20
WATER, FOREST AND WILD LIFE RESOURCES IN INDIA

20.1 INTRODUCTION

In the previous lesson, we studied two very vital natural resources viz. land and soils. We surveyed their utilisation, and the need for their systematic conservation. In this lesson, we will see that resources such as water, forests and wild life are equally important. These three natural resources are very closely inter-related to one another. Over exploitation of any one of these may badly affect the other two. A critical point has been reached where we need to lay very emphatic emphasis on their conservation and preservation as the case may be. In this lesson, we will study their present status, assess their utilization and analyse problems and list urgent measures for their adequate conservation.

20.2 OBJECTIVES

After studying this lesson you will able to :

- explain the meaning of water budget;
- establish relationship between physiography and terrain on one hand and suitable means of irrigation on the other;
- analyse the need for conservation of water resources;
- locate major river valley projects on the map of India;
- state the important direct and indirect benefits of forests;
- describe the different forest types in India along with typical trees of each;
- highlight the causes and consequences of deforestation;
- suggest suitable measures for conservation of forest resources;
- describe measures adopted for the conservation of wild life; and
- locate important national parks and wild life sanctuaries on the map of India.

20.3 WATER RESOURCE

Water is the most precious gift of nature. It is difficult to conceive life without water. Fresh water is in great demand in order to feed ever increasing population by irrigating crops standing on millions and millions of hectares of land. Likewise, the need for water has been growing very fast for domestic and industrial purposes. The rapid urbanisation demands water in ever increasing quantities for drainage and disposal of sewerage. Water is also a must for sanitation and public health. Storage and continuous supply of water is a pre-requisite for generation of hydroelectricity and for cooling pipes in the nuclear power plants. Fresh water is needed for inland fisheries, promotion of general tourism and white water sports. Thus entire human civilization depends on sufficient water supplies for its sustenance and progress. But the supply of water is by no means unlimited. Several areas are blessed with generous supplies of water but face catastrophic floods. In other areas, water is scarce and deadly droughts are not uncommon. Not only utilization of water is wasteful, but industry and people pollute our water resources without being punished.

20.4 WATER BUDGET

The water budget means the balance between the available water and usable and non-usable water. The water resources of India are unevenly distributed. Rainfall is an important source of water supply to the plants. It causes surface run-off. Through seepage and percolation, it recharges ground water. Rains in India are erratic and rainfall unevenly distributed. Rains vary from as little as 10 cm at Jaisalmer in west Rajasthan to as high as 1148 cm at Cherrapunji. Occasionally, Cherrapunji receives as much as 100 cm in a single day. India is at the mercy of the monsoons. India is one of the wettest countries of the world with average rainfall of 110 cm. About a third of this evaporates and runs off to the sea through the rivers. It is estimated that the remaining 20% seeps into the ground and recharges ground water reservoirs. Each year, India receives on an average 4200 km^3 of water. The total natural flow available is about 1800 km^3. However, the utilizable amountof water has been estimated at 1140 km^3. 90% of India's rainfall is received in three months from June to August. The number of rainy days varies from 137 on the west coast to less than 10 in Rajasthan. The areal distribution of rainfall in India is further uneven, as 8% of the total geographical area receives more than 200 cm rainfall, 20% between 125 to 200 cm, 42% between 75 cm to 125 cm and 30% less than 75 cm. In other words, approximately, 30% geographical area receives high rainfall and another 30% low rainfall. More than 80% of the country's area receives more than 80% of annual rainfall in about 100 days. For six to eight months of the year, the rainfall is either scanty or nill over a major part of the country. Roughly, 82° E longitude is the dividing line, east of which water is surplus and to the west it is deficit. Thus, the great problem of India's rainfall is its most uneven distribution both on space and time.

Rainfall is drained into the sea through a number of river systems. It is the main source of water.

On the basis of size of catchments, the rivers of India can be divided into four groups,

(1) Major rivers with catchment areas of more than 20,000 km^2,
(2) Medium rivers with catchment areas of 2,000 to 20,000 km^2,
(3) Small rivers with catchment areas of lessthan 2,000 km^2 and
(4) Desert rivers which flow for some distance and disappear into desert.

The rivers are well spread over the entire country excepting Thar desert. There are 121 major river in India covering 2.35 million km^2 of basin area. The medium rivers are 44 with basin area of 0.24 million km^2. The minor rivers are numerous and are essentially small streams with catchment area of 0.2 million km^2. The total basin area of desert rivers is about 1,00,000 km. The total annual volume of water discharged by all the river systems is 176.80 million hectare meters. Of this, the major river systems contribute 85%, while the medium and minor, including desert, rivers contribute 7% and 8% respectively.

Accordingly to Central Water Commission, the basinwise water availability are as follows.

Table No. 20.1 Basinwise Water Availability

	Basins	Average annual flow percentage (in Million hectare metre)	
1	Ganga	44.40	60%
2	Brahmaputra	59.07	
3	Godavari	11.89	
4	Krishna	6.82	11%
5	Kaveri	2.06	
6	East flowing rivers from Pennar to Krishna and from Godavari to Mahanadi	2.38	
7	East flowing river from Cape Comorin to Kaveri	1.77	
8	Mahanadi	6.68	10%
9	Brahmani & Baitarani	3.62	
10	Subranarekha	1.07	
11	Damodar and Kasai	2.40	
12	Sabarmati	0.28	
13	Mahe	1.18	
14	West flowing rivers except Narmada and Tapti	19.77	15%
15	Narmada	4.29	
16	Tapti	1.69	
17	Indus	7.33	4%
		176.70	100%

* The water budget means the balance between the available water and usable and non-usable water.
* On the basis of catchement, the rivers of India can be divided into four groups. They are major rivers, medium rivers, small rivers and desert rivers. there are 121 major rivers, 44 medium rivers and numerour small rivers.

20.5 WATER UTILISATION

Water utilisation is an interplay of demand and supply of water. Both these conditions in India vary from place to place and region to region giving rise to contrasting patterns of utilisation. It is the modernisation of culture which increases the demand for water. India has been making increasing use of its water resources. Water is being increasingly used in agricultural, domestic, industrial and hydel power generation sectors. Water utilisation is of the order of 540 km^3 of which 360 km^3 is from surface water and 180 km^3 from groundwater. Out of this, 470 km^3 are used for irrigation. This has since become an essential component of country's agricultural economy.

Irrigation : It accounts for 87% of the total water utilised in the country. Possibly in years to come when industrial development increases, the share of irrigation is bound to decline. Since Independence the utilisation of irrigation water has increased by nearly two and a half times. As again the ultimate irrigation potential of 113.5 million hectare meter, the actual utilisation for irrigation in 1991-92 was only 71% of the potential. This has not achieved its full potential for several reasons. Some lands still have to be levelled and field channels constructed to direct the flood water. Major irrigation works also increase social and environmental costs, like loss of biodiversity in submerged area and resettlement of people displaced by large dams. There is also a reluctance on the part of farmers to switch over to the new cropping pattern, that is from dry farming to irrigation farming.

The major source of irrigation is mainly in the form of wells and tube wells which account for 46% of irrigation. Canals account for 36%, tanks for 7% and 11% by other sources.

(a) Wells and Tube wells : Wells and tube wells irrigation is important in northern and eastern plains, In these regions groundwater is available at a reasonable depth and is tapped with the help of electricity ever since the rural electrification has been taken up almost on war footing. Earlier all wells were hand or animal operated. But now power driven pumps have become very common. Where electricity is not available, the diesel run water pumps are in use. Well predominate in Gujarat, Rajasthan, Punjab, Uttar Pradesh, Maharashtra and Haryana. The pre-eminent position of groundwater in irrigation is recognised and is twice as productive as canal water.

(b) Canal : Canal irrigation is prevalent in the northern plains and eastern coastal plains and along the narrow valleys of the Deccan rivers. This includes large areas of land in Punjab, Haryana, Uttar Pradesh, Bihar, parts of southern states, Orissa, West Bengal and Assam. Most irrigation canals are aligned along the river interflow so that they provide irrigation to a large area. The canal systems taken out from the Yamuna, the Sutlej, the Ravi, the Ganga, Sarda, Gandak, Son and the Kosi are all perennial. The Gangetic plains provide suitable areas for perennial canals.

(c) Tank : Throughout Peninsula India storage reservoirs or tanks have been created by utilising the natural variations in the terrain and by damming small streams. Here, rivers are non-perennial and canals become dry for a considerable time. The irrigation system of India, therefore, is based on utilisation of various types which are suitable for different conditions.

* In India water is increasingly used in agricultural, domestic, industrial and hydel power generation.
* Irrigation accounts for 87% of the total water utilised in the country.
* The majoro source of irrigation in India is wells and tubewells, canals and tanks.

IN-TEXT QUESTIONS 20.1

1. Define water budget.
   (i) _____ (ii) _____ (iii) _____ (iv) _____
2. Name four major sectors in which water is utilised.
   (i) _____ (ii) _____ (iii) _____
3. Name three states where canal irrigation is more prevalent.
   _____
4. Choose the most appropriate alternative for each of the following :
   (a) Which one of the following irrigates the largest area in India.
   (i) Wells and tube wells
   (ii) Canal
   (iii) Tanks
   (iv) Other means
   (b) How much land is irrigated by canals.
   (i) 46%
   (ii) 57%
   (iii) 36%
   (iv) 7%
   (c) In which region tank irrigation is most prevalent.
   (i) Himalayas
   (ii) Northern plains
   (iii) Peninsular plateau
   (iv) Rajasthan desert

20.6 RIVER VALLEY PROJECTS

India has made enormous progress in harnessing rivers and constructing canal systems eminating from dams and reservoirs. India is one of the leading dam builders in the world today. The newly built river dams in India mostly multipurposes. The various purposes which are performed by these dams are irrigation, flood control, generation of hydroelectricity, navigation, recreation, fisheries and controlling soil erosion. Such a multifaceted river valley project simultaneously serves several purpose and hence the nomenclature - Multipurpose

Projects. In India, till 1990, 1754 large dams, with an average height of 15 metres and above had been constructed and 154 more were under construction. Among the most noteworthy multipurpose projects are the Damodar Valley Project in Bihar and West Bengal, Bhakra Nangal on the Sutlej in Himachal Pradesh and Punjab, Hirakud dam on the Mahanadi in Orissa, Rihand dam on Son in M.P. and U.P., Kosi in North Bihar, Tungabhadra in Karnataka, Gandhisagar and Rana Pratap Sagar on Chambal in M.P. and Rajasthan, Nizam Sagar on Godavari in Andhra Pradesh, Mettur dam on Kaveri in Tamil Nadu, Koyana a tributary of Krishna in Maharashtra, Tawa on the Narmada in M.P., Krishna Raja Sagar on Kaveri in Karnataka, Gandak along Indo-Nepal border, Nagarjuna Sagar on Krishna in Andhra Pradesh etc. Yet, only 15% of the country's total hydroelectric potential was developed by 1994, which in absolute terms is 12407 m.w. Some of the major multi-purpose river valley projects and irrigation project are discussed below :

(1) The Bhakra Nangal Project

The Bhakra-Nangal project is a joint venture of Punjab, Himachal Pradesh and Haryana. It stands first in India in respect of height and gravity of the dam. Under this project, two dams have been constructed over the river Sutlej. They are the Bhakra Dam and the Nangal Dam further down stream.

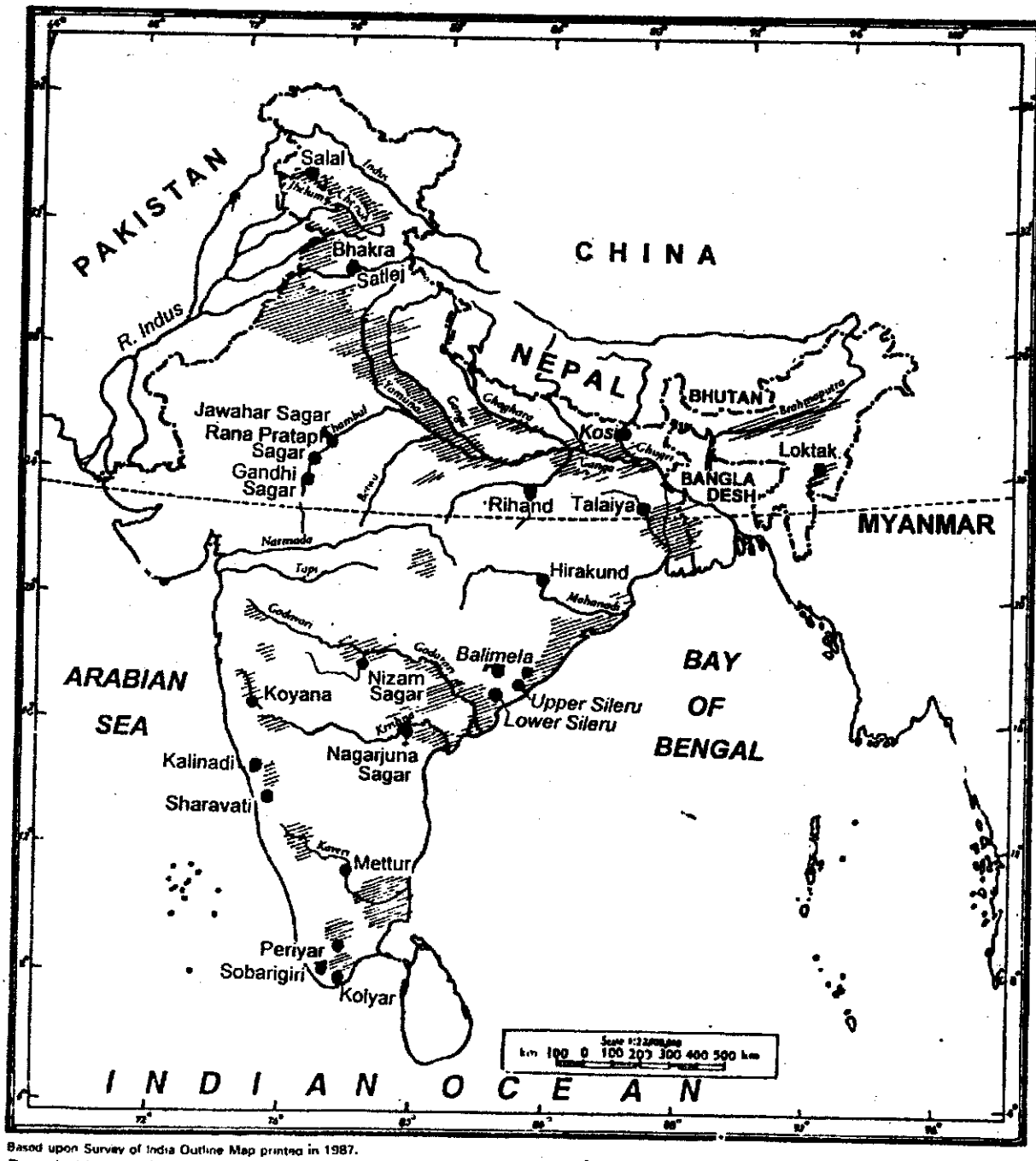
(i) The Bhakra Dam is situated to the north of Chandigarh over the Sutlej river. It is the highest dam of India and its height from river level is 226 metres. The dam has a man made lake called the Gobind Sagar reservoir. It has been named after the great Guru Gobind Singh. Its water storing capacity is 7.8 lakh hectares of water.
(ii) The Nangal Dam has been erected 13 kilometres west of the Bhakra at Nangal. Under this project 1100 kilometre long canals and 3400 kilometre long distributaries irrigate 14 lakh hectares of agricultural land. 1204 mw electricity is generated by this project.

(2) The Damodar Valley Corporation

An agency jointly formed by the states of Bihar and West Bengal. Before the completion of this project, the Damodar river was considered to be the sorrow of Bihar and West Bengal. Its floods affected thousands of people through loss of property worth crores of rupees every year. After the completion of the project, the river has become a boon to these states.

Under this project, four dams and reservoirs have been built on the Damodar and its tributaries. Its canals irrigate 4,50,000 hectare of agricultural land. They also provide 136 kilometres of inland waterways. Power stations of the Damodar Valley Corporation (DVC) generate 104 mw of hydroelectricity. Three thermal power stations have also come up in the region. Their power generation capacity is 1077 mw per year.

Development of hydroelectricity and thermal power and water ways have led to the industrial development of the valley. The valley is industrially the most developed region of the country. It is famous as the Chhotanagpur Plateau Region.



Based upon Survey of India Outline Map printed in 1987.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 20.1 Major River valley projects in India

(3) The Hirakud Project

Hirakud dam has been constructed on the Mahanadi in Orissa. This is now the second longest dam of the world having a length of 4801 metres with 21 kilometres long dykes on both sides of it. Canals irrigate 2.51 lakh hectares of agricultural land. The total power generation capcity of its power house is 270 mw of hydroelectricity per annum.

(4) Tungbhadra Project

The Tungbhadra Project is a joint effort of Andhra Pradesh and Karnataka on the Tungbhadra, a tributary of the Krishna river. Its irrigation potential is 4.97 lakh hectares of agricultural land. By 1981 the canals had started irrigating 3.22 lakh hectares of agricultural land.

(5) The Indira Gandh Canal

It is the longest irrigation canal in the World. The length of the main canal is 468 kilometres and that of its water fetching canals is 215 kilometres. When the project will be completed it could be able to irrigate 12.6 lakh hectares of land. Now it irrigates about 4.02 lakh hectares. The entire canal is being lined-up to do away with seepage of water in the sandy terrain. With the commencement of the canal irrigation, the desert has literally begun to bloom. It is hoped that in the years to come, Rajasthan will become the third granary of the country after Punjab and Haryana. Suratgarh farm symbolises this hope. Wheat, sugarcane and long staple cotton are being grown in abundance in the north-western parts of Rajasthan.

(6) The Nagarjun Sagar Project

The Nagarjun Sagar Project is primarily an irrigation project. A dam has been built on river Krishna near Nandi Konda village, 144 kilometres from Hyderabad. It has 3414 metre long dykes on both sides. Two canals on each side of the dam have irrigational capacity of 6.89 lakh hectares of agricultural land.

* Major River Valley Projects are those which perform various functions such as irrigation, flood control, generation of hydro-electricity, navigation, recreation, fisheries and controlling soil erosion.

20.7 PROBLEMS OF WATER UTILISATION

There is vast potential resource of water that can be utilised. Millions of cusecs of water flow unutilised into the sea. Floods and droughts are the common phenomena in India. Both are the major problems of the water management. Floods are seen as an indication of accelerated run off of rain water rendering the supply. Droughts on the other hand show the evidence of dwindling water supplies when they are needed the most. Every year on an average nearly 1500 human beings and about 0.10 million herds of cattle die in floods. In addition about 1.20 million houses were destroyed as also standing crops covering nearly 3.5 million hectares. Conversely, while there is flood in one part of the country, other parts are in the grip of drought. Every year the drought prone areas seem to be expanding. About 108 million hectares, which work out to be one third of the country's geographical area, are affected by drought. The consequences are similar to floods as far as loss in human lives and cattle are concerned.

Water supplies are relatively adequate for city dwellers, inadequate for slums and squatter settlements and thoroughly inadequate for 56% of the rural populatipn. The situation in urban areas is much better. However, our mega cities are in deep trouble. Chennai, Mumbai and Delhi reel under chronic water shortages. Slums and low income areas often receive non-tap water through private vendors. Such water is more expensive than municipal water. There are 2.27 lakh villages without safe drinking water within easy reach. About 44% of the rural population is still to be provided with safe drinking water. The performance in terms of water utilisation of 1754 large dams is below par. All the reservoirs are over-silted. An over-silted reservoir cannot make even modest claims. It has been observed that not even a single dam has rehabilitated the people whose lands were submerged. Due to financial constraints, hundred of dams have not even been completed. The treatment of reservoirs that are vulnerable to permanent siltation should be given top priority.

Water logging and salinity are the main problems caused by large irrigation projects. In India, 6-10 million hectares of fertile land suffer from water logging. It is because of overuse of water in irrigated areas, seepage of water from canals and distributaries, lack of land development, adoption of unsuitable crop patterns, poor water use practices and poor recharging of groundwater facilities. The relatively high groundwater withdrawals in coastal areas has depleted acquifers. It caused general lowering of the water table. As a result shallow wells go dry. In the coastal belts, saline water encroaches over the depleted reservoirs rendering the water reserves unfit for consumption. Such developments are observed in the coastal areas of Tamil Nadu, Vishakhapatnam in Andhra Pradesh, Saurashtra and 24-Parganas in West Bengal.

Interstate water disputes also create problems in water utilisation. Rivers like the Narmada, Chambal, Damodar, Krishna, Godavari, Kaveri, Mahanadi etc. traverse through two or more states. Others like the Ganga, Brahmputra, Kosi, Gandak, Indus, Sutlej etc. flow through neighbouring countries and are international rivers. In such a situation, water is shared among the states or neighbouring countries through which river flows. There are instances of political differences which result in allowing river waters to flow into the sea entirely unused. There are instances of political difference among sharing states and countries creating tension on the issue of sharing irrigation waters. Several such issues have emerged in India like Ganga water dispute between India and Bangladesh, Kaveri water dispute between Karnataka and Tamil Nadu and distribution of river water in Rajasthan, Punjab and Haryana. They have led to new regional verbal wars. It is not only the population growth that is straining our limited water resources but there is also a notorious wastage ininnumerable ways.

Deteriorating water quality is another problem of this resource. Both surface water and groundwater are seriously contaminated. This deterioration is a consequence of a wide range of human activities, including intensive use of mineral fertilisers, pesticides, discharge of heavy metals and hazardous chemicals into rivers, release of waste effluents either directly into the streams or into drains/channels that eventually join the streams. The Ganga and the

Damodar are perhaps the most polluted rivers in India. Activities in ports and harbours, discharge of sewage from cities and towns on the coast and effluent discharges from industries located near the coast are the important sources of pollution of coastal sea waters.

20.8 CONSERVATION OF WATER

There is surplus of water in the north and deficit in the west and south. This necessitates water conservation at the national level to achieve balanced development and rational utilisation of water resources. The conservation and management of water is described as having the right amount of water available for a particular use at the right time and with the right quality. In other words, having too much, or too little or the wrong quality of water is poor management. Conservation requires collection of information on water availability, including data on rainfall, run off, surface storage and evaporation gathered through satellites. The development of irrigation is playing a vital role in controlling floods and providing protection to flood prone areas. Since the launching of National Flood Control Programme in 1954, an area of 15 million hectares has been provided with protection. Flood protection measures include construction of embankments and drainage channels, reservoirs and town protection works. Considering the complexity and magnitude of the flood control problem with Northeast, the government has constituted the Brahmputra River Board with a view to control floods check erosion, improve drainage, and harnessing the waters of the basin for irrigation, hydropower generation and navigation. At the country level, over 400 kms of embankments have been built annually since 1954 containing the river more or less in its existing course.

For moderating flood, reservoirs along many rivers have been constructed to store water during the time of high discharge and releasing it when the critical conditions are past. Inter basin water transfer has been suggested as one of the measure in the seventies, but this method is not economically feasible. Watershed management in the catchments of flood prone rivers of selected river basins has been taken up during the previous plans. Integrated basin development approach has also been adopted for the best use of available water resources. The Command Area Development (CAD) programme was launched in January 1975 with the objective of ensuring faster and better utilisation of irrigation projects. The sprinkler and drip irrigation systems are being encouraged in many parts of the country for improving irrigation efficiency. Efficiency should also be increased in domestic and industrial utilisation of water. However, in some areas pricing or metering as a device for managing water demand has also been adopted. Mechanisms have been set up to regulate the sharing of river water between India and her neighbouring countries. The Indus Water Treaty of 1960 between India and Pakistan settles disputes mutually. The Indo-Bangladesh Joint Rivers Commission started functioning in 1972 in maximising the benefits in the fields of flood forecasting, flood control and river development. India has a number of joint projects with Nepal like Kosi Project and Gandak Projects. The Central Board for the Prevention and Control of Water Pollution was constituted in 1984 to study water pollution in both Ganga and Yamuna basins. A plan of action has been drawn up for checking pollution by a Central Ganga Authority. Finally, our national water policy of 1987 stresses treating river basin as the basic unit for water resources planning.

* Problems associated with water utilisation are floods, shortages of water, water logging and satinity inter-state water dispute, and deteriorating quality of water.
* Various methods are adopted for conservation of water. They are National Flood control programme, Water shed managment, Command area development programme, inter basin water transfer, efficient use of water, water pricing and international water treaty.

IN-TEXT QUESTIONS 20.2

1. Name four major objectives of multipurpose river valley project?
   (i) _____ (ii) _____
   (iii) _____ (iv) _____
2. Name the river and states on which the following projects have been established.

	River	State/States
(a) Bhakra Nangal Project	_____	_____
(b) Damodar Valley Project	_____	_____
(c) Hirakud Project	_____	_____
(d) Nagarjuna Sagar Project	_____	_____
(e) Krishna Raj Sagar Project	_____	_____

3. Define conservation and management of water.
   _____

20.9 FOREST RESOURCES

A forest is defined as a community of living trees and associated organisms which covers a considerable area. Forests are a renewable resource. They perform productive as well as protective functions. They contribute substantially to the economic development of the country by providing timber, industrial wood, fuel wood, fodder and other product. Forests also perform protective function by moderating local climates, regulating stream flow, reducing soil erosion and controlling floods. In addition, forests play a vital role in enhancing the quality of environment. Forests are also interwoven with our culture as they afford opportunities for inspiration, enhancement of human values, spiritual strength and recreation.

In India, there are no reliable statistics of the forest cover. According to Ministry of agriculture, present day forest cover is around 67.22 million hectares (22.1% of the total land) while according to Central Forestry Commission (1980) it is around 74.8 million hectares (i.e. 22.7%). Visual interpretation of satellite imageries in 1990-91, along with their field checking, shows a forest area of 6.3 lakh km^2, as compared to 7.4 lakh km^2 in 1982. This means the forest cover has shrunk further to 19.4% of our country's land area, which stands at 32.8 lakh km^2. Out of this area, dense forests account for 3.8 lakh km^2 or about 63% of the total whereas open forests account for 2.5 lakh km^2 or 39% with the mangrove forests accounting for only 1%.

The total figure means nothing unless we look at the variations in forest cover in different parts of India. It is essential to keep in mind that a major chunk of these forests are located in inacessible or sparsely populated zones which are confined to the Himalayas, the Western and Eastern Ghats, other mountain ranges of the Penninsualr plateau and parts of the Chhota Nagpur plateau and the Bastar region. The state wise distribution of forests shows a distinct pattern in different parts of India. In terms of proportion of forest to total area, the north east zone stands out with Arunachal Pradesh, Mehgalaya, Mizoram, Manipur and Nagaland depicting more than 70%. But Sikkim and Tripura have forested zones ranging between 42% to 52% and Assam's scenario is dismal at 30% . Yet, all these states are placed much above the national average. On the other hand, the eastern zone comprising West Bengal and Orissa is in stark contrast, with West Bengal's forest area being just 9%. The northern and central zone comprising of U.P., Bihar, M.P. and Himachal Pradesh has forest cover ranging between 10% to 30%. The situation in the north western zone, comprising of Punjab, Haryana, Delhi, Rajasthan and Gujarat is no better, with the forest cover being less than 10% of the total area because of low rain fall. Haryana has the lowest proportion of forest cover, being 1.2% of the total geographical area. In the southern zone, except for Kerala and Goa where the forest cover is 26% and 33% respectively, rest of the states have forest cover lying between 13% and 17%, mainly due to the rain shadow effect.

20.10 DISTRIBUTION OF MAJOR FOREST TYPES

Forests are an index of climate. The type of forests changes with the duration and amount of rainfall. However, altitudes are the major exception areas. In the mountainous areas, the temperature decreases with height and accordingly forest changes with height. Further, in coastal areas of the Ganga Brahmputra delta a special type of swamp forest is found due to tidal flooding. Thus, forests in India may be broadly classified into following six major groups:

1. Tropical Evergreen or Rain Forests

Tropical evergreen or rain forests are found in areas with an annual rainfall of more than 200 cm. They occupy the windward elongated strip of the Western Ghats, lower slopes of the eastern and north eastern Himalayas, the Brahmputra valley, the slopes surrounding the Ganga-Brahumputra delta and the Andaman & Nicobar Islands. Although these areas are physically isolated, their forests show similarity of structure and function. It is a broad-leaved forest of dense growth and an extremely diverse fauna and flora. The struggle is not for moisture but for light and air. Trees become very tall and usually reach a height of 35 to 50 meters or even beyond. They are unbranched except at the top. The number of species is very large. Trees include rosewood, telsur, pan etc. in the Western Ghats and champa, toon and gurjan in West Bengal and the Northeast. The economically important plants are rubber, ebony, mahogany and rosewood. The total area under this type of forests in India is about 65 lakh hectares.

2. Tropical Deciduous Forests

This type of forest are found in areas where the annual rainfall is between 100-200 cm. Deciduous forests are also called monsoon forests. They shed their leaves in the dry season.

It is estimated that one-third of our land area is covered with these forests. A narrow strip along the western side of the Peninsular plateau, the eastern slopes of the Western Ghats, an extensive area in the Chotanagpur Plateau, Orissa, eastern Madhya Pradesh, and the sub-Himalayan zone in Himachal Pradesh and Uttar Pradesh. There is no undergrowth and trees are widely spaced. The main species are teak, sal, banyan, sandal wood and ironwood. The commercial importance of these trees is much greater than that of rainforests. Teak is characteristic of both the Western Ghats as well as Madhya Pradesh and is used for furniture and construction of houses. Sal is more greagarious and occurs in pure stands than the teak. It is economically valuable. It is commonly found in Chotanagpur, Madhya Pradesh, Orissa, Assam, West Bengal and Uttar Pradesh. Equally important is sandalwood which occurs in the deciduous forests of Karnataka and is famous for its oil and scented wood. Mahua, khair, shisham, tendu, neem and bamboos are other significant and widely distributed species. The total area under tropical deciduous forests is approximately 225 lakh hectares.

3. Dry Deciduous Forests

The tropical dry deciduous forests cover large portions of India (39%) and are the most common forest type followed by tropical deciduous (31%). The two types of tropical deciduous forests contribute the bulk of forest area in India. The dry deciduous is found in areas with rainfall between 50 to 100 cm in the drier parts of north western, central and Deccan India. The trees are stunted by long dry season, often degenerate to bushes. Due to low rainfall, thorns and scrub predominat in eastern Rajasthan and the interior peninsula. The most common species in addition to thorny forests are neem, shisham, pipal and ber, but their heights are small. Various species of acacia also grow of which babul is commercially important. Babul provides tanning materials for hides and skins. The total area under this forest is estimated at about 300 lakh hectares.

4. The Semi-Deserts and Deserts Forests

This type is also known as the thorn forest and scrub receiving less than 50 cm of rainfall annually. These forests cover both the Thar desert and the driest part of the Deccan, where, occasionally the annual rainfall drops to less than 25 cm. Here biomass and organic productivity are very low. Broad leaved, deciduous thorny bushes, generally widely spaced and with heights ranging from 1 to 2 meters make up most of the vegetation. The most common species are acacia and euphorbia.

5. Mountain Forests

Mountain forests differ in their characteristics depending upon their altitude though geology, soil, climate and there biotic factors exert a considerable influence. There is altitudinal change in forest in the Himalayas from the Shiwaliks to the central ranges resulting into belts running from west to east. The western Himalayas are by and large arid and cold and the eastern Himalayas are wet and warm to cool. The upper limit of forest growth in the more humid eastern Himalayas varies from 4600 to 4900 metres and from 4000 to 4200 metres in the western. The sub-Himalayan tract of West Bengal and upper Assam up to 1000m is covered by tropical rainforest (rainfall 250cm). Moving west ward along the Shiwaliks both moist and dry deciduous forests are found, where moist and dry shorea robusta are

characteristic trees (100-200 cm). The wet broad leaf sub-tropical forest is found over lower slopes from 1000m to 2000m in the eastern Himalayas. This zone, with mean annual rainfall of 220 to 500 cm. is dominated by evergreen oaks, chestnuts, ash, beech and sal. This forest grades to sub-tropical pine in Uttar Pradesh and sub-tropical dry evergreen in Punjab and Kashmir. Here, rainfall rarely exceeds 100 cm and is characterised by long hot and very dry season and a cold winter. The dominant trees of this forest are chir and pine, which have a wide variety of constructional uses. They are very open with trees widely spaced. Above the sub-tropical forest beginning from 2000 m and continuing to 3000 m are the temperate mountain forests. It is also called Coniferous forest belt. The forest is described as wet temperate in West Bengal, Assam and Aruncahal Pradesh with oak, laurel, chestnut and rhododendrons as species; deodar in Uttar Pradesh with deodar, cedar, pines, silver fir and spruce as dominating species and dry temperate in Himachal Pradesh and Jammu & Kashmir where the deodars and pines are joined by juniper, oak and ash. The deodar attains great height and yields valuable and moderate hard wood. It is of great value for constructional uses. Finally, alpine vegetation is found above 3000 m throughout the Himalayas, occasionally extending up to 5500 m. This type is widespread in rainier ranges with precipitation below 40 cm. Rhodendrons are plentiful and in addition, stunted silver furs, juniper, bushes and beech are also found.

6. Mangrove Forests

These forests occur in the Ganga-Brahmputra delta called Sunderbans. Main tree is sundri. Their hard wood species used mostly for fuel and boat making. This forest is always associated with wetness in the deltas of the bigger rivers as well as in estuaries and creeks.

* In India forest may be croadly classified into six types. They are Tropical Evergreen or Rain Forests, Tropical Deciduous Forest, Dry Deciduous Forest, Semi Deserts and Deserts Forest, Mountain Forest and Mangrove Forest.

20.11 DEFORESTATION

The history of forests in India is linked with its political history. The epics Ramayana and Mahabharata give an attractive description of forests like Dandakaranya, Nandanvan and Khandavavan. During the days of Ashoka and Akbar, trees were planted along the roads, canals, highways and on camping sites. In those days, people made use of forests without any restriction. The general policy was to expand agriculture. After the Mughal rule, a gradual destruction of forests started. Before the British period, the forests were adequate to meet the requirements of the subsistence economy of the people but during the British period, the policies of the colonial government accelerated the process of deforestation. The teak forests along the Malabar coast were over-exploited to meet the requirements of British navy. The sandal wood trees of Karnataka found their way to European markets. The early years of railway expansion (1853-1891) used Himalayan deodars for railway sleepers. The railway lines were laid primarily with a view to link India's raw material producing areas with the ports of export. Before the coal mines of Damodar valley became fully operative, the railway companies also used local timber as fuel for the locomotives.

Since Independence, deforestation has assumed alarming proportions. While 75 million hectares are covered by forests in Government records, now there are forests over only 35 million hectares-about 11% of India's total land against a requirement of 33%. In hilly areas in particular, only one-third of the total area is under forests as against the 60% laid down in the national forest policy. With our fast increasing population, that stands at 900 million and a livestock population of 400 million, our shrinking forests are fast becoming issues of concern. The growing demand for food and fuel wood leads to deforestation. Industries, mining and quarrying activities have contributed to forest destruction. The construction of hill roads mostly in the strategic areas or in the ecologically fragile belt in the Himalayas has equally contributed. Commercial exploitation for timber as well as other products has been almost unrestricted. For example, bamboo stocks of much of Peninsular India have been depleted. Therefore, paper mills now depend on Arunachal Pradesh. The growing need for making paching boxes for apples has led to fast depletion of fir and other species in Himachal Pradesh and Jammu & Kashmir. Dam building has also played havoc with natural vegetation cover. India has been losing about 1.3 million hectares of forest cover each year. At this rate, unless attempts are made to arrest destruction, India would lose its valuable asset.

* Some of the important areas of immediate action of forest protection are afforestation and development of waste lands, reafforestation and replantation in the existing forests, restriction on grazing and supply of other kinds of fuels, control on merchantising timber and mono culture.
* Since Independence deforestation has assumed alarming proportion.
* The growing demand for flood and fuel, industries, mining and quarying activities, construction of hill roads leads to deforestation.

20.12 CONSERVATION OF FOREST

It is heartening that we and our government have recognised the urgent need to check the dangerous trend of the deforestation or depletion of forests. Main objective is the maintenance of environmental stability and ecological balance. Some of the important areas of immediate action of forest protection are afforestation and development of waste lands, reafforestation and replantation in the existing forests, restriction on grazing and supply of other kinds of fuels, control on merchantising timber and mono culture. In order to achieve these objectives numerous programmes and projects were started and initiated. Afforestation, social forestry and farm forestry are more important projects among them. Afforestation aims at planting trees to increase general forest wealth. The aim of the social forestry and farm forestry is to augment fuel and minor wood resources for farmers by encouraging new plantation of fuel wood trees and small trees to cater to the farm needs.

In 1980, the Forests (Conservation) Act was enacted to check indiscriminate deforestation and diversion of forestland for non-forest purposes. As a result of this Act, the diversion of forest land for non-forest activities has come down considerably, though not completely.

IN-TEXT QUESTIONS 20.3

1. What are the six major types of Forests in India.
   (i) _____ (ii) _____
   (iii) _____ (iv) _____
   (v) _____ (vi) _____
2. Name the type of forests in which pine trees are found.
   _____
3. Name two commercially important trees in tropical deciduous forests growing in abundance.
   (i) _____ (ii) _____
4. Which forest type occupies largest area of India.
   _____
5. Name any four activities which have lead to deforestation.
   (i) _____ (ii) _____
   (iii) _____ (iv) _____

20.13 WILDLIFE RESOURCES

India possesses around 6.5% of world's fauna. Country's wildlife diversity is unmatched due to a variety of ecological conditions. The wildlife peculiar to India include the lion, tiger, elephant, dear, antelope, leopard, rhinos, bustard, duck, crocodile, turtle, lizard, python. Areas rich in wildlife include North East India, the Western states region, the Bastar region, the Andaman and Nicobar Islands and the Sundarbans mangrove forests. Two of the regions, North east India and the Western Ghats are recognised internationally as biodiversity 'hot spots'. India was once very rich in its wildlife. But organised indulgence of former Indian rulers, princes and British officers in hunting wild animals has destroyed our rich wild life to a very great extent. Though at present, hunting has been banned, poachers and herdsmen persistently penetrate into the forests for grazing their cattle and interfere with the habitat of wild animals. As a result, numerous species of wild animals are facing extinction. Elephants, once found all over India, have now disappeared from Maharashtra, M.P. and Andhra Pradesh.

To preserve its vanishing species, the Government of India decided to protect them. The Wildlife Protection Act was enacted in 1972. This Act has given statutory status to the protection of wild life. This Act adopted by all states except Jammu and Kashmir (which has its own Act), governs wild life conservation and protection of endangered species. The Act prohibits trade in rare and endangered species. This has been amended to make it more effective. A Central Zoo Authority has been set up to look after the management of zoological parks in the country. It co-ordinates the activities of over 200 existing zoos.

Under the Wildlife Protection Act, eight wildlife reserves have been developed throughout the country. The wildlife reserves are classified in two types : (i) national parks and (ii) wild life sanctuaries. Other than this, Biosphere reserves also helps in preserving wild life. National parks are the places where entire wildlife (ecosystem) is protected. The wildlife sanctuaries are places or areas where wild animals and birds are kept in their natural environment. A special category of sanctuaries in India is a tiger reserve. Under this scheme, 23 Tiger Reserves have been set up all over the country. The main objective of Project Tiger scheme is to ensure maintenance of vanishing population of tigers in India for scientific, economic aesthetic, cultural and ecological values. The list of Tiger Reserves is given below :

* India possesses around 6.5% of world's fauna.
* Due to organised indulgence of former Indian rulers, princes and British officers in hunting wild animals has destroyed our rich wild life to a great extent.
* National Parks are the places where entire wildlife (Eco-system) is protected whereas wildlife sanctuaries are places where wild animals and birds are kept in their natural environment.

Table No. 20.2 : Tiger Reserves

	Name of Tiger Reserve	State	Total area in km^2
1.	Bandipur	Karnataka	866
2.	Corbett	U.P.	1316
3.	Kanha	M.P	1945
4.	Manas	Assam	2840
5.	Melghat	Maharashtra	1957
6.	Palamau	Bihar	1026
7.	Ranthambhore	Rajasthan	1334
8.	Simlipal	Orissa	2750
9.	Sunderbans	West Bengal	2585
10.	Periyar	Kerala	777
11.	Sariska	Rajasthan	866
12.	Buxar	West Bengal	759
13.	Indravati	M.P.	2799
14.	Nagarjun Sagar	A.P.	3568
15.	Namdapha	Arunachal Pradesh	1985
16.	Dudhwa	U.P.	811
17.	Kalakad-Mundanth Weai	Tamil Nadu	800
18.	Valmik	Bihar	840
19.	Pench	M.P.	758
20.	Tadoba-Andheri	Maharashtra	620
21.	Bandhavgarh	M.P.	1162
22.	Panna	M.P.	542
23.	Dampha	Mizoram	500
		Total	33046

As per available statistics, there are at present 80 National Parks and 44 Wild life Sanctuaries covering about 148700 km^2 area. The network is spread over all the bio- geographic zones of the country including Himalayan, peninsular, marine, estuarine, riverine, mangrove and desert ecosystems. National Parks and Wildlife Sanctuaries are further put into five major categories. They are National Parks, Wildlife Sanctuaries, Tiger Project, Project Elephant and Bird Sanctuaries. The following table and the map show the distribution of these reserves in India.

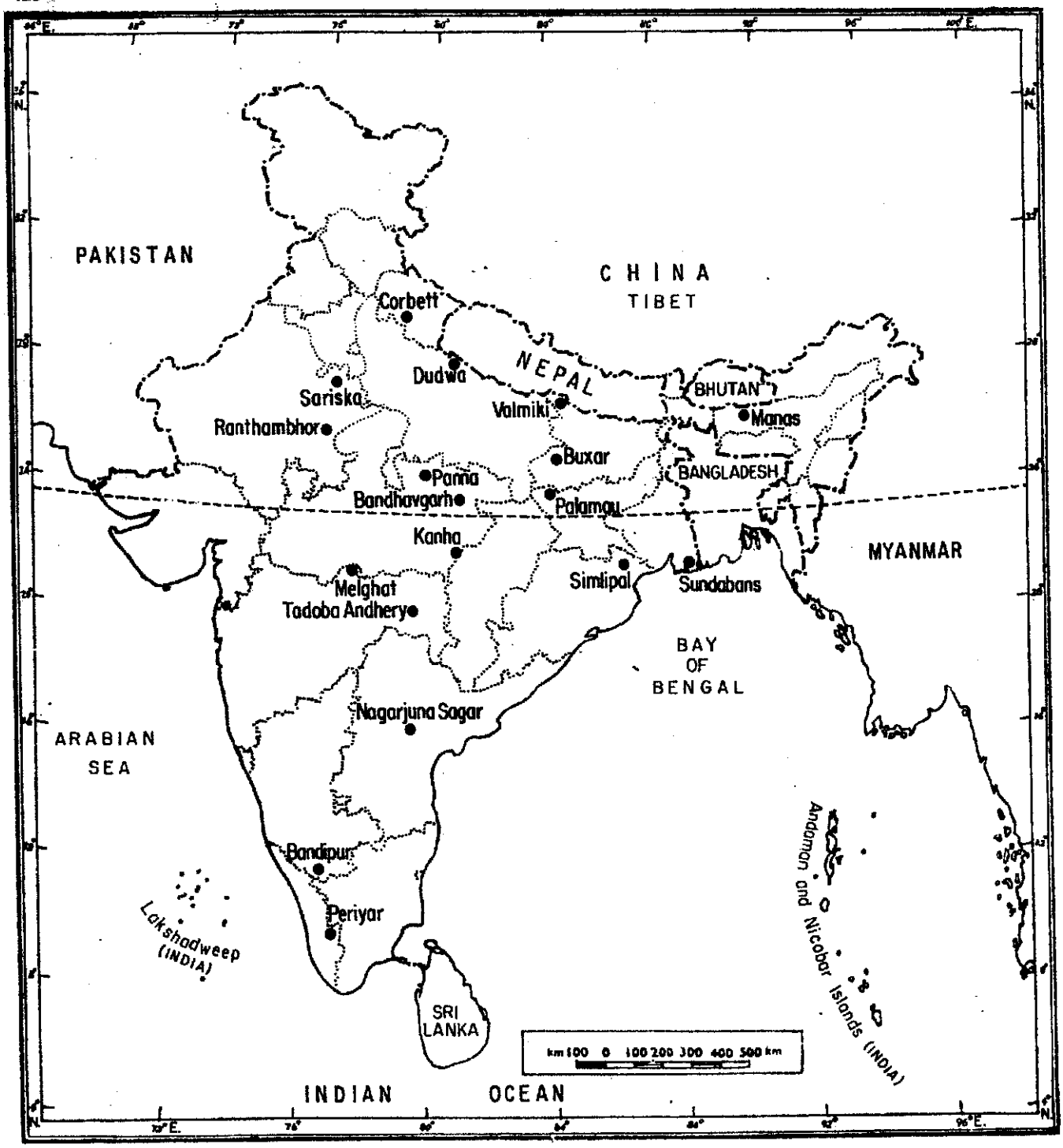
In addition there are Biosphere reserves which are multi-purpose protected areas to preserve the genetic diversity in representative eco-systems. The major objectives of bio-sphere reserves are : (i) to conserve diversity and integrity of plants, animals and micro-organisma ; (ii) to promote research on ecological conservation and other environmental aspects and (iii) to provide facilities for education, awareness and training. So far eight bio-sphere reserves have been set up viz. : (i) Nilgiri; (ii) Nanda Devi; (iii) Nokrek; (iv) Great Nicobar; (v) Gulf of Mannar; (vi) Manas; (vii) Sunderban and (viii) Simlipal.

* There are 23 Tiger Reserves in India.
* There are at present 80 National Parks and 44 Wild Life Sanctuaries covering about 148700 Km^2 area.
* Other than Tiger Reserves, National Parks Wild life sanctuaries, there are eight Biosphere Reserves.

Table No. 20.3 Major Wildlife Reserves in India

Reserve	Status NP/WS/BS	Area (in sq. km)	State & Location
Bannergatta	NP	104.2	Karnataka (Bangalore)
Borivli	NP	679.9	Maharashtra (Greater Bombay)
Gir	NP	140.4	Gujarat (Junagadh)
Hazaribag	NP	186.25	Bihar (Hazaribag)
Jaldapara	WS	115.53	West Bengal (Jalpaiguri)
Kaziranga	NP	430	Assam (Jorhat)
Keibul Lamjao	NP	25	Manipur (Churachandpur)
Keoladeo Ghana	NP,BS	29	Rajasthan (Bharatpur)
Khangchendzonga (Kanchanjunga)	NP	850	Sikkim
Mudumalai	WS	321	Tamil Nadu (Nilgiri)
Nagarhole	NP	571.55	Karnataka
Nawegaon (Bhandara)	NP	133.38	Maharashtra
Pench (Nagpur)	NP	257.26	Maharashtra
Shivpuri (Madhav)	NP	156	M.P. (Shivpuri)

Note : NP – National Park
WS – Wildlife Reserves
TP – Tiger Project
ES – Bird Sanctuaries



Based upon Survey of India outline map printed in 1979.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

The boundary of Meghalaya shown on this map is as demarcated from the North-Eastern Areas (Reorganisation) Act 1971, but has yet to be verified.

*Reg. No. 7340 HD'79-2000.

*Printed at the 101 (H.L.O.) Printing Group of Survey of India.

*Price: Twentyfive Paise.

*These may be deleted when printing a map based on this outline map.

(ii) Wild Life Reserves of Special Significace

Among the wild life reserves located in different parts of the country, several reserves are of special significance as they have been established with a purpose of protecting and developing a certain species of wild life. They are :

(a) Gir National Park (Gujarat) for lions.
(b) Chandraprabha wild life sanctuary (U.P.) for lions.
(c) Kaziranga National Park (Assam) for one horned rhinoceros.
(d) Manas wild life sanctuary (Assam) for one horned rhinoceros.
(e) Dachigam National Park (Kashmir) for Kashmir Stag.
(f) Corbett National Park (U.P.) for tiger

20.14 CONSERVATION OF WILD LIFE

Wild animals are important to us as they help to maintain the ecological balance in the environment. They also add to the scenic beauty of the nature. National Parks and wild life sanctuaries are important places for recreation and picnic. But the number and areas of wild life are depleting fast. Hence there is an imperative need for conserving them. The following measures can prove effective tools for conserving wild life.

(a) Ban on hunting should be strictly implemented.
(b) Poachers and herdsmen should not be allowed to enter the forests.
(c) More National Parks and wild life sanctuaries should be established.
(d) Existing national parks and sanctuaries should be further developed and more amenities should be provided in them.
(e) Captive breeding of wild life should be encouraged.
(f) Seminars, workshops, exhibitions should be arranged in national parks and sanctuaries to improve the wild life and general awareness among the public.
(g) Adequate medical facilities should be provided in national parks and sanctuaries for the wild life so that their health is improved.
(h) Proper conditions should be created for living and breeding in the national parks and sanctuaries.

IN-TEXT QUESTIONS 20.4

1. Explain briefly the following terms.
   (a) National Parks

   _____
   _____

2. Biosphere reserves

   _____
   _____

3. Wild life sanctuaries

   _____
   _____

4. For which species the following wild life sanctuaries/National parks are known for?
   (a) Kaziranga National Park _____
   (b) Gir National Park _____
   (c) Corbet National Park _____
5. Name any four biosphere reserves in India.
   (i) _____ (ii) _____
   (iii) _____ (iv) _____
6. Name two animal species for the preservation of which specific projects have been taken up so far.
   (i) _____ (ii) _____

WHAT YOU HAVE LEARNT

Water, forest and wild life are three vital natural resources. Like many parts of the world, water in India is one of the vital natural resources. There are various uses of water like agricultural, industrial, domestic and hydro-power generation. Irrigation accounts for the largest use of water. In India, there are mainly three sources of irrigation viz. wells and tube wells, canals and tanks. There are various problems associated with water resources. These are fluctuation in water quantity, quality of water, inter-state water disputes, ground water depletion, water logging and financial constraints. To check this, various conservation methods are adopted. They are flood control, construction of dams and reservoirs, inter basin water transfer, command area development, increasing water use efficiency etc. Like water, forest and wild life are also vital natural resource. In India, forests are broadly divided under six categories. They are tropical evergreen or rain forests, tropical deciduous forests, dry deciduous forests, the semi deserts and deserts forests, mountain forests and mangrove forests. These forest resources are depleting very fast. Various conservation methods have been adopted to solve this problem. They are afforestation, social forestry etc. India has a very rich and varied wild life resources but like forests, wild life resources are also facing a threat. For their preservation various wild life sanctuaries and national parks have been established.

TERMINAL QUESTIONS

1. What is a Multipurpose River Valley Project? List the main purposes a river valley project serves.
2. What are the major problems associated with the utilisation of water? Describe the measures adopted to solve them.
3. Distinguish between :
   (a) Tank irrigation and well irrigation
   (b) Irrigation project and multipurpose river valley project
   (c) National parks and wild life sanctuaries
   (d) Tropical deciduous and moist deciduous forest.
4. What are the six major forest types in India? Describe their distribution and economic significance of each.

5. Highlight the need to conserve forest resources and state the measures adopted for their conservation.
6. Describe the various steps taken up to preserve wild life in India.
7. Locate and label the following on our outline map of India :
   (a) Periyar Sanctuary
   (b) Jim Corbett National Park
   (c) Manas Sanctuary
   (d) Gulf of Mannar Biosphere Reserve
   (e) Dachgaum
8. Locate the following dams on appropriate rivers shown in the map of India.
   (a) Hirakud dam
   (b) Mettur dam
   (c) Bhakra dam
   (d) Rana Pratap Sagar
   (e) Nagarjuna Sagar.

CHECK YOUR ANSWERS

INTEXT QUESTIONS

20.1

1. The water budget means the balance between the available water and usable and non usable water.
2. Agricultural, Industrial, Domestic & Power generation.
3. Punjab, Haryana, U.P., Bihar, Orissa, West Bengal & Assam (any three)
4. a (i); b (iii); c (iii)

20.2

1. Irrigation, flood control, power generation, navigation, recreation, fisheries and controlling soil erosion (any four)
2.

	River	State/States
(a)	Sutlej	Punjab, Haryana & Himachal Pradesh
(b)	Damodar	Bihar, West Bengal
(c)	Mahanadi	Orissa
(d)	Krishna	Andhra Pradesh
(e)	Cauvery	Karnataka

3. The conservation and management of water is defined as having the right amount of water available for a particular use at the right time with the righ quality.

20.3

1. (i) Tropical Evergreen, (ii) Tropical Deciduous, (iii) Dry Deciduous, (iv) Semi Desert or Desert, (v) Mountain and (vi) Mangroove forest
2. Mountain forest
3. (a) Teak and (b) Sal
4. Dry Deciduous Forest
5. (i) the early years of railway expansion, (ii) the growing demand for food and fuel wood, (iii) industrialisation, (iv) mining and quarrying, (v) construction of hill roads (any four)

20.4

1. National parks are the places where entire wild life is protected.
2. Bio-sphere reserves are multipurpose protected area to preserve the genetic diversity in representative eco-system.
3. Wild life sanctuaries are places or areas where wild animals or birds are kept in their natural environment.
4. (a) one horned rhinoceros
   (b) lion
   (c) tiger
5. Nilgiri, Nanda Devi, Nokrek, Great Nicobar, Gulf of Mannar Manas, Sunderban, Simlipar (any four)

TERMINAL QUESTIONS

1. Multi purpose river valley projects are those which performs various functions. These functions are power generation, irrigation, flood control, navigation, recreation, fisheries and controlling soil erosion.
2. Refer sections 20.7 and 20.8
3. (a) Refer sections 20.5 (a)
   (b) Refer sections 20.6
   (c) Refer sections 20.13
   (d) Refer sections 20.10
4. Refer sections 20.10
5. Refer sections 20.12
6. Refer sections 20.14
7. Refer maps
8. Refer maps