

10th – Geography- Water Resources



Even though three-fourth of the earth's surface is covered with water, only a small proportion of it accounts for fresh water. This fresh water is mainly obtained from surface runoff and groundwater that is continually being renewed and recharged through the hydrological cycle. The hydrological cycle ensures that water is a renewable resource. Some facts and figures about water are given below

Water: Some Facts and Figures: As per UN World Water Development estimation 2003, 96.5 per cent of the earth's water exists as oceans and seas, 1 per cent as saline groundwater and saline lakes and the remaining 2.5 per cent as fresh water in rivers, lakes, snow and ice. 70 % of this fresh water is stored as ice sheets and glaciers in Antarctica, Greenland and mountainous regions of the world. Less than 30% of this is stored below earth's surface as groundwater in the world's aquifers, India receives nearly 4% of the global precipitation (rain and snow) but ranks 133rd in the world in terms of water availability per person per annum because of huge population shares the limited fresh water. The report states that by the year 2025, large parts of India will join other countries or regions of the world in facing absolute water scarcity.

Water Scarcity: Shortage of water as compared to its demand is known as water scarcity. This is a situation in which there is not enough water to meet all demands, including that needed for ecosystems to function effectively. However, water scarcity in most cases is caused by over-exploitation, excessive use and unequal access to water among different social groups. Though the average annual precipitation in India as a whole is 114 cm, the variation in seasonal and annual precipitation, with some areas like Western Rajasthan and Ladakh area of Jammu and Kashmir receiving less than 20 cm annually.

Causes of Water Scarcity: Water scarcity is the result of depletion of limited availability of fresh water. It may occur in regions having ample water sources, but suffer from unequal access. According to Falkenmark, a Swedish expert, water stress occurs when water availability is between 1000 and 1600 cubic metre per person per year.

A large Population: Large population of India requires more food so agriculture is done on a large scale. This requires more water which reduces the supply of fresh water in wells and rivers. The states of Punjab and Haryana suffer from over utilization of water needed for agriculture.

Intensive Industrialization: The increasing number of industries has made matters worse by exerting pressure on existing fresh water resources. Industries apart from being heavy users of water also require power to run them. Much of the energy comes from hydroelectric power. Now-a-days in India, hydroelectric power contributes approx. 22% of the total electricity produced.

Increasing Urbanization: It has increased pressure on fresh water resources, due to its requirement for domestic purposes as well as for industrial use. Emergences of urban centres with large and dense population and urban lifestyles have not only added to water requirements, but have further aggravated the problem. Most societies and colonies their own groundwater pumping devices to meet their water needs with over-exploitation, this causes the depletion in several of these cities.

Water Pollution: Another problem adding to water scarcity is the water scarcity is the pollution of water resources. Domestic and industrial waste chemical



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pesticides and fertilizers are dumped into rivers and lakes without treatment, thus making these water sources unfit for use. Water stress further leads to water scarcity, over exploitation and mismanagement of water resources are going to reduce this resource and cause ecological crisis that will have a great impact on our lives.

Pollution in Rivers: India's rivers, especially the smaller ones, have all turned into toxic streams, but even the big ones like the Ganga and Yamuna are far from being pure. The assault on India's rivers from population growth, agriculture modernisation, urbanisation and industrialisation is enormous and growing by the day. This entire life stands threatened.

Managing the water resources: To cope up with water scarcity, conserve and manage the water resources, different ways of storing water in ancient times and multipurpose river projects in modern times have come up.

1. Multi-purpose River Projects - Archaeological and historical records show that from ancient times, we have been constructing sophisticated hydraulic structures like dams built of stone rubble, reservoir or lakes, embankments and canals for irrigation. Multi-Purpose River Projects launched after independence aims to develop proper management of water resources by storing river water for many purposes. Such as generation of hydroelectricity, irrigation, flood control, fish breeding, soil conservation etc. First Prime Minister, Mr. Jawaharlal Nehru, proclaimed multi-purpose river projects as 'The Temples of Modern India'. As they initiate development of agriculture and the village economy with rapid industrialisation and growth of the urban economy.

Hydraulic Structures in Ancient India: Water harvesting system for channeling the flood waters of the river Ganga in the 1st century BC, Sringaverapura near Allahabad.

- Dams, lakes and irrigation systems extensively built during Chandragupta Maurya's reign in 3rd century BCE.
- Bhopal lake, an artificial lake built in the 11th century.
- Tank in Hauz Khas, Delhi constructed by Iltutmish for supplying water to Shri Fort area in the 14th century,
- Irrigation works found in Kalinga (Odisha). Naganjunakonda (Andhra Pradesh), Bennur (Karnataka) and Kolhapur (Maharashtra).

Objectives of Multi-Purpose Projects:

- A Generation of electric power. According to the Economic Survey of India 2005-06, such projects are generating 30000 MW of power (37000 MW in March 2010).
- Soil conservation. These projects conserve soil by slowing down the speed of river water.
- Flood control. These projects control floods by storing 'excess water in their reservoirs.
- Irrigation. During the dry season, the stored water can be used to irrigate the fields.
- Afforestation. Trees are systematically planted around reservoirs, thus helping in preserving the natural eco-systems as well as wildlife.
- Fisheries. These projects provide controlled conditions for breeding of fish.
- Water navigation. These projects provide for inland water navigation through the main river as well as associated canals,



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- Tourism. The reservoirs also act as tourist attraction where boating etc. can be done by the people.

Dams: A dam is a barrier across flowing water that obstructs, directs or retards the flow, often creating a reservoir or a lake. Most dams have a section called a spillway or weir through which the river water flows continuously. Dams are classified according to structure, intended purpose or height. Based on structure and the materials used, dams are classified as timber dams, embankment dams or masonry dams with several sub-types. According to the height, dams can be categorised as large dams and major dams, low dams, medium height dams and high dams,

Adverse Effects and Limitations of Multi-Purpose Projects:

- Environmental impact. A variety of flora and fauna as well as human settlements get submerged or displaced by water reservoir formed by a dam. Therefore, dams face many protests which are also supported by NGOs.
- Effect on Soil Fertility. Annual floods used to renew the soil with silt that acted as a natural fertiliser. But reduction in floods reduces the fertility of the soil and increases salinity. The reservoirs that are created on the flood plains submerge the existing vegetation and soil leading to its decomposition over a period of time.
- Impact on Society. Large river projects cause large-scale displacement of local communities along-with destruction of their livelihood and culture. Poor farmers suffer as their agricultural land is taken away. This causes social gap between the rich landowners and landless poor.
- Impact on Aquatic Life. Fish in the reservoir of the dams do not get sufficient nutrient materials. Also, they cannot migrate beyond the dam for spawning.
- Change in Cropping Pattern. Farmers have changed the crop pattern in many regions by shifting to water intensive and commercial farming due to increased availability of water from these projects.
- Territorial Water Disputes. Due to a river flowing beyond State and Country boundaries, sharing of river water is a troublesome issue. Sometimes, this problem delays projects and sometimes it may cause water scarcity in one area or another. Big dams over upstream create water scarcity led inter-State disputes in downstream states i.e. big dam at Koyna result in dispute between Karnataka and Andhra Pradesh over Krishna-Godavari river.
- Excessive Sedimentation at the Bottom of Reservoir. Regulating of rivers affect their natural flow causing poor sediment flow and excessive collection of sediments at the bottom of the reservoir, resulting in rockier stream beds and poorer habitats of aquatic life.
- Failure to control Floods. The big dams have mostly been unsuccessful in controlling flood at the time of excessive rainfall. For example, the release of water from dams during heavy rains aggravated the flood situation in Maharashtra and Gujarat in 2006. The floods have not only devastated life and property but also caused extensive soil erosion.

Narmada Bachao Andolan or Save Narmada Movement: It is a Non - Governmental Organisation (NGO) that mobilized tribal people, farmers, environmentalists and human right activists against the Sardar Sarovar Dam built across the Narmada River in Gujarat. It focused on the environmental issues related to trees that would be submerged under the dam water. Recently it has

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re-focused the aim to enable poor citizens, especially the outsees to get full rehabilitation facilities from the government. People accepted the pain of displacement believing in the promise of irrigated fields and plentiful harvests.

Major Multipurpose river projects in India are:

1. Bhakra Nagal: Bhakra dam is the highest gravity dam in India. The Nangal water project is being used both for hydel power production and irrigation.
2. Tehri Dam: This is the highest rock and Earth-fill embankment dam in India.
3. Damodar Valley Project: Earlier to this project, the Damodar river was known as Sorrow of Bengal', due to frequent floods in it.
4. Narmada Valley Project: famous due to prolonged agitation against it.
5. Krishna Raj Sagar and Mettur Dams on Kaveri: these have created an ongoing interstate river water dispute between Tamil Nadu and Karnataka.
6. Hirakud p[roject: ot si built on Mahanadi river with purpose of integrated conservation of water with flood control.

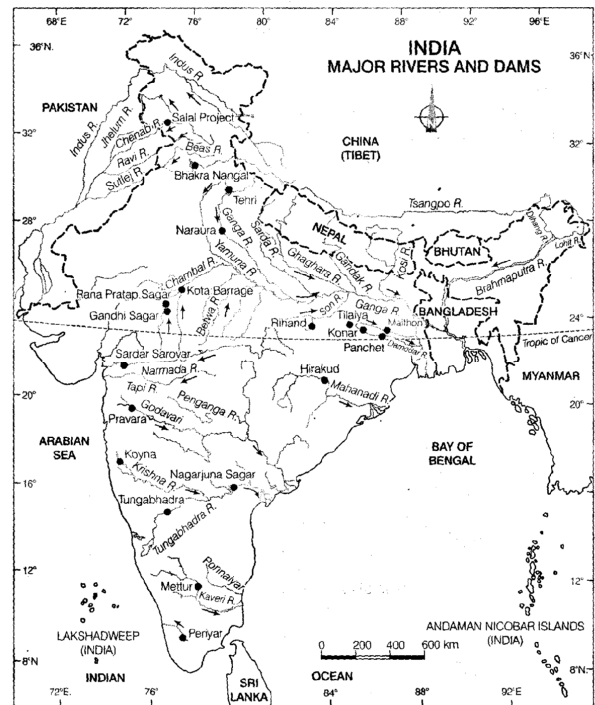
Movements Against Multi-Purpose Projects

In recent years, multi-purpose projects and large dams face several resentment and opposition from public as well as Civil Society because of their multiple adverse effects. Some incidents are given below

- Sardar Sarovar Dam project built over Narmada river in Gujarat caused large-scale displacement of local community. An NGO named Narmada Bachao Andolan came forward with many environmentalists and social activists demanding proper rehabilitation and ecological protections.
- Similarly, massive displacement in Tehri Dam Project on Bhagirathi drew many social movements.

Major River Projects

River Projects	Rivers
Salal Project	Chenab
Bhakra Nangal	Sutlej
Tehri	Bhagirathi (Ganga)
Naraura	Ganga
Rana Pratap Sagar	Chambal
Gandhi Sagar	Chambal
Kota Barrage	Chambal
Sardar Sarovar	Narmada
Pravara	Pravara (Godavari)
Koyna	Krishna
Nagarjuna Sagar	Krishna
Tungabhadra	Tungabhadra (Krishna)
Mettur	Kaveri
Krishna Raj Sagar	Kaveri
Periyar	Periyar
Hirakud	Mahanadi
Tilaya, Konar, Maitthon and Panchet	Damodar (DVC)



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- Rihand valley project over Son river in Uttar Pradesh created massive displacement due to which it is facing public agitation.
- Farmers were agitated upto a riot when more water of Sabarmati basin, Gujarat, supplied to urban areas over drought areas.
- Inter-state water disputes are also common with regard to sharing the costs and benefits of the multi-purpose projects.

Even though dams have their negative impacts, they become an inevitable asset to sustain our progress of development. Intensive industrialisation and urbanisation depend on water for use and energy. Now hydroelectric power contributes 22 per cent of India's total energy and due to limitation of thermal power projects, hydropower become the hope of future along-with other renewable sources.

Rainwater Harvesting: Rainwater harvesting is the accumulation and storage of rainwater for reuse before it runs-off. Uses include water for the garden, water for livestock, water for irrigation etc. Due to increasing problems resulting from multi-purpose river projects, water harvesting systems are an alternative for improvement in water availability. It does not harm the environment also.

In India, there existed an extraordinary tradition of water harvesting system keeping in mind the climatic conditions and water needs. People had knowledge of rainfall systems and techniques to harvest groundwater, rainwater, river water and flood water.

Rainwater Harvesting Methods in India

(i) **Khadins and Johads:** In arid and semi-arid regions, agricultural fields were converted into rainfed storage structures that allowed the water to stand and moisten the soil like the Khadins in Jaisalmer and Johads in other parts of Rajasthan.

(ii) **Rooftop rainwater harvesting:** People living regions of Rajasthan and Gujarat, where rainfall is scanty, have used rooftop rainwater harvesting systems to store drinking water. Process of rooftop rainwater harvesting is given below

- (a) Rainwater falling on the roof is collected through PVC pipes.
- (b) The collected water is filtered by passing it through a layer of sand and bricks.
- (c) The filtered water is then collected through and underground pipe in a sump.
- (d) Excess water in the sump is then collected in the well that gets recharged with fresh water.

Rainwater Harvesting in Shillong: It is the most common practice in Shillong, Meghalaya. It is interesting because Cherapunjee and Mawsynram situated at a distance of 55 km from Shillong and receive the highest rainfall in the world, yet the State Capital Shillong faces acute shortage of water. Nearly every household in the city has a rooftop rainwater harvesting structure. Nearly 15-25 per cent of the total water requirement of the household comes from rooftop water harvesting.

(iii) **Tankas or Tanks.** The Tanks in Semi-arid and arid regions of Rajasthan, particularly in Bikaner, Phalodi and Barmer can store rain water that is locally called Palar Pani. Here they have used underground tanks (called tankas) for water storage. The process is similar to rooftop rainwater harvesting system. The tanks could be as large as a big room; one household in Phalodi had a tank that was 6.1 metres deep, 4.27 metres long and 2.44 metres wide.





(iv) **Inundation channels:** In the flood plains of Bengal, people developed inundation channels (is a channel that is connected to a large river so that the flood water in the river flows in it) to irrigate their fields.

(v) **Guls or Kuls:** In hilly and mountain regions, people built diversion channels to collect rainwater, spring water and store in circular tanks like the 'guls' or 'kuls'. For example, Western Himalayan i.e. Himachal Pradesh for agriculture.

(vi) **Bamboo drip irrigation system:** This system for irrigation is in use for 200 years in Meghalaya. It is old system of utilising stream and spring water by using bamboo pipes. Spring water from the hill slopes, flows into the bamboo pipes which is then transported to distant places through the same pipes.

Advantages of Rainwater Harvesting

(i) It is considered as the purest form of natural water and a major source of drinking water.

(ii) The stored water is a reliable source of water when other sources dry up.

(iii) The water stored under the ground in tanks help in cooling basement rooms in the hot summer.

(iv) It helps in meeting our growing water needs.

Now-a-days, perennial Rajasthan canal supplies plenty of water in the Western Rajasthan and consequently the practice of rooftop rainwater harvesting is declining. In many parts of rural and urban India, rainwater harvesting successfully adapted to store and conserve rainwater. One such example is a remote village in Mysore, Karnataka named Gendathur that has installed about 200 rooftop rain harvesting systems. Gendathur receives an annual precipitation of 1000 mm and with 80 per cent of collection efficiency and of about 10 fillings; every house can collect and use about 50000 litres of water annually. From the 20 houses, the net amount of rainwater harvested annually amounts to 100000 litres. Tamil Nadu is the first and the only state in India which has made rooftop rainwater harvesting structure compulsory to all the houses across the state and punish the defaulters.

Exercise

1. Which areas undertake the Khadins and Johads system of rainwater harvesting?
2. Where is Guls or Kul water harvesting system practiced?
3. Do you think Tamil Nadu Government making legal provision to punish rainwater harvesting defaulters is right?
4. How agricultural fields are used for rainwater harvesting in Rajasthan?
5. Match the Following

Rainwater Harvesting Techniques	Areas
(i) Khadins	Bikaner
(ii) Inundation channels	Jaisalmer
(iii) Bamboo drip irrigation	Meghalaya
(iv) Tankas	Bengal
6. 96,5% of the earth's water exists as oceans and seas and 2.5 % as fresh water. Where the rest of the water exist?
7. India receives nearly 4 per cent of the global precipitation and about 114 cm annual rainfall, but ranks 133rd in the world in water availability per person per annum. Why does It rank so low?
8. Which states or regions in India are likely to suffer from water scarcity?



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9. According to Citizens' Fifth Report, CSE 1999 which two rivers are far from being pure?
10. Fill in the blanks.
- (i) Nearly 70 per cent of fresh water exists in _____
- (ii) The total renewable water resources of India are estimated at _____ sq. km. per annum.
11. Which multipurpose projects have created inter State dispute between Karnataka and Tamil Nadu?
12. Which artificial lake was built in 11th century in Madhya Pradesh?
13. What was the cause due to which the Sabarmati basin farmers agitated upto a level of riot?
14. What percentage of energy requirement is fulfilled by hydroelectricity in India?
15. State True or False:
- Multi-purpose river projects also help in conserving biodiversity.
 - Bhakra Nangal dam is constructed on Satluj river.
 - Narmada Bachao Andolan (an NGO) mobilises people for Koyna dam on Narmada river.

