

CHAPTER

2

WATER RESOURCES

Syllabus

- *Water Resources: Sources, distribution, utilisation, multi-purpose projects, water scarcity, need for conservation and management, rainwater harvesting. (One case study to be introduced)*



TOPIC-1

Water Scarcity and Water Conservation; Multipurpose River Projects

Quick Review

- The main source of water on earth is the hydrological cycle.
- 3/4th of the Earth's surface is covered with water, but fresh water accounts for a small proportion. Fresh water is mainly obtained from surface run off and ground water which is continually renewed and recharged through the hydrological cycle.
- **Water scarcity** : It is caused by over-exploitation, excessive use of and unequal access to water among different social groups.
- **An area having ample water resources can have to face water scarcity due to the following reasons :**
 - Greater demand for water by large and growing population and unequal access to it.
 - Water resources are being over-exploited to expand agriculture and consequently ground water levels are falling.
 - Post independent India has witnessed intense industrialisation and urbanisation, exerting increasing pressure on fresh water resources.
 - Multiplying urban centers with large and dense populations have further aggravated the problem of water scarcity.
- In housing societies or colonies, most of the houses have their own ground water pumping devices to meet the water needs. Thus, water resources are being overexploited.
- **Multi-purpose river projects and integrated water resource management :**
 - The history reveals use of many sophisticated hydraulic structures from ancient times, such as dams of stone, reservoirs or lakes, embankments and canals for irrigation.
 - **Some ancient hydraulic structures are listed below :**
 - Sringerapur near Allahabad had a sophisticated water harvesting system, which channelised the flood water of the Ganga River. It dates back to 1st century B.C.
 - There are many extensively built dams, lakes and irrigation systems. The most important Lake is Sudarshan lake at Junagarh in Gujarat.
 - Bhopal Lake is one of the largest artificial lakes built in the 11th century A.D.
 - In the 14th century, the tank in Hauz Khas, Delhi was constructed by Iltutmish for supplying water to the Siri Fort area.

TOPIC - 1

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- **Uses of dams :**
 - Irrigation
 - Hydro Electricity generation
 - Water supply for domestic and industrial uses
 - Flood control
 - Recreation
 - Inland navigation
 - Fish breeding
- Dams are referred to as multipurpose projects.
- Jawaharlal Nehru proudly proclaimed dams as the temples of modern India because of their potential to integrate development of agriculture and the village economy with rapid industrialisation and growth of the urban economy.
- Damodar Valley Corporation — built on river Damodar — beneficiary states are Jharkhand and West Bengal.
- Bhakra Nangal — built on river Sutlej — beneficiary states are Punjab, Haryana and Rajasthan, Himachal Pradesh.
- Hirakud — built on river Mahanadi — beneficiary state is Odisha.
- Kosi — built on river Kosi — beneficiary state is Bihar and our neighbouring country Nepal.
- Chambal Valley — built on river Chambal — beneficiary states are Madhya Pradesh and Rajasthan.
- **Reasons for opposing multi-purpose projects :**
 - Poor sediment flow
 - Excessive sedimentation at the bottom of the reservoir
 - Poorer habitats for the rivers' aquatic life
 - Difficult for aquatic fauna to migrate
 - Submerge the existing vegetation and soil leading to its decomposition over a period of time.

Know the Terms

- **Hydrological cycle :** This is the journey that water takes as it circulates from the land to the sky and back again. It is also known as the 'water cycle'.
- **Fresh water :** Naturally occurring water on earth's surface in ice sheets, glaciers, lakes, rivers and underground as groundwater, which is suitable for drinking within some form of purification.
- **Ground water :** The water which exists below the ground surface in the zone of saturation and can be extracted through well or any other means or emerges as springs and base flows in streams and rivers.
- **Hydraulic structure :** All dams, lakes, canals, wells and ponds, etc. in which rainwater is collected.
- **Hydroelectricity :** It is the power which is generated with the help of running water.
- **Dam :** A dam is a barrier across flowing water that obstructs, directs or retards the flow, often creating a reservoir, lake or impoundment.
- **Multipurpose project :** A multi-purpose project or river valley project serves a number of purposes simultaneously such as irrigation, flood control, generating hydroelectricity and tourism, e.g., the Bhakra Nangal Dam.

Know the Links

- www.indianetzone.com > ... > Water Resources in India > Indian Rivers
- www.slideshare.net/crystal4/water-conservation-8637332



Very Short Answer Type Questions

(1 mark each)

- | | |
|--|---|
| <p>Ⓐ Q. 1. Name any one river valley project which has significantly contributed to the loss of forests.
[Board Term-I, (WQ7FXWC) 2014]</p> <p>Ans. Sardar Sarovar Dam. 1</p> | <p>Ⓐ Q. 3. How much percent of the total volume of world's water is estimated to exist as fresh water?
Ans. 2.5 percent. 1</p> |
| <p>Ⓐ Q. 2. Write the major source of fresh water in India?
Ans. Ground water. 1</p> | <p>Ⓐ Q. 4. What percentage of the total volume of world's water is estimated to exist as oceans?
Ans. 96.5%. 1</p> |

[A] Q. 5. What are the causes of water scarcity ?

Ans. Rapid growth of population, uneven distribution of water resources and increase in demand of water. 1

[A] Q. 6. Which largest artificial lake was built in 11th century?

Ans. Bhopal Lake. 1

[A] Q. 7. On which river has the Hirakud Dam been constructed?

Ans. River Mahanadi. 1

[A] Q. 8. On which river 'Bhakhra Nangal Dam' has been constructed?

Ans. River Satluj. 1

[U] Q. 9. Who proclaimed dams as the temple of modern India?

Ans. Jawaharlal Nehru. 1

[A] Q. 10. Which river is known as the 'River of Sorrow' in west Bengal?

Ans. Damodar River. 1

[U] Q. 11. Name two social movements which were against the multipurpose projects.

Ans. Narmada Bachao Andolan and Tehri Dam Andolan. 1

[A] Q. 12. The Nagarjuna Sagar Dam is built on which river?

Ans. Krishna River. 1

[A] Q. 13. On which river the Salal Dam is built?

Ans. Chenab River. 1

[A] Q. 14. In which state the release of water from dams during heavy rains aggravated the flood situation in 2006?

Ans. Maharashtra and Gujarat. 1

[U] Q. 15. Name the hydraulic structure that was constructed by Iltutmish in the 14th century for supplying water to Siri Fort area.

Ans. Tank in Hauz Khas, Delhi. 1

[A] Q. 16. On which issues did the Narmada Bachao Andolan first focus?

Ans. Environmental issues related to submergence of trees under the dam water. 1

Short Answer Type Questions

(3 marks each)

[U] Q. 1. Mention any four main objectives of multipurpose river valley projects. Name any two Multipurpose Projects of India.

[Board Term-I, Set (6AP67LB) 2015]

OR

What is a multipurpose river valley project? Mention any four objectives of it.

[Board Term-I, (CB4QHT1) 2016-17]

Ans. A project where many uses of the impounded water are integrated with one another is known as multipurpose project. It is built for irrigation, power generation, water supply, flood control, recreation, etc. 3

(CBSE Marking Scheme 2016)

[U] Q. 2. Water scarcity in most cases is caused by over exploitation, excessive use and unequal access to water among different social groups. Explain the meaning of the statement with the help of examples. [Board Term-I, Set (XOKG2SB) 2015]

Ans. We can understand the meaning of the above statement through these example:

- (i) After a heavy downpour, a boy collects drinking water in Kolkata.
- (ii) A Kashmiri earthquake survivor carries water in the snow in a devastated village.
- (iii) A Rajasthani woman balances her matka and travel large distances to collect water. 1×3=3

[U] Q. 3. Why did Jawaharlal Nehru proclaim the dams as the "temples of modern India"? Explain any three reasons. [Board Term-I, (R9UJGYG) 2014]

Ans. Jawaharlal Nehru proclaimed the dams as the "temples of modern India" because :

- (i) They eliminate or reduce flooding.
- (ii) Provide water for agriculture.

(iii) Provide water for human and industrial consumption.

(iv) Provide hydroelectricity for houses and industries. (Any three) 1×3=3

[A] Q. 4. How have intensive industrialization and urbanization posed a great pressure on existing fresh water resources in India. Explain.

[Board Term-I, KVS-2014]

OR

[A] How does urbanization and urban lifestyle lead to over exploitation of water resources? Explain.

[Board Term-I, (3K) 2013]

OR

[A] How have intensive industrialization and urbanization posed a great pressure on existing fresh water resources in India? Explain.

[Board Term-I, (36) 2012]

Ans. Post independent India witnessed intensive industrialisation and urbanisation.

- (i) **Arrival of MNC's :** Apart from fresh water they require electricity, which comes from hydroelectric power.
- (ii) Multiplying urban centers with large and dense populations and urban life styles have not only added to water and energy requirements, but have further aggravated the problem.
- (iii) Large-scale migration from rural to urban areas is causing over exploitation of water resources. 1×3=3

(CBSE Marking Scheme, 2013)

[U] Q. 5. List any three advantages and three disadvantages of multipurpose river project.

[Board Term-I, (H3), 2013 (35) 2012]

OR

- [U] What are the advantages and disadvantages of multipurpose river project? [NCERT]
[Board Term-I, NCT-2014]

Ans. Advantages :

- (i) These are the main source of power generation.
- (ii) They provide us neat, pollution free and cheapest energy which is the backbone of industry and agriculture.
- (iii) These projects control the floods because water can be stored in them. These projects have converted many, 'rivers of sorrows' into 'rivers of boon'.
- (iv) These projects are the main source of irrigation and also help in conserving soil.

Disadvantages :

- (i) Due to the construction of dams, there are no adequate floods in the river. Because of this, the soil of the downstream region does not get nutrient rich silt.
- (ii) Dams also fragment rivers making it difficult for aquatic fauna to migrate for spawning, i.e., to produce eggs.
- (iii) It resulted in displacement of local communities.
- (iv) The multipurpose projects induced earthquake, caused waterborne diseases. $1\frac{1}{2} + 1\frac{1}{2} = 3$
(CBSE Marking Scheme, 2013)

- [A] Q. 6. Highlight any three hydraulic structures as part of water management programmes initiated in ancient India along with the period when they were built. [Board Term-I, (34, 36, 55), 2012 Set (580018, 27, 33) 2011]

Ans. Sophisticated hydraulic structures like dams build of stone rubble, reservoirs or lakes, embankments and canals for irrigation were built in various regions of the country.

- (i) A sophisticated water harvesting system channe-lling the flood water of river Ganga was built at Sringerapur near Allahabad in the 1st century B.C.
- (ii) Nagarjunakonda in Andhra Pradesh, Bennur in Karnataka, Kolhapur in Maharashtra and Kalinga in Odisha have evidences of irrigation structures.
- (iii) In the 11th century, Bhopal Lake, one of the largest artificial lakes of its time was built.
- (iv) The tank in Hauz Khas, Delhi was constructed by Iltutmish in the 14th century to supply water to the Siri Fort Area. (Any three) $1 \times 3 = 3$
(CBSE Marking Scheme, 2012)

- [U] Q. 7. Why is groundwater a highly overused resource? [Board Term-I, (580034) 2011]

Ans. Groundwater is a highly overused resource because of the following reasons :

- (i) Due to large and growing population and consequent greater demands for water and unequal access to it.
- (ii) To facilitate higher food grain production for large population, water resources are being overexploited to expand irrigated areas and dry season agriculture.
- (iii) In the housing societies or colonies in the cities, there is an arrangement of own ground water pumping devices to meet water needs. $1 \times 3 = 3$



Long Answer Type Questions

(5 marks each)

- [A] Q. 1. Explain any three reasons responsible for water scarcity in India?
[Board Term-I, (580013, 23, 45) 2013, 2011]

OR

- [A] Water is available in abundance in India even then scarcity of water is experienced in major parts of the country. Explain it with four examples.

Ans. (i) The availability of water resources varies over space and time, mainly due to the variations in seasonal and annual precipitation.
(ii) Over-exploitation, excessive use and unequal access to water among different social groups.
(iii) Water scarcity may be an outcome of large and growing population and consequent greater demands for water. A large population means more water to produce more food. Hence, to facilitate higher food-grain production, water resources are being overexploited to expand irrigated areas for dry-season agriculture.
(iv) Most farmers have their own wells and tubewells in their farms for irrigation to increase their production. But it may lead to falling groundwater levels, adversely affecting water

availability and food security of the people. Thus, inspite of abundant water there is water scarcity. $1\frac{1}{4} \times 4 = 5$
(CBSE Marking Scheme, 2013)

- [U] Q. 2. 'Three-fourths of the earth's surface is covered with water but there is still scarcity of water across the globe.' Explain giving three reasons.
[Board 2010, 2011 (T-1)]

Ans. Water scarcity is due to the following causes :

- (i) 96.5 per cent of the total volume of world's water is estimated to exist as oceans and only 2.5 per cent as fresh water. Nearly 70 per cent of this freshwater occurs as ice sheets and glaciers, while a little less than 30 per cent is stored as groundwater in the world's aquifers.
- (ii) Water availability varies over space and time mainly due to the variation in seasonal and annual precipitation.
- (iii) Rapid urbanisation
- (iv) Rapid increase in population that demand more and more water.
- (v) Industrialisation is another cause; large industrial houses are using more and more water.

- (vi) More water is required to generate electricity.
 (vii) Rising income levels also create more demand for water. (Any five) $1 \times 5 = 5$
- [U] Q.3. In recent years, multipurpose projects and large dams have come under great scrutiny and opposition. Explain why. (Board 2010)
- OR
- [U] What objections have been raised against multipurpose river valley projects?
- Ans. In recent years, multipurpose projects and large dams have come under great scrutiny and opposition for a variety of reasons.
- (i) Regulating and damming of rivers affect their natural flow.
 - (ii) River's diversion and barricading due to building of dams affect migration and spawning of aquatic life.
 - (iii) The reservoirs lead to decomposition of soil and land degradation.
 - (iv) The dams have triggered floods due to sedimentation in the reservoir and release of excess water during heavy rains.
 - (v) Large scale displacement of local communities, local people who give up their land for the projects hardly receive any benefit.
 - (vi) Interstate water disputes with regard to sharing the costs and benefits of multi-purpose projects are leading to tension between states, e.g., Kaveri-Godavari dispute, Sabarmati water dispute.
 - (vii) Sometime multipurpose projects induced earthquakes, caused water borne-diseases and pests, and led to pollution resulting from excessive use of water. (Any five) $1 \times 5 = 5$



TOPIC-2

Rainwater Harvesting

Quick Review

- Rain water harvesting system was a viable alternative of multipurpose projects both socio-economically and environmentally.
- In hill and mountainous regions, people built diversion channels like the 'guls' or 'kuls' of the Western Himalayas for agriculture.
- In arid and semi-arid regions of Rajasthan, almost all houses traditionally had underground tanks for storing drinking water.
- Rain water is also referred to as palarpani and it is considered as the purest form of natural water.
- Today, in western Rajasthan, the practice of rooftop rainwater harvesting is on the decline as plenty of water is available due to the perennial Rajasthan Canal.
- In Gendathur, a remote and backward village in Mysore, Karnataka, villagers have installed in their household's rooftop, rainwater harvesting system to meet their water needs.
- Roof-top rain water harvesting is the most common practice in Shillong in Meghalaya.
- In Meghalaya, a 200-year-old system of tapping stream and spring water by using bamboo pipes is prevalent.
- Tamil Nadu is the first and the only state in India which has made roof-top rain water harvesting structures compulsory. There are legal provisions to punish the defaulters.
- **Roof-top rain water harvesting was commonly practised in Rajasthan to store drinking water. Roof-top rain water harvesting is done through the following ways :**
 - Roof top rain water is collected using a PVC pipe.
 - Filtered using sand and bricks.
 - Underground pipe takes water to sump for immediate usage.
 - Excess water from the sump is taken to the well.
 - Water from the well recharges the underground tanka.
 - Later take water from the well.

Know the Terms

- **Rain water harvesting :** Rainwater harvesting is gathering, accumulating and storing rainwater for different uses.
- **Aquifer :** A layer of rock or soil which can absorb and hold water.
- **Water scarcity :** Shortage of water as compared to its demand is known as water scarcity.
- **Guls or Kuls :** In hilly and mountainous regions, people build diversion channels like the 'Guls' or 'Kuls' of Western Himalayas for agriculture.
- **Inundation canal :** It is meant to direct flood waters during the rainy season.

- **Drip irrigation** : It is a type of irrigation in which water gets dropped in the form of drips close to roots of the plants in order to conserve the moisture.
- **Surface runoff** : This is the water flow that occurs when the soil is infiltrated to full capacity and excess water from rain, melted snow or other sources flows over the land.

Know the Links

- theconstructor.org/water.../methods-of-rainwater-harvesting/5420
- www.slideshare.net/pjcionitb/rain-water-harvesting-ppt



Very Short Answer Type Questions

(1 mark each)

- [U] Q. 1. Which water is recharged by roof-top rainwater harvesting technique? Ans. Western Himalayas. 1
- Ans. Ground water. 1
- [U] Q. 2. In which region, people built 'Guls' or 'Kuls' for irrigation? Ans. Meghalaya. 1
- [U] Q. 3. In which state Bamboo Drip Irrigation, is prevalent? 1



Short Answer Type Questions

(3 marks each)

- [U] Q. 1. What is Bamboo Drip Irrigation? Mention any two features of it. [Board Term-I, (33) 2012]

Ans. (i) Bamboo Drip Irrigation system is a 200 year old system of tapping stream and spring water by using bamboo pipe and transporting water from higher to lower regions through gravity.

(ii) Features :

- (a) 18-20 liters of water enters the bamboo pipe system, get transported over hundreds of meters and finally reduces to 20-80 drops per minute at the site of the plant.
- (b) The flow of water into the pipes is controlled by manipulating the pipe positions. 1+2=3
- (CBSE Marking Scheme, 2012)

- [A] Q. 2. Describe any three traditional methods of rainwater harvesting adopted in different parts of India. [Board Term-I, 2014 (X30T4XE)]

[Board Term-I, Set (C5JWEVD) 2015]

[Board Term-I, (NLTM8TU) 2016-17]

OR

- [A] "Rain water harvesting system is viable alternative both socially, economically and environmentally". Support the statement with three examples. [Board Term-I, (33) 2012]

OR

- [A] Describe any three different rain water harvesting systems practised in India.

[Board Term-I, (45) 2012]

Ans. (i) In hilly and mountainous regions, people build diversion channels like 'gul' or 'kul' in Western Himalaya for agriculture.

- (ii) Roof-top rainwater harvesting was commonly practised to store drinking water particularly in Rajasthan and Gujarat.

- (iii) In West Bengal, people develop inundation channels to irrigate their fields.

- (iv) In semi-arid regions agricultural fields are converted into rainfed storage structures that allowed the water to stand and moist the soil

(Any three) $1 \times 3 = 3$

(CBSE Marking Scheme, 2016)

- [U] Q. 3. Explain the working of underground tanks as a part of roof top rainwater harvesting system practised in Rajasthan. [DDE-2015, Set-M]

[Board Term-I, 2014 (WQ7FXWC), (R9UJGYG), 2012 (34, 39), 2011 (580040), 2010 (C)]

OR

- [U] How were the underground tanks beneficial to the people of Rajasthan? Explain.

[Board Term-I, (37) 2012]

[Board Term-I, (OEQL2HT) 2016-17]

OR

- [U] Discuss how rainwater harvesting in semi-arid regions of Rajasthan is carried out. [NCERT]

Ans. (i) In semi-arid and arid regions of Rajasthan almost all the houses traditionally had underground tanks for storing drinking water.

- (ii) The tanks can be as large as big rooms.

- (iii) The tanks were part of the well-developed roof-top rainwater harvesting system.

- (iv) Tanks were connected to the sloping roofs of the houses through a pipe.

- (v) Rain falling on these rooftops would travel down the pipe and stored in these underground tanks.

- (vi) Usually first rain water is not collected to clean the rooftop and the pipe. (Any three) $1 \times 3 = 3$

(CBSE Marking Scheme, 2016)



Long Answer Type Questions

(5 marks each)

Q. 1. Why is roof top water harvesting important in Rajasthan? Explain. [Board Term-I, KVS-2014]

Ans. Roof top water harvesting is important in Rajasthan because :

- (i) It was commonly practised to store drinking water.
- (ii) The rainwater can be stored in the tanks till the next rainfall, making it an extremely reliable source of drinking water when all other sources are dried up, particularly in the summers.
- (iii) Rain water, or palar pani, as commonly referred to in these parts, is considered the purest form of natural water.
- (iv) Many houses construct underground rooms adjoining the 'tanka' to beat the summer heat as it would keep the room cool.
- (v) Some houses still maintain the tanks since they do not like the taste of tap water. $1 \times 5 = 5$

Q. 2. Why are different water harvesting systems considered a viable alternative both socio-economically and environmentally in a country like India?

[Board Term-1, (580011), 2011 (BD) 2010]

Ans. Keeping into view the disadvantages and rising resistance against the multi-purpose projects, water harvesting system is considered a viable alternative both socio-economically and environmentally.

- (i) In ancient India also alongwith the sophisticated hydraulic structures, there existed an extraordinary tradition of various water harvesting systems.
- (ii) People adopted different techniques in different areas. In hilly regions people built diversion channels like the 'guls' or 'kuls' for agriculture.
- (iii) Roof-top rain water harvesting was commonly practised to store drinking water, particularly in Rajasthan.

- (iv) In the flood plains of Bengal, people developed inundation channels to irrigate their fields. Khadins, Johads and Tanks are the forms of rain water harvesting practised in Rajasthan.

$1\frac{1}{4} \times 4 = 5$

(CBSE Marking Scheme, 2011)

Q. 3. Describe any four traditional methods of rain water harvesting adopted in different parts of India.

[Board Term-I, (580014, 16, 21, 28, 37, 41) 2011]

Ans. Methods of rain water harvesting used in India are :

- (i) **Guls and Kuls** : People built guls and kuls in hilly and mountainous regions to divert water. These are simple channels. They are mainly used in the Western Himalayas.
- (ii) **Roof top rain water harvesting** : Commonly practised to store drinking water in Rajasthan.
- (iii) **Inundation Channels** : These channels developed in the flood plains of Bengal to irrigate fields.
- (iv) **Khadins and Johads** : In arid and semi-arid regions, some agricultural fields were converted into rain fed storage structures. These structures are found in Rajasthan.
- (v) **Tankas** : The tankas were built inside the main house or the courtyard. They were connected to the sloping roofs of the houses through a pipe. Rain falling on the rooftops would travel down the pipe and was stored in these underground 'tankas'. The first spell of rain was usually not collected as this would clean the roofs and the pipes. $1 \times 5 = 5$

(CBSE Marking Scheme, 2011)

