Water Resources Demand and Utilisation

Water is a cyclic resource with abundant supplies on the globe. Approximately 71% of the earth's surface is covered with water, but freshwater constitutes only about 3% of the total water. A very small proportion of freshwater is effectively available for human use, and its availability varies over space and time. Assessment, efficient use, and conservation of water are necessary to ensure sustainable development.

India accounts for about 2.45% of the world's surface area, 4% of the world's water resources, and about 16% of the world's population. The total water available from precipitation in the country annually is about 4000 cubic kilometers. The availability from surface water and replenishable groundwater is 1869 cubic kilometers, out of which only 60% can be put to beneficial uses. Thus, the total utilizable water resource in the country is only 1122 cubic kilometers.

There are four major sources of surface water: rivers, lakes, ponds, and tanks. However, due to topographical, hydrological, and other constraints, only about 690 cubic kilometers (32%) of the available surface water can be utilized. Water flow in a river depends on the size of its catchment area and rainfall within it. Much of the annual water flow in south

Indian rivers like the Godavari, Krishna, and Kaveri has been harnessed, but it is yet to be done in the Brahmaputra and Ganga basins.

The total replenishable groundwater resources in the country are about 432 cubic kilometers. Groundwater utilization is relatively high in river basins in the north-western region and parts of south India, especially in Punjab, Haryana, Rajasthan, and Tamil Nadu. States like Chhattisgarh, Odisha, and Kerala utilize only a small proportion of their groundwater potential.

India has a vast and indented coastline, leading to the formation of lagoons and lakes, especially in Kerala, Odisha, and West Bengal. Traditionally an agrarian economy, about two-thirds of India's population depends on agriculture. Development of irrigation to increase agricultural production has been a high priority, with multipurpose river valley projects like Bhakra-Nangal, Hirakud, Damodar Valley, Nagarjuna Sagar, and Indira Gandhi Canal Project.

Agriculture accounts for most surface and groundwater utilization: 89% of surface water and 92% of groundwater. The industrial sector uses 2% of surface water and 5% of groundwater, while the domestic sector uses 9% of surface water. Irrigation is essential due to spatio-temporal variability in rainfall, with large drought-prone areas in north-western India and the Deccan Plateau. Irrigation enables multiple cropping and higher agricultural productivity. For example, in Punjab, Haryana, and western Uttar Pradesh, more than 85% of net sown area is irrigated, mostly through wells and tube wells, leading to groundwater depletion in these states.

Exam Questions

Q1: What are the major sources of surface water in India?

A1: The major sources of surface water in India are rivers, lakes, ponds, and tanks.

Q2: Why is irrigation important in India?

A2: Irrigation is important due to uneven rainfall distribution, drought-prone areas, and to enable multiple cropping and higher agricultural productivity.

Q3: Which sectors use the most water in India?

A3: Agriculture uses the most water, accounting for 89% of surface water and 92% of groundwater utilization.

Deterioration of Water Quality, Water Conservation and Management, Prevention of Water Pollution, Recycle and Reuse of Water

The per capita availability of water is decreasing due to population growth. Toxic substances entering water bodies cause pollution, deteriorating water quality and affecting aquatic systems. Pollutants can also seep into groundwater. The Ganga and Yamuna rivers are highly polluted.

Due to the high cost of desalinisation, seawater is not a viable source of freshwater in India. Therefore, effective policies and measures for water conservation are essential. These include watershed development, rainwater harvesting, water recycling and reuse, and conjunctive use of water.

Pollutants from agriculture (fertilizers and insecticides), domestic waste, and industrial effluents enter rivers, with concentrations highest during summer when water flow is low. The Central Pollution Control Board (CPCB) monitors water quality at 507 stations nationwide.

Public awareness is crucial to reduce water pollution. Recycling and reuse of water can improve freshwater availability. For example, treated wastewater can be used by industries for cooling and firefighting, and in urban areas, water used for bathing and washing can be reused for gardening. Currently, recycling is limited but has great potential.

Exam Questions

Q1: What causes deterioration of water quality in India?

A1: Pollution from toxic substances, agricultural runoff, domestic and industrial waste causes deterioration of water quality.

Q2: Why is desalinisation not a major source of freshwater in India?

A2: Because desalinisation is costly, making seawater an impractical source of freshwater.

Q3: How can water be conserved and reused?

A3: Through watershed development, rainwater harvesting, recycling treated wastewater, and conjunctive use of water.

Watershed Management and Rainwater Harvesting

Watershed management involves efficient management and conservation of surface and groundwater resources. It includes prevention of runoff, storage, and recharge of groundwater through methods like percolation tanks and recharge wells. Broadly, it encompasses conservation, regeneration, and judicious use of natural and human resources within a watershed.

The goal is to balance natural resources and societal needs. The Central and State Governments have initiated many watershed development programs, such as Haryali, which helps rural populations conserve water for drinking, irrigation, fisheries, and afforestation. Programs like Neeru-Meeru in Andhra Pradesh and Arvary Pani Sansad in Rajasthan involve community participation in constructing water-harvesting structures like percolation tanks, dugout ponds (Johads), and check dams.

Successful watershed projects have rejuvenated environments and economies. Public awareness about watershed benefits is essential.

Rainwater harvesting captures and stores rainwater for various uses. Traditional methods include surface storage in lakes, ponds, and irrigation tanks. There is wide scope to use rainwater harvesting to conserve water, including rooftop and open space harvesting. Urban areas especially benefit as water demand exceeds supply.

Exam Questions

Q1: What is watershed management?

A1: Watershed management is the conservation and efficient use of surface and groundwater resources within a watershed.

Q2: Name some water harvesting structures used in watershed management.

A2: Percolation tanks, dugout ponds (Johads), check dams, and recharge wells.

Q3: Why is rainwater harvesting important in urban areas?

A3: Because water demand in urban areas often exceeds supply, rainwater harvesting helps conserve and supplement water resources.

Solved Examples

Example 1: Calculate the percentage of total water resources in India that is utilizable.

Solution: Total water available = 1869 cubic km; Utilizable water = 1122 cubic km.

Percentage utilizable = (1122 / 1869) × 100 ≈ 60%

Example 2: Why is groundwater depletion a concern in Punjab and Haryana?

Solution: These states use a large proportion of groundwater for irrigation through wells and tube wells, leading to depletion.

Practice Set

Easy

- What percentage of the earth's surface is covered by water?
- Name two major rivers in India where water flow has been largely harnessed.

Moderate

- Explain the importance of irrigation in Indian agriculture.
- What are the main causes of water pollution in India?

Challenging

- Discuss the role of watershed management in sustainable water conservation.
- Describe the methods and benefits of rainwater harvesting in urban areas.

Answer Key

- 71% of the earth's surface is covered by water.
- Godavari and Krishna rivers.
- Irrigation helps overcome uneven rainfall, supports multiple cropping, and increases productivity.
- Water pollution is caused by agricultural runoff, domestic waste, and industrial effluents.
- Watershed management conserves water and land resources, prevents runoff, and recharges groundwater, ensuring sustainable use.
- Rainwater harvesting captures and stores rainwater, reduces dependence on groundwater, and helps meet urban water demand.

Quick Reference

- Water covers 71% of Earth; only 3% is freshwater.
- India's utilizable water is about 1122 cubic km annually.
- Agriculture uses the majority of water resources.
- Water pollution affects major rivers like Ganga and Yamuna.
- Watershed management and rainwater harvesting are key conservation methods.

Glossary

- **Abundant:** Existing in large quantities.
- **Catchment Area:** Area from which rainfall flows into a river or reservoir.
- **Replenishable Resources:** Resources that can be renewed naturally.
- **Lagoons:** Shallow water bodies separated from the sea by barriers.
- **Desalinisation:** Process of removing minerals from saline water.
- **Reclaimed Waste Water:** Treated wastewater reused for other purposes.
- **Watershed Management:** Conservation and management of land and water resources in a watershed.
- **Rainwater Harvesting:** Collecting and storing rainwater for use.

Time Period / Year	Event / Change	Importance
Prehistoric times	Traditional rainwater harvesting methods	Conservation of water in rural areas

Post-independence	Multipurpose river valley projects initiated	Increase irrigation and agricultural productivity
Recent decades	Watershed development programs like Haryali	Community participation in water conservation
Present	Urban rainwater harvesting adoption	Address urban water scarcity