*Notes*

16

# WATER RESOURCES

Water is one of the basic resources for human beings as well as all other life forms on earth. Water is so important for life that we cannot imagine life without it. The evolution of life itself took place in the water. In the evolution of all kinds of life, water has played an important role. The amount of water found in living beings is 65 percent and 65 to 99 percent in plants. This clearly shows the need and utility of water. Water, which is a precious gift of nature , has several uses. Water is very essential for development. Although it is available in abundance covering 3/4 of the earth, yet it is a scarce resource; and the fact is that only 3 % is potable. Hence its utilisation and conservation is the most challenging task for mankind. The demand for water continues to rise whereas the supply and availability of water resources is limited as far as human use is concerned. Thus, an efficient planning and implementation programme of water resource appraisal, development, conservation, and management is required.

From the point of view of availability and suitability, the potable water is limited in India. Moreover, it has highly uneven geographical distribution. Another disturbing issue is day by day deteriorating quality of water. It is a matter of great concern for all of us. Besides coordinating the demand and supply of the water, there is a need to keep the balance among different sources of water along with the balance among different uses of water. Hence conservation of water resources is an essential requirement.

## OUTCOMES

After studying this lesson, learner:

- states the significance of water resources;
- describes the different sources of water and its utilisation pattern;
- explains the uneven distribution of water;
- asseses the issues related to water resources and suggest solutions and

Notes

- analyses methods of Water Resource conservation and Management with special reference to traditional methods.

## 16.1 WATER RESOURCES: SIGNIFICANCE FOR LIFE

Water is the most valuable resource of nature. This is a renewable and inexhaustible resource but is in trouble these days. Demand for water has been increasing continuously and its supply decreasing. If we look at the water resources of India in the global context, India has 4 percent water whereas she is housing 16 percent of the world's population. It means the per capita availability of water is quite low in our country. One-eighth area of the country is flood prone and one-sixth area is under the grip of drought. Nature of the monsoon is mostly responsible for uneven distribution of water. Food grains and other agricultural products are required in large quantities for the growing population. For this reason, the use of water for irrigation of crops has been increasing. India ranks first in the world in terms of irrigated area. The demand for water has increased in the cities due to rapid urbanisation, industrialization, and modernization. In addition, the demand for water has been increasing for sewerage and for removing all kinds of wastes.

## 16.2 SOURCES OF WATER

There are four main sources of water:

A. Surface water

B. Underground water

C. Atmospheric water

D. Oceanic water.

In our daily life we use only surface water and underground water.

### A. Surface water

The main source of surface water is precipitation. About 20 percent of the precipitation evaporates and becomes atmospheric water. A part of the running water goes underground. The large part of surface water is found in rivers, rivulets, ponds, and lakes. Remaining water flows into the seas, oceans. Water found on the surface is called surface water. About two - third of the total surface water flows into three major rivers of the country - Indus, Ganges and Brahmaputra.

The water storage capacity of reservoirs constructed in India so far is about 17400 billion cubic metres. At the time of independence, the water storage capacity was only 180 billion cubic metres. Hence water storage capacity has increased about ten times. The storage capacity

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of usable water in the Ganges basin is the maximum. Despite maximum annual flow, the storage capacity of usable water is the least in the Brahmaputra basin. The storage capacity in Godavari, Krishna, Mahanadi and Indus is sufficient. Annual water flow in the three major rivers of India - Indus, Ganga and Brahmaputra are very high. Hence water storage capacity of these rivers can be increased.

Table 16.1 INDIA: Distribution of surface and underground water according to river basins (Figures in billion Cubic metre)

| River Basin | Catchment Area ($km^2$) | Avg. monsoon runoff ($km^3$) | Avg. annual SW potential ($km^3$) | Estimated utilisable SW ($km^3$) | Estimated replenishable GW ($km^3$) | Static GW reserve ($km^3$) | Predominant Aquifers |
|---|---|---|---|---|---|---|---|
| Indus | 321289 | 58.60 | 73.31 | 46.00 | 26.49 | 1338.20 | Cr |
| Ganga | 861452 | 401.30 | 525.02 | 250.00 | 170.99 | 7834.10 | Al, Cr |
| Brahmaputra, Barak, and others | 236136 | 477.50 | 585.60 | 24.00 | 35.07 | 1018.50 | Al, Cr |
| Godavari | 312812 | 107.10 | 110.54 | 76.30 | 40.65 | 59.40 | DT, Cr, |
| Krishna | 258948 | 61.00 | 78.12 | 58.00 | 26.41 | 36.00 | DT, Cr, St |
| Cauvery | 81155 | 18.90 | 21.36 | 19.00 | 12.30 | 42.40 | Cr, St |
| Subernarekha | 29200 | 6.20 | 12.37 | 6.81 | 1.82 | 11.10 | Cr, Al |
| Brahamani and Baitarni | 39033 | 15.30 | 28.48 | 18.30 | 4.05 | 41.30 | Cr, St |
| Mahanadi | 141589 | 16.00 | 66.88 | 49.99 | 16.46 | 66.00 | Cr, St |
| Pennar | 55213 | 60.20 | 6.32 | 6.86 | 4.93 | 119.70 | Cr |
| Mahi | 34842 | 32.60 | 11.02 | 3.10 | 4.20 | 43.40 | Al |
| Sabarmati | 21674 | 9.70 | 3.81 | 1.93 | 3.00 | 10.80 | Al |
| Narmada | 98796 | 3.40 | 45.64 | 34.50 | 10.83 | 28.20 | DT, Al |
| Tapi | 65145 | 10.70 | 14.88 | 14.50 | 8.27 | 12.60 | Al |
| West flowing rivers from Tapi to Tadri | 52900 | 13.60 | 87.41 | 11.94 | 8.70 | 113.20 | DT |
| West flowing rivers from Tadri to Kanyakumari | 56200 | 36.90 | 113.53 | 24.27 | 9.00 | 18.40 | Cr |
| East flowing rivers between Mahanadi and Pennar | — | 16.20 | 22.52 | 13.11 | 9.00 | 7.50 | Cr |
| East flowing rivers between Pennar and Kanyakumari | 100100 | 80.30 | 16.46 | 16.73 | 9.20 | 11.20 | Cr |
| West flowing rivers of Kutch, Saurashtra including Luni | 321900 | 97.80 | 15.10 | 14.98 | 11.23 | — | Cr, St |
| Area of inland drainage in Rajasthan desert | 60000 | — | — | — | — | — | Sand, Al, St |
| Minor river basins draining into Bangladesh and Myanmar | 36300 | 24.80 | 31.00 | — | 18.80 | — | Al, St |
| Total | 3184684 | 1548.10 | 1869.37 | 690.32 | 431.40 | 10812.00 | |

Source: Basin wise distribution of surface and groundwater resources in India (source: Central Water Commission and Central Ground Water Board)


Fig. 16.1 : India Basin wise Water Resource

## B. Underground water

Rain water percolates into the earth's surface and becomes underground water. The process of percolation also takes place from the surface water. Large amount of water gets collected under the Earth's surface by these two methods. This is called underground water.

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According to the Central Underground Water Board, the annual replenishable underground water resource in India is 433 billion cubic metres. Out of this about 399 billion cubic metre water is available for various uses.

The distribution of underground water is not the same everywhere. Availability of underground water depends upon the amount of rainfall, nature of rainfall, nature of land and its gradient. In the areas of high rainfall where the land is almost flat and has porous rocks, the water easily percolates and reaches the aquifers. Therefore, underground water is available in plenty at shallow depths in these areas. In the areas like Rajasthan where the land is flat and has porous sandy soil, the underground water is less in amount and is available at greater depths due to lack of rainfall. In the North-Eastern regions of the country, in spite of adequate rainfall, underground water is available in less quantity at greater depths. It is because the land is sloppy and the conditions are not suitable for percolation of water. There are large reserves of underground water in the plains of Ganga - Brahmaputra and in coastal plains. The availability of underground water is less in peninsular plateau, Himalayan region and desert areas.

Underground water is used on a large scale in the areas where the rainfall is comparatively less. The use of groundwater is more in Punjab, Haryana, Rajasthan, Tamil Nadu, Gujarat and Uttar Pradesh. Andhra Pradesh, Madhya Pradesh, Maharashtra, Karnataka and Chhattisgarh are such states where in spite of rainfall, the use of underground water is less. There is a dire need to develop underground water resources in these states.

## 16.3 WATER BUDGET

Water Budget means the balance between the available water in the country and the water under use. There is a great variation in the availability of water resources in India. The availability of water also varies according to the season. Water is available in sufficient quantities during the rainy season. As the dry season sets in, there is a shortage of water. Likewise water is available plentily in areas having flat surface, porous soil in comparison to the areas having sloped land and non-porous soil. The use or demand on water resources is increasing day by day with the increase of population. The reserves of our surface and underground water are about 23840 billion cubic metres. Out of this only 10860 billion cubic metre water is required for use. The unit of measurement of the amount of water is cubic metre and hectare metre.

In simple terms, Water budget means the rate of change in water stored in a region. For example, a watershed is balanced by the rate at which water flows in and out of the region. After thorough understanding of water budgets and underlying hydrologic processes, a foundation for effective water-resource and environmental planning, conservation and management could be formulated. The Observed changes in water budgets of an area over time thus can be used to assess the effects of changes in the climate and as a result of human activities on water resources. Comparison of water budgets from different areas helps in assessing the factors such as geology, soils, vegetation, and land use on the hydrologic cycle.

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The natural hydrological cycle is affected in many ways by human activities. Modifications carried out on the land to accommodate large scale agriculture, such as installation of drainage and irrigation systems, many a times alter infiltration, runoff, evaporation, and evapotranspiration rates. Similarly, Buildings, roads, and parking lots in urban areas tend to increase runoff and thus decrease infiltration. Dams reduce flooding in many regions. Water budgets thus provide a basis for assessing how a natural or human-induced change in one part of the hydrologic cycle may affect various other aspects of this cycle.

## INTEXT QUESTIONS 16.1

1. What is the ranking of India in the World in terms of irrigated area
2. The surface water storage capacity of which river basin is maximum in India?
3. Name 5 states of India where underground water is used on a large scale.

## 16.4 UTILISATION PATTERN

Population in India has been increasing rapidly. It has increased about three times since independence. Due to this increase in population, the demand for water has increased in all the spheres for eg. for domestic use, irrigation and industries. On the other hand, per capita annual availability of water has been decreasing over the years. In 1951 per capita annual availability of water was 5177 cubic metre per person which has decreased to 1829 cubic metre per person annually in 2001. In the coming years by 2025 per capita availability of water is expected to become 1342 cubic metres annually. It is to be noted that the water crisis arises when the per capita availability of water falls below 1000 cubic metres annually. Today many countries are facing the water crisis and have to import water to sustain.

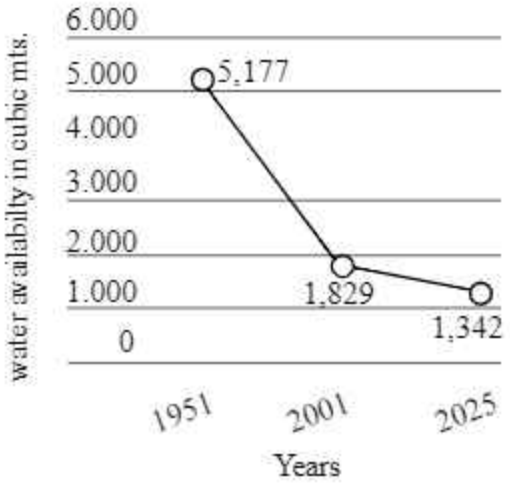


Fig. 16.2 : Water Availability in India

*Notes*

Water is used for many direct and indirect purposes. Direct purposes include mostly domestic i.e. bathing, drinking, cooking and irrigation while examples of indirect purposes are in processing wood to make paper and also in producing steel for automobiles. The major bulk of the world's water use is for agriculture, industry, and electricity. Even one cannot imagine fishing, forestry and water sports without huge amounts of water resources. In this way, water is essential for all kinds of developmental work. It is essential in all spheres of life. Due to rapid growth of urban population, the demand for water in urban areas has increased tremendously.

The most common water uses include:

- Domestic (drinking and Household) Needs;
- Recreation (Sports activities such as River Rafting, Kayaking etc);
- Industry and Commerce;
- Agriculture (Irrigation);
- Hygiene and Public Health;
- Hydroelectricity Generation (Energy)

We humans require fresh water. Only 2.5% of total water on the Earth is freshwater, and over two-thirds of this is frozen in the glaciers and polar ice caps. The Water demand already exceeds its supply in many parts of the world, and many more areas are expected to experience this imbalance in the very near future. It is estimated that 70% of world-wide water use is for irrigation purposes in agriculture. Climate change will have significant impacts on the water resources. Due to the ever increasing human population the demand for water is growing day by day and many of the world's major aquifers are getting depleted. Pollutants from industries threaten the water quality, but the most widespread, especially in the less developed countries, is the discharge of raw sewage into natural waters.

Table 16.2 India: Changing pattern of use of water 1990-2050
(Figures in billion cubic metere)

| Use | 1990 | 2000 | 2010* | 2025* | 2050* |
|---|---|---|---|---|---|
| Domestic | 25 | 33 | 42 | 52 | 60 |
| Irrigation | 460 | 536 | 653 | 770 | 800 |
| Industry | 15 | 30 | 79 | 120 | 130 |
| Energy | 19 | 27 | 44 | 71 | 120 |
| Others | 30 | 33 | 35 | 37 | 40 |
| Total | 549 | 659 | 853 | 1050 | 1150 |

*Estimated

India is an agricultural country. Hence plenty of water is needed for irrigation. 536 billion cubic metre water was used for irrigation in the year 2000. It is 81 percent of the total water used. The remaining percentage of water was used for domestic, industrial and other purposes.

There has been a rapid increase in the irrigated area in India since independence. Total irrigated areas in 1999-2000 was 8.47 crore hectare. The maximum capacity of the use of water for irrigation in India is 11.35 crore hectare metre. But about three-fourth water of this capacity is being used. The demand for irrigation in India has been increasing continuously.

The reasons for the increasing demand of irrigation are as follow:

1. Regional and seasonal variations in the distribution of rainfall.
2. Wide and uncertain gaps in rainfall season.
3. Growing demand for water for commercial crops.
4. Changing cropping pattern.

## MEANS OF IRRIGATION

There are three main means of irrigation in India:

A Wells and Tubewells;

B Canals; and

C Tanks.

TUBEWELL

WELL

TANK

CANAL

Fig. 16.3 : Means of Irrigattion

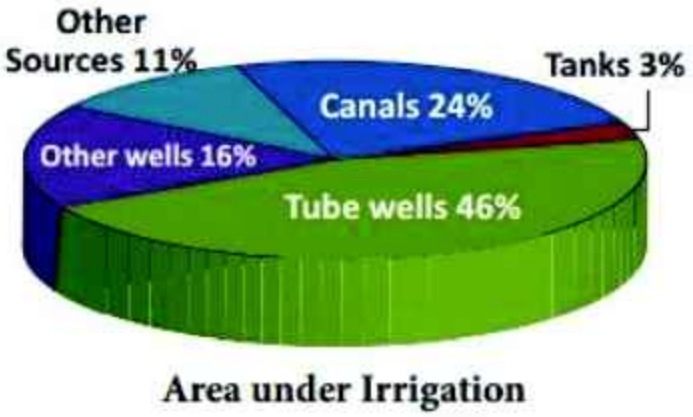


Fig. 16.4 : Area under Irrigation

## A. Wells And Tube-Wells

Irrigation by wells is an old practice in India. It has increased tremendously with the use of diesel and electric pumping sets. Irrigated area by wells and Tubewells in 1950- 51 was only 59 lakh hectares which has increased to 30 million hectares in 1997- 98. During this period total irrigated area has increased from 30 percent to 57 percent. From 2001- 02 to 2014-15 there is 20% increase in net irrigation, due to extensive extraction of groundwater. In the said period i.e. 2001-02, nearly 41% of Net irrigated area got water from Tube Wells whereas this increased to 46% in 2014-15. but Irrigation declined from 21% to 16% only. Uttar Pradesh has the largest area under Well irrigation followed by Rajasthan, Madhya Pradesh, Punjab, Gujarat, Maharashtra and Bihar. There are large reserves of underground water in the alluvial plains of north India. Digging and constructing wells and tubewells is easy and the cost of their construction is also comparatively less. Therefore, irrigation by wells and tubewells is popular among farmers. In states like Gujarat, Goa, Rajasthan and Maharashtra, only about 60 percent irrigation is carried on by wells and tubewells.

## B. Canals

Canals were the main means of irrigation upto 1960. Canals contributed about 40 percent in the total irrigated area of the country. In 1996-97 it came down to about 31 percent. About 1.74 crore hectare area was irrigated by canals in 1996- 97. Half of this area (52.5 percent) is limited to the states of North India. Haryana, Odisha, Karnataka, West Bengal, Andhra Pradesh and Punjab are worth mentioning for canal irrigation. Jammu-Kashmir, Mizoram, Assam and Tripura are such states which greatly depend upon canal irrigation because there is lack of other means of irrigation in these states. Mizoram which has the least irrigated area is completely dependent upon canals for irrigation. Canal irrigation declined from 27% in 2001-02 to 24% in 2014-15.

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### C. Tanks

The contribution of tanks in irrigation has reduced. About 3 percent of the irrigated area is irrigated by tanks. Irrigation by tanks is popular in the peninsular plateau area. Tamil Nadu is the leading state in irrigation by tanks. About 22 percent of the area is irrigated by tanks here. In Odisha, Maharashtra, Karnataka, Kerala and West Bengal tank irrigation is prevalent.

## INTEXT QUESTIONS 16.2

1. What are the various means of irrigation in India?
2. Name the states where irrigation is done mainly by tanks?
3. Give reasons for the increase in demand for irrigation.

## 16.5 RAIN WATER HARVESTING

Rain water harvesting generally means collection of rainwater where it falls. Where there is shortage of water, groundwater can be recharged by harvesting rainwater. In this process, water is made to go underground after collecting rain water locally, without polluting the same.

### Why do we need Rain water harvesting?

Three main reasons are responsible for this:

1. Scarcity of surface water
2. Growing dependence on underground water.
3. Increasing urbanisation.

There can be two Scenarios of Rain water harvesting:

### A. Urban Scenario

Total amount of rain water recovered in an area is called 'rain water reserve'. Effective management of rain water reserves is called 'potential water harvesting'. Think for a while the area of the roof of your house is 100 square metres and the 'average rainfall' of this area is 60 cms. Suppose the water on the roof has neither flowed, percolated nor evaporated then there will be 60 cms, high water on the roof.

Volume of water = Area of the roof X Amount of annual rainfall = 100 x 60 cms = 100 x .6 = 60 cubic metres.

In other words, a family can collect 60,000 litres of water in a year. All water related needs of this family can be met with this. On an average a person needs 10 litres of water for drinking daily. If your family consists of 6 members, then you need 6x10x365 = 21900 litres of water. Remaining (60,000 - 21,900) = 38,100 litre water can be used in dry weather when there is a scarcity of water.


Fig. 16.5: Rainwater Harvesting in Urban area

## B. Rural Scenario

The tradition of rainwater harvesting is very old in India. But the utility of water harvesting has never been felt so much as it is today. Even today the people living in the areas of water scarcity try to do their domestic work by adopting old methods. Deepening and dredging of wells, tanks and ponds are included in these methods. Water harvesting in the small channels (locally known as bawli) is an important traditional method in the areas of water scarcity. Now we can be in a better and secure situation by adopting a new technique of water harvesting. Think for a while. If the people living in 5,87,000 villages in India, engage themselves in harvesting rainwater of their 2000 lakh hectare area, there will be a lot of water available for use. On an average a village comes under the radius of 37,500 lakh cubic metre rain water reserve. By this calculation we come to know that there is great potential for rainwater harvesting.

Fig. 16.6 : A Traditional Method of Rainwater Harvesting

## METHODS OF RAINWATER HARVESTING

We can adopt different methods for rainwater harvesting according to need, available facilities and environmental conditions. The following methods are worth mentioning-

1. Construction of potholes - We can harvest water in small ditches constructed in those areas where there is not much underground water. These ditches may be constructed 1-2 metres wide and 2-3 metres deep. Their shape could be anything. These ditches are filled with rubbles and sand. Rainwater can easily percolate through these.

2. Construction of trenches - In the lower regions where porous rocks are found after making trenches of 0.5 to 1-metre width, 1 to 1.5-metre depth and 10 to 15-metre length, these are filled with rubbles. These trenches should be made parallel to the slope of the land.

3. Use of wells - The wells which have become dry and are not being used at present can be used for water harvesting.

4. Handpump - Stored rainwater can be made underground with the help of a filter by running handpumps in the areas of lack of underground water.

### Case Study of Rainwater Harvesting

Dudhatoli Lok Vikas Sansthan

Ufrakhal, Pauri Garhwal, Uttarakhand

Ufrakhal village, located in the midst of Chamoli and Almora region, was once considered one of the most backward areas in India. Today, it is completely transformed. The person responsible for this change is Sh. Sachidanand Bharti. He started mobilising women to conserve forests. Then, his task became simple. The villagers began to understand that the conservation of water, land and forest can be done in an integrated manner.

Initial setbacks like the dying of the saplings instigated Bharti to find a solution. After discussions with the villagers, it was decided to dig small pits near the newly planted saplings to collect enough water during monsoon. The idea clicked. Today, the trees of Baas, Kaafal, Amaat, Chir, and Awala amongst many other species are the most precious jewels of this forest. Next, he encouraged the villagers to dig 1,500 small pits (Jal Tarais) in the forests of Gaadkhark. The impact was immediate and evidently inspiring. Today, a number of small nallahs (drains) have become perennial, which culminate into a big nallah known as Gaadganga.

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## INTEXT QUESTIONS 16.3

1. Why do we need to harvest rainwater?
2. Name any two methods of rain water harvesting.
3. How is water being conserved and channels recharged in Ufrakhal, Uttarakhand?

## 16.6 ISSUES OF WATER RESOURCES

There are many issues related to water resources. The list is exhaustive. There is scarcity, pollution, depletion of water. We can list them as follows:

- Intense urbanisation leads to increasing demand for water,
- Pollutants in water due to release of untreated industrial water and urban sewage to water bodies
- Tremendous demand for water for drinking and economic and social development.
- Water stress and scarcity in many regions of the planet due to alterations in availability and ever increasing demand.
- Problems of stress/pressure and scarcity due to global changes with extreme hydrological events
- Problems caused by the lack of articulation and lack of consistent actions of governability of water resources as well as environmental sustainability.

## 16.7 NATIONAL WATER POLICY

The main Objective of National Water Policy is to take cognizance of the existing situation of country's water resource, and to propose a framework for creation of a system of laws and institutions and further for a plan of action with a unified national perspective.

Water is a national valuable reserve. It is essential for the Government to evolve policy for the development and management of water resources so that surface and underground water is not only properly used but also conserved for the future. Nature of rainfall has also compelled us to think in this direction. 'National Water Policy' was formulated and accepted in September 1987. It was revised in 2002 and presented as 'National Water Policy' 2002 and again updated in 2012 as problems arose in the previous policy during the course of time.

Water is an important constituent of the ecosystem. It should be considered essential for all kinds of life. It should be developed, conserved and managed in a planned manner. It is essential to think about its social and economic aspects of water as large areas of the country

suffer due to drought and floods every year. It causes not only the loss of property and human life but the wheel of development is also stopped. The problems of floods and drought are not limited to the boundaries of a particular state. This requires thinking at the national level. Several problems arise in planning and management of water resources. More exploitation of underground water in many areas of the country have posed serious challenges such as dried up aquifers as well as lowering of water table. The demand of water is on increase for domestic use, industries, energy production etc. Water resources are already scarce, and with ever increasing demand by the growing population there shall be a worrisome future of water. Quality of water is also an important aspect. Pollution of surface and underground water has been increasing. Main sources of water pollution due to human activities include domestic wastewater, industrial effluents and chemicals used in agriculture. Sometimes water pollution is also caused by natural factors. Erosion, landslides, decomposition of plants and animals are the main natural sources of water pollution. Three fourths of the total surface water in our country is polluted.

## IMPLEMENTATION OF NATIONAL WATER POLICY

National Water Board should prepare a plan of action, based on the National Water Policy, as approved by the National Water Resources Council, to regularly monitor its effective implementation. The State Water Policies may need to be drafted/revised in accordance with this policy keeping in mind the basic concerns and principles in a unified national perspective.

### Watershed Development Programme

Watershed is defined as an area where the runoff resulting from rainfall is collected and drained out through a common point. Watersheds are composed of a number of streams and creeks that drain into progressively larger streams to eventually form a river. Each of the streams or creeks have their own watersheds, or sub-basins, that flow from higher elevations to lower elevations. The adjacent watersheds are separated by ridges which are called water divides. Within a watershed, water may come from various directions, but it drains out at a single point. Therefore, it is easier to manage water, soil and forest and other related resources within small watersheds by checking water at outlet points. By growing forests in the upper reaches of the watershed, the water flow through streams slows down, groundwater gets recharged and soil erosion gets reduced. The drained out water at the outlet point can be checked easily. Therefore, small watersheds are the ideal units to manage the natural resources like land, soil, water, forest etc.

The Watershed Development Programme was originally initiated by the National Wasteland Development Board, Ministry of Environment and Forest. Now the programme is placed under the Department of Land Resources under the Ministry of Rural Development. The Department of Land Resources is implementing the Integrated Watershed Development Programme (IWMP) from 2009-10 with an objective to cover 55 million hectares of rain fed land by 2027.

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### Benefits of Watershed Development Programme:

- Water storage, flood control, checking sedimentation
- Erosion control and prevention of soil
- Recharging groundwater to provide regular water supply
- Minimising over-exploitation of resources
- Increase in the agricultural production and productivity
- Decrease in deforestation
- Wildlife preservation
- Pollution control

### The success of Watershed Development Programme is possible by:

a. More scientific thinking;

b. perfect techniques;

c. Participation of local population;

d. coordination among various departmental agencies, and

e. an independent ministry to follow up.

### National River Linking Programme

The Inter-Linking of Rivers (ILR) programme is aimed at linking water surplus river basins with water deficit river basins so that the excess water from surplus regions could be diverted to deficient regions. The idea behind the interlinking of rivers is to reduce flood and drought havocs in water surplus and water deficit areas respectively. Thirty-seven rivers are identified to be interlinked by a network of about 3000 storage dams.

#### Benefits of River Linking Programme

- The irrigation of about 250 lakh hectare additional agricultural area is possible by surface water after the success of this programme.
- Underground water will be available to irrigate additional agricultural areas of about 100 lakh hectares.
- Additional hydro-electricity of about 340 lakh kilowatt will be generated.
- Besides these benefits, many other benefits like flood control, water transport, water supply, fishing, removal of acidity from the soil and control on water pollution will also be achieved.

### Challenges in River Interlinking

- **Project feasibility:** The estimated cost of the Project is very high which requires huge structure and great engineering capacity.
- **Environmental impact:** The wildlife, flora and fauna of the river systems would be affected because of large scale displacements and modifications.
- **Impact on society:** The displacement of people for building of dams and reservoirs would create agony among local people.
- **Inter-state disputes:** The dispute among states coming under particular projects may arise for sharing of water and other resources.

## 16.8 METHODS OF WATER CONSERVATION

If we do not conserve water today, future generations may have difficulty surviving due to scarcity of water. The participation of an individual, society and the Govt. is essential for water conservation.

The following methods can be adopted for water conservation -

1. Dams and reservoirs should be constructed on rivers so that river water does not go waste into the seas and oceans.
2. The water of rivers should be saved from pollution by urban waste at all costs.
3. Mass awakening should be around for water conservation.
4. Solicit active participation of the people in all the activities related to water conservation and efficient management.
5. Potable water should not be used for gardening, washing of vehicles and cleaning of households.
6. Broken pipelines of water should immediately be repaired.
7. Every drop of water is precious, this should be popularised among the masses.
8. Such crops should not be grown in rain fed areas which require more water.
9. There should be stress on afforestation.

### A case study: efforts of tarun bharat sangh towards water conservation

Tarun Bharat Sangh was established in 1985 under the guidance of Shri Rajendra Singh. It started in Hamirpur village of Thanagazi Tehsil in Alwar district of Rajasthan. The residents of

Notes

Thanagazi area under the guidance of Tarun Bharat Sangh( NGO) achieved such a miracle which could not be achieved by Central Water Authority while searching for the Sarswati in Western Rajasthan and Bhabha Atomic Research Centre together. Arvari river was reborn with the efforts of this organisation which took 15 years. Previously the river was dry and barren. There are two branches of Arvari river. The total length of these is 45 kilometres. Its watershed area is spread in 503 square kms. Parts of Jaipur, Dausa and Alwar districts are included in this. Previously agriculture was practised here. There were no means of irrigation. Agriculture used to be done only on 10 percent of the land. Agriculture was entirely dependent upon rain. There was one cropped agriculture. To remove the water scarcity in the area, the NGO-Tarun Bharat Sangh with the help of villagers cleaned and deepened the tanks and ponds. Besides this, they also vowed to construct ponds on the sloppy parts of the hilly region. A village was chosen for this work in 1985-86. The results were very encouraging. Many other villagers followed the same process by making ponds constructed in their areas. 'Save water' and 'JoharAndolan' were started in 1996. More than 3500 ponds have so far been constructed in this area. The villagers themselves have constructed more than 70 ponds. Water level of underground aquifers has risen after construction of these ponds. Water is available throughout the year in wells, tanks, ponds and rivers. Agricultural output has also improved. There is more Greenery. Even the animals are healthier, cows and buffaloes are helping in the rise of dairying as a supplementary occupation,

The standard of living of the people has improved. The families below poverty line are also able to earn 40-50 thousand rupees per annum. Migration of people from villages to cities has stopped. Even migrated families have now started coming back to their villages. The residents of 70 villages in Arvari river basin have constituted a unique 'parliament' of 150 members. This 'parliament' has been named as 'Arvari Sansad' after the name of the Arvari river. The members of 'Arvari Sansad' took oath on the banks of the river in Hamirpur on 26th January 1999. The constitution of Arvari Sansad came into effect from this day. This is such a sansad which not only frames the rules and laws but follows them also. All residents of the area follow these rules and laws strictly and also get them followed by others. Arvari sansad has framed some rules and laws keeping the needs of the people, ecological balance and land in mind.

The following are worth mentoring among them:-

1. Ban on growing crops such as sugarcane, rice and chillies which require more water.
2. No one will use the river water for agriculture after Holi and before the end of the rainy season.
3. No industrial unit will be established in the watershed area.
4. Recommended growing of millets, Jowar-Bajra and Maize.

*Notes*

5. Allowed to grow vegetables in the lower parts of the river.

6. Ban on hunting and cutting of green trees.

7. No person with an axe will enter into the recently developed 'Bhairon Dev Manas' sanctuary.

8. The whole region has been declared as an area of biodiversity

9. Ban on sending food grains and vegetables outside the region

10. Ban on grazing of animals by the people living outside the watershed area.

Today Arvari river has become very useful for the residents of the area. The people of the area worship this river also. Fairs and festivals are celebrated. Arvari Sansad has established 'Arvari temple', 'Arvari treasury' and 'ArvariSectariate'. Such programmes are being carried on in other areas also. In this connection very encouraging programmes are going on in Gujarat, Madhya Pradesh and Chhattisgarh.

## INTEXT QUESTIONS 16.4

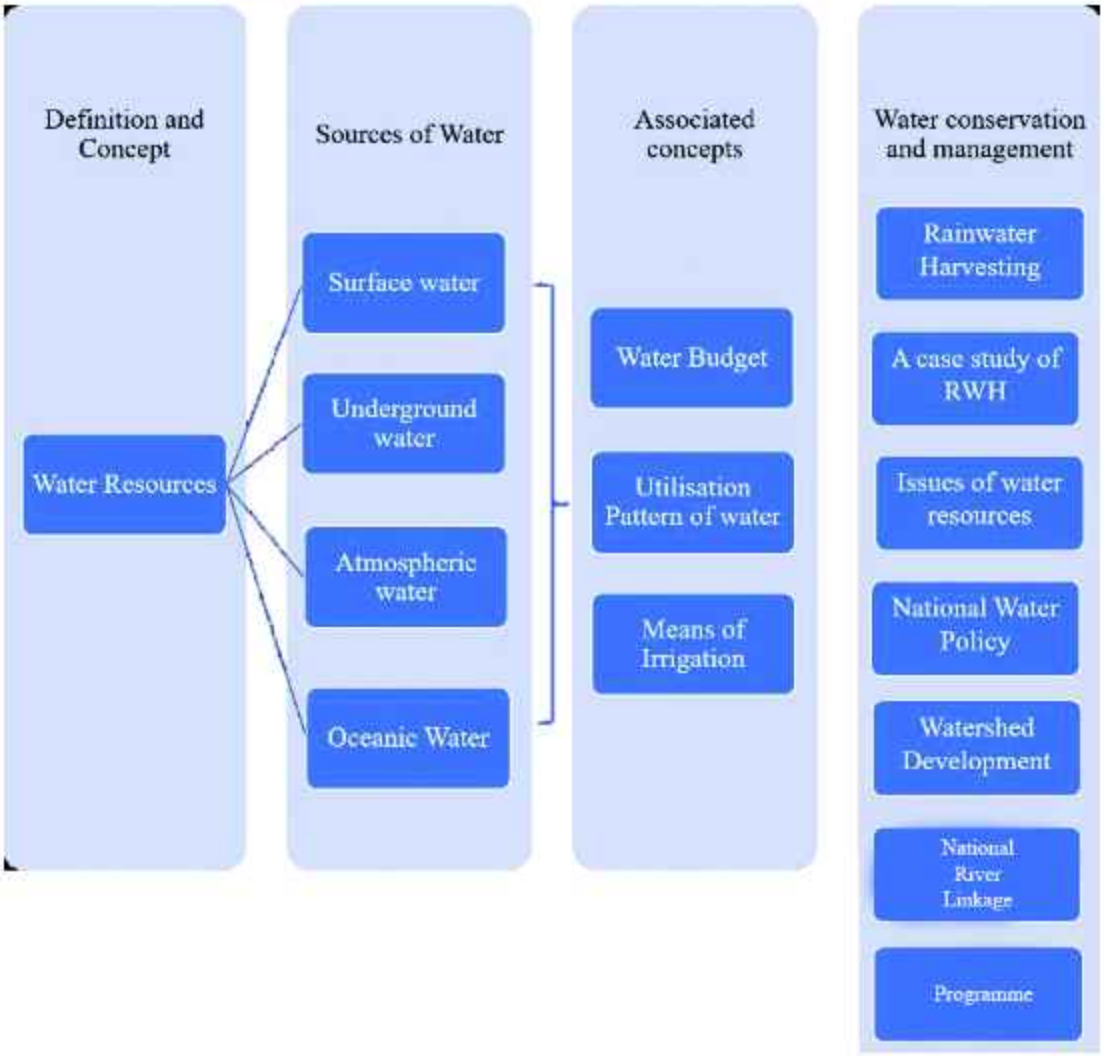
1. Mention any four problems related to water resources.

   a._____b._____c._____d._____

2. What is the main objective of the National Water Policy?

3. What are the challenges in interlinking rivers? Any two

## WHAT YOU HAVE LEARNT




## TERMINAL QUESTIONS

1. Answer the following questions in brief-

   (i) What is the meaning of water resources?

   (ii) Mention the main sources of surface water.

   (iii) Why is more underground water available in the northern great plains of the country?

   (iv) State the meaning of rain water harvesting.

   (v) Explain the meaning of watershed.

(vii) What are the benefits of the National River Linking Programme?

2. Differentiate among the following -

   (a) Surface water and underground water.

   (b) Rain water harvesting and watershed development.

3. Why is the distribution of water uneven in India? Explain with examples.

4. "Underground water is a reliable and continued resource of water supply". Prove the logic of this statement.

5. Describe main methods of rainwater harvesting.

6. Which benefits can be achieved by watershed development? Mention them.

7. Why are desired results not achieved by watershed development projects? Give reasons.

8. Why is water conservation essential? Explain different methods of water conservation.

9. Evaluate the utility and applicability of water-shed development programmes in India.

## ANSWERS TO INTEXT QUESTIONS

**16.1.**

1. First
2. Ganga
3. Punjab, Haryana, Rajasthan, Tamil Nadu, Gujrat, UP (Any Five)

**16.2.**

1. Wells and tube wells, Canals, Tanks
2. Tamilnadu, Odisha, Maharashtra, Karnataka etc.
3. Regional and seasonal variations in rain, growing demand for commerical crops etc

**16.3.**

1. Scarcity of Surface water, dependancy on underground water, increasing urbanisation.

*Notes*

2. i) Construction of Potholes

   ii) Construction of trenches

   iii) Use of wells

   iv) Use of handpump

3. Water Pits

16.4.

1. a) Increasing demand of water for urbanisation

   b) Pollution

   c) Demand for economic activity

   d) Scarcity due to global change

2. To take cognizance of existing situatin of country's water resources

3. i) Project Feasibility

   ii) Environmental impact

   iii) Impact on society (Any 2)

# MODULE –8

**Economic Geography of India**

17. Agriculture and Food Security
18. Mineral and Energy Resources
19. Major Industries and Industrial Complexes
20. Foreign Direct Investment (FDI), Transport, Communication and Trade