WATER CONSERVATION AND RAIN WATER HARVESTING
(BCV654A)

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COURSE OBJECTIVES

- Appreciate basic concepts of Water and its importance.
- Learn elementary knowledge of ground water.
- Conceptually learn various theories related to Groundwater recharge.
- Study about Subsurface investigation of Ground water.

SYLLABUS

MODULE 1:

Water and its importance Monsoon- types and behavior in India, rainfall — characteristics and distribution, onset and withdrawal of effective rains, dry spells and wet spells, critical dry spells, water loss from the soil, measurement and factors, hydrological cycle, Importance and issues relating water status Scenario of water in Karnataka: sources, geographical distribution, quality. Water (hydrological) cycle, influence of human activity on the water cycle, Surface water resources.

MODULE 2:

Elementary knowledge of ground water: General aquifer. Water quality" and its impact on human beings. Water harvesting: need, principles of water harvesting, general water harvesting methods - rain water harvesting - methods, classes, benefits, approach, rooftop rainwater harvesting, subsurface barrier/dykes, farm ponding, etc mostly used in rural areas.

MODULE 3:

Groundwater recharge: Factors affecting groundwater recharge, Revival of traditional techniques for water harvesting. Calculation of available rain water for harvesting. Preparation of suitable technical drawing and design of rain water harvesting structure.

MODULE 4:

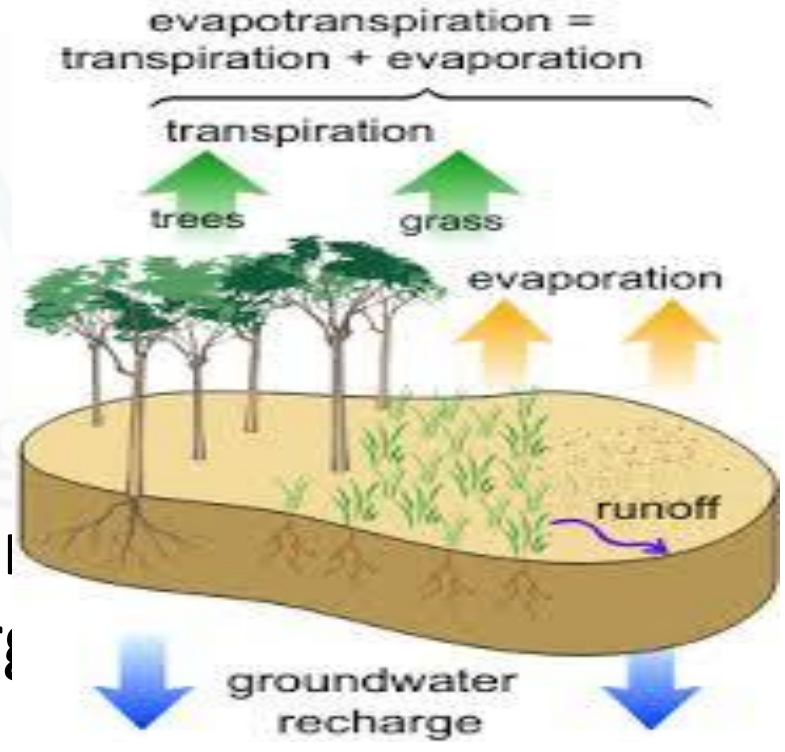
Elementary conservation of water: Importance, knowledge regarding conservation/saving of water in daily use, in agriculture, in industries. Water Conservation strategies- Limiting the consumption, Reuse and recycling, Elimination of losses, Pollution prevention.

MODULE 5:

Subsurface investigation of Ground water: General, geophysical methods and its importance. Present law regarding water management Water footprints- blue water footprint, green water footprint, grey water footprint. Sustainability assessment.

- **MODULE 3:**
- Groundwater recharge: Factors affecting groundwater recharge, Revival of traditional techniques for water harvesting. Calculation of available rain water for harvesting. Preparation of suitable technical drawing and design of rain water harvesting structure

- Groundwater recharge is the natural or artificial process where water moves downward from the surface into the ground, replenishing underground aquifers. This process is crucial for maintaining water resources and can occur naturally through precipitation or artificially through methods like recharg ponds or wells.



- Natural Groundwater Recharge:
- Precipitation:

Rain and snowmelt infiltrate the ground and percolate through soil and rock layers to reach the water table.

- Rivers and Lakes:

Water from rivers and lakes can also contribute to groundwater recharge, particularly along their edges.

- Wetlands:

Wetlands act as natural sponges, absorbing and slowly releasing water, which contributes to groundwater recharge.

- Depression Focused Recharge:

Water can accumulate in depressions and infiltrate into the ground, especially after heavy rainfall.

- Artificial Groundwater Recharge:
- Surface Spreading:

Water is spread on the surface of the land, allowing it to infiltrate into the ground, often using infiltration basins or ponds.

- Recharge Wells:

Water is injected directly into the subsurface through wells, bypassing the natural infiltration process.

- Recharge Pits/Shafts:

These are excavated pits or shafts that are filled with porous materials to facilitate water infiltration.

- Induced Recharge:

Pumping water from an aquifer can create a hydraulic gradient that draws surface water into the aquifer.

- Reclaimed Water:

Treated wastewater can be used for artificial recharge to replenish aquifers.

- Ground water recharge methods
- **Groundwater recharge is a process, where water seeps down from the surface of the earth and gets collected in aquifers. So, the process is also known as deep percolation or recharging the ground water table.**
- **Groundwater recharge happens in two ways:**
- Direct Recharge
- Indirect recharge

- **Direct recharge: Water added by directly in vertical percolation to the groundwater reservoir in excess of soil moisture and evapotranspiration deficits. Such as surface spreading like flooding, basins or percolation tank, stream augmentation, ditch and furrow system. In sub surface like recharge well, recharge pit/shaft, dug well.**
- **Indirect recharge: Results from percolation to the water table following runoff and localization in joints, as ponding in low lying areas and lakes, or through beds of surface water courses. Such as induced recharge.**
- **Natural recharge happens as rain falls on the land surface, infiltrates into soils, and moves through pore spaces down to the water table. Natural recharge also can take place as surface-water leakage from rivers, streams, lakes, and wetlands.**
- 1. Through rain or snowmelt
- 2. Rivers and lakes
- 3. Depression focused recharge

- **1. Climatic Factors**
- **Rainfall**: The amount, intensity, and distribution of rainfall significantly impact groundwater recharge. Eastern India experiences high monsoon rainfall, which enhances recharge.
- **Temperature**: High temperatures lead to higher evaporation, reducing the amount of water that infiltrates the ground.
- **Humidity**: Higher humidity reduces evaporation losses, allowing more water to seep into the ground.

- **2. Geological and Soil Characteristics**
- **Soil Type**: Sandy soils allow better infiltration, whereas clayey soils have low permeability, restricting groundwater recharge.
- **Rock Formation**: Areas with porous and permeable rocks (such as sandstone and limestone) facilitate better recharge, while hard rocks (such as granite) limit water movement.
- **Topography**: Flat or gently sloping terrain allows more water to infiltrate, while steep slopes lead to more surface runoff.

- **3. Hydrological Factors**
- **Surface Water Bodies**: Rivers, lakes, and ponds contribute to groundwater recharge through seepage. Eastern India has major rivers like the Ganga, Brahmaputra, and Subarnarekha that influence groundwater levels.
- **Water Table Depth**: A shallow water table allows faster recharge, while a deep water table takes longer to replenish.

- **4. Vegetation and Land Use**
- **Forests and Green Cover**: Dense vegetation promotes infiltration by reducing surface runoff and soil erosion.
- **Agricultural Practices**: Unplanned irrigation and excessive water use can lower groundwater levels, while sustainable practices (such as check dams and contour farming) improve recharge.
- **Urbanization**: Rapid urban expansion with concrete surfaces reduces infiltration and increases surface runoff, leading to lower recharge rates.

- **5. Human Activities**
- **Over-Extraction**: Excessive groundwater pumping for irrigation and domestic use depletes reserves faster than they can be recharged.
- **Water Conservation Measures**: Rainwater harvesting, artificial recharge structures, and watershed management projects help improve groundwater levels.

- **6. Natural Disasters**
- **Floods**: While floods increase surface water availability, they may also cause soil erosion, which can reduce infiltration in some areas.
- **Droughts**: Extended dry periods reduce recharge opportunities as rainfall decreases and evaporation increases.

- Groundwater recharge is crucial in India for several reasons:
- 1. Depleting Groundwater LevelsOver-extraction of groundwater for agriculture, industries, and domestic use has led to severe depletion.Many regions in India, especially North India, are experiencing groundwater crises.
- 2. Agricultural DependencyAround 60% of irrigation in India depends on groundwater.Recharge ensures water availability for farmers, especially in drought-prone areas

- 3. Water Scarcity & Population GrowthWith a growing population, the demand for water is increasing.
- Recharge helps sustain water availability for drinking and sanitation.
- 4. Drought Mitigation Many Indian states face frequent droughts

Artificial groundwater recharge can help store excess rainwater for use during dry periods.

- 5. Urbanization & Declining Rainwater AbsorptionRapid urbanization reduces natural recharge areas.
- Concrete surfaces prevent rainwater from seeping into the ground.

6. Preventing Land Subsidence

- Over-extraction of groundwater leads to land sinking, damaging infrastructure.
- Recharge helps maintain underground water pressure and soil stability

- **7. Protecting Ecosystems & Rivers**
- Many rivers are sustained by groundwater during dry seasons. Recharge supports aquatic life and maintains natural water flow

Ways to Improve Groundwater Recharge in India

- Rainwater harvesting
- Construction of recharge wells and check dams
- Afforestation to enhance infiltration
- Sustainable water use policies

The Revival of traditional water system:

The revival of traditional water harvesting techniques, like johads, tanks, and stepwells, is crucial for sustainable water management, particularly in regions facing water scarcity, as these methods are efficient, cost-effective, and environmentally sound.

Why revive traditional methods?

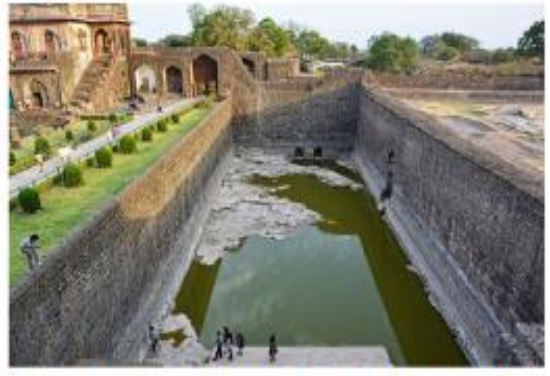
- **Addressing water scarcity:** Traditional systems are often designed to capture and store rainwater, which is crucial in regions with seasonal rainfall or droughts.
- **Groundwater recharge:** Many traditional systems, like johads and stepwells, facilitate groundwater recharge, ensuring long-term water availability.
- **Cost-effectiveness and sustainability:** These methods are often built using local materials and require minimal maintenance, making them a sustainable and affordable solution.
- **Environmental benefits:** Traditional systems can help prevent soil erosion, improve water quality, and support biodiversity.

- **Examples of traditional water harvesting techniques:**
- **Johads:** Small earthen check dams that capture and conserve rainwater, improving percolation and groundwater recharge.
- **Tanks (Eri):** Large, interconnected water bodies used for irrigation and drinking water.
- **Stepwells (Bawari):** Multi-level wells that collect rainwater and allow it to percolate into the ground.
- **Taanka:** A traditional rainwater harvesting technique indigenous to the Thar desert region of Rajasthan, a cylindrical paved underground pit into which rainwater from rooftops, courtyards or artificially prepared catchments flows.
- **Kunds:** Underground storage tanks used for rainwater collection.

- **Why the revival is important:**
- **Climate change:** Traditional systems can help communities adapt to climate change and its impacts on water availability.
- **Sustainable development:** Reviving these systems contributes to sustainable water management and food security.
- **Community participation:** Traditional systems often involve local communities in their construction and management, fostering a sense of ownership and responsibility

- **Examples of Revival Efforts:**
- **Rajasthan:** A thirty-year project has helped local people build 10,000 johads – earthen dams – that have rejuvenated underground water storage and enabled the long-dry rivers to flow once more.
- **Jakhni Village:** Through the implementation of traditional water conservation techniques, such as intensive tree plantation, farm ponds, and rainwater harvesting, Jakhni village successfully revived its water bodies, improved agricultural productivity, and reduced migration.

(i)Jhalaras (ancient and traditional RWH)



(ii)Talab or Bandhi (ancient and traditional RWH)

(iii) Bawari (ancient and traditional RWH)

(iv)Taanka (ancient and traditional RWH)

(v) Ahar Pynes (ancient and traditional RWH)

(vi) Johads (ancient and traditional RWH)

(vii) Panam Keni (ancient and traditional RWH)

(viii) Khadin (ancient and traditional RWH)

(ix) Kund (ancient and traditional RWH)

(x) Baoli (ancient and traditional RWH)

(xi) Nadi (ancient and traditional RWH)

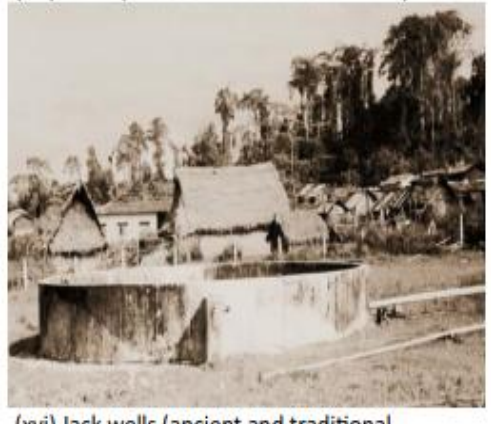
(xii) Bhandara Phad (ancient and traditional RWH)

(xiii) Zing (ancient and traditional RWH)

RWH)

(xiv) Kuhls (ancient and traditional RWH)

(xv) Zabo (ancient and traditional RWH)



(xvi) Jack wells (ancient and traditional RWH)

(xvii) Ramtek Model (ancient and traditional RWH)

(xviii) Pat System (ancient and traditional RWH)

(xix) Eri (ancient and traditional RWH)

(xx) Dongs (ancient and traditional RWH)