himalayas and discharge their waters either in the Bay of Bengal or in the Arabian Sea. Identify these rivers of North India. Large rivers flowing on the Peninsular plateau have their origin in the Western Ghats and discharge their waters in the Bay of Bengal. Identify these rivers of the South India.

The Narmada and Tapi are two large rivers which are exceptions. They along with many small rivers discharge their waters in the Arabian Sea.

Name these rivers of the western coastal region from the Konkan to the Malabar coast.

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. Hence, this scheme has been followed in this book.

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.

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. 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

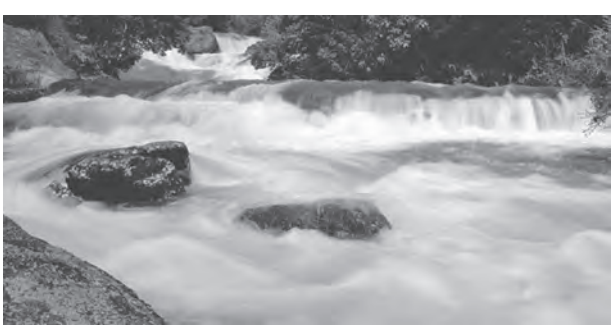

Figure 3.3 : Rapids

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 tortous, but over the plains they display a strong meandering tendency and shift their courses frequently. River Kosi, also know 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? Do you think that the discharge of the water in the rivers in general and the Kosi in particular, remains the same, or does it fluctuate? When does the river course receive the maximum quantity of water? What are the positive and negative effects of flooding?

Evolution of the Himalayan Drainage

There are 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 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:

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 Ladakh. It enters into Pakistan near Chilas in the Dardistan region. Find out the area known as Dardistan.

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 through Union Territories of Ladakh and 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 Dhaoladhar 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.

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 Uttarakhand. 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 Dhauli 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. 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 Padma. The 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

Do you Know?

'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

You may explore about this project at http://nmcg.nic.in/NamamiGanga.aspx#

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 m). 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 bank. Much of its water feeds the western and eastern Yamuna and the Agra canals for irrigation purposes.

Name the states which are drained by the river Yamuna.

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. 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, 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.

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 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.

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 characterised 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.

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

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, Odisha 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 and Telangana.

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.

Collect information about Narmada river conservation mission named "Namami Devi Narmade" and discuss with your peers.

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.

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. Why does this happen? Is it the problem of availability of water resource or that of its management? Can you suggest some measures to mitigate the problems of floods and droughts simultaneously occuring in different parts of the country? (See Chapter 6 of the book).

Can these problems be solved or minimised by trasfering the surplus water from one basin to the water deficit basins? Do we have some schemes of inter-basin linkage?

Teachers may explain the following examples

- Periyar Diversion Scheme
- Indira Gandhi Canal Project
- Kurnool-Cuddapah Canal
- Beas-Satluj Link Canal
- Ganga-Kaveri Link Canal

Have you read in the newspapers about the linking of rivers? Do you think that digging a canal is enough to transfer water from the Ganga basin to the Peninsular river? What is the major problem? Consult Chapter 2 of this book and find out the difficulties posed by the unevenness of the terrain. How can the water be lifted from the plain area to the plateau area? Is there sufficient surplus water in the north Indian rivers which can be transferred on a regular basis? Organise a debate on the whole issue and prepare a write up. How do you rank the following problems in using river water?

(i) No availability in sufficient quantity
(ii) River water pollution
(iii) Load of silt in the river water
(iv) Uneven seasonal flow of water
(v) River water disputes between states
(vi) Shrinking of channels due to the extension of settlements towards the thalweg.

Why are the rivers polluted? Have you seen the dirty waters of cities entering into the rivers? Where do the industrial affluents and wastes get disposed of ? Most of the cremation grounds are on the banks of rivers and the dead bodies are sometimes thrown in the rivers. On the occasion of some festivals, the flowers and statues are immersed in the rivers. Large scale bathing and washing of clothes also pollute river waters. How can the rivers be made pollution free? Have you read about Ganga Action Plan, or about a campaign for cleaning the Yamuna at Delhi? Collect materials on schemes for making rivers pollution free and organise the materials in a write up.

EXERCISES

1. Choose the right answer from the four alternatives given below.
   (i) Which one of the following rivers was known as the 'Sorrow of Bengal'?
   (a) The Gandak (c) The Kosi
   (b) The Son (d) The Damodar
   (ii) Which one of the following rivers has the largest river basin in India?
   (a) The Indus (c) The Ganga
   (b) The Brahmaputra (d) The Krishna
   (iii) Which one of the following rivers is not included in 'Panchnad'?
   (a) The Ravi (c) The Indus
   (b) The Chenab (d) The Jhelum
   (iv) Which one of the following rivers flows in a rift valley?
   (a) The Son (c) The Yamuna
   (b) The Narmada (d) The Luni
   (v) Which one of the following is the place of confluence of the Alaknanda and the Bhagirathi?
   (a) Vishnu Prayag (c) Karan Prayag
   (b) Rudra Prayag (d) Deva Prayag
2. State the differences between the following.
   (i) River Basin and Watershed
   (ii) Dendritic and Trellis drainage pattern
   (iii) Radial and Centripetal drainage pattern
   (iv) Delta and Estuary
3. Answer the following questions in about 30 words.
   (i) What are the socio-economic advantages of inter-linking of rivers in India?

(ii) Write three characterstics of the Peninsular river.

4. Answer the following questions in not more than 125 words.

(i) What are the important characteristic features of north Indian rivers? How are these different from Peninsular rivers?

(ii) Suppose you are travelling from Haridwar to Siliguri along the foothills of the Himalayas. Name the important rivers you will come across. Describe the characteristics of any one of them.

Project/Activity

Study the Appendix III and answer the following questions.

(i) Which river has the largest proportion of catchment area in the country?

(ii) Make a comparative bar diagram on a graph paper to show the length of the courses of the rivers.