



**BHARATHIDASAN UNIVERSITY**  
Tiruchirappalli- 620024, Tamil Nadu, India

# **Programme: M.Sc., Biotechnology(Environment)**

**Course Title :Natural Resources**

**Course Code :EC01**

## **Unit-I**

### **Water Resources**

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Water is one of the most essential components for life on Earth, influencing ecosystems, weather patterns, and human activities. Understanding its origin, properties, and distribution is crucial for sustainable management of water resources.

# 1. Origin of Water

- *Cosmic Origin:*

1. Water on Earth is believed to have originated from two main sources:

1. **Volcanic Outgassing:** During Earth's early formation, water vapor released from volcanic activity condensed to form oceans.
2. **Extraterrestrial Contributions:** Comets and asteroids containing ice delivered water to Earth during the late heavy bombardment period.

- *Natural Reservoirs:*

- Water is stored in various reservoirs, including oceans, glaciers, groundwater, rivers, and the atmosphere.

## 2. Composition of Water

1. Chemically, water is composed of two hydrogen atoms and one oxygen atom (H<sub>2</sub>O).
2. **Dissolved Minerals and Salts:** Natural water contains ions like calcium, magnesium, sodium, and chloride, influencing its hardness and salinity.
3. **Impurities:** Water may also contain organic matter, sediments, and pollutants from natural and anthropogenic sources.

# 3. Hydrological Cycle

- The hydrological cycle describes the continuous movement of water within the Earth-atmosphere system.

- **Key Processes:**

1. **Evaporation:** Water from oceans, rivers, and other surfaces turns into vapor.
2. **Transpiration:** Plants release water vapor into the atmosphere.
3. **Condensation:** Water vapor cools to form clouds.
4. **Precipitation:** Water falls to Earth as rain, snow, sleet, or hail.
5. **Runoff:** Water flows over land into rivers, lakes, and oceans.
6. **Infiltration:** Water seeps into the ground, replenishing aquifers.

- The cycle ensures a dynamic exchange between different reservoirs, maintaining Earth's water balance

# 4. Properties of Water

- ***Physical Properties:***

1. **Polarity:** Water is a polar molecule, making it an excellent solvent.
2. **Density:** Water has a maximum density at 4°C, causing ice to float.
3. **Specific Heat Capacity:** Water can store and release significant amounts of heat, moderating Earth's climate.

- ***Chemical Properties:***

1. **Neutral pH:** Pure water has a pH of 7, making it neutral.
2. **Reactivity:** Water participates in chemical reactions, including hydrolysis and redox reactions.

# 5. Types and Characteristics of Water Bodies

- **Surface Water Bodies:**

1. Rivers and Streams:

1. Dynamic systems transporting water, sediments, and nutrients.
2. Examples: Nile, Amazon.

2. Lakes and Ponds:

1. Stationary water bodies that may vary in size and salinity.
2. Types: Freshwater (e.g., Lake Superior) and saline (e.g., Great Salt Lake).

3. Wetlands:

1. Areas saturated with water, supporting diverse ecosystems.
2. Examples: Mangroves, marshes.

# *Groundwater:*

1. Found in aquifers beneath Earth's surface.
2. Often cleaner than surface water but may contain dissolved minerals.

- ***Marine Water Bodies:***

1. Include oceans and seas, covering 71% of Earth's surface.
2. Characterized by high salinity (average ~35 ppt).
3. Play a critical role in regulating climate and supporting marine biodiversity.



- **6. Human Use of Surface and Groundwater**

- ***Surface Water:***

1. **Agriculture:** Irrigation for crops, accounting for the largest share of water use.
2. **Industrial Use:** Cooling, processing, and waste disposal.
3. **Drinking Water and Sanitation:** Municipal supply for households.
4. **Recreation:** Activities like swimming, boating, and fishing.

- ***Groundwater:***

1. **Drinking Water:** Often a primary source for rural areas.
  2. **Irrigation:** Supplies water to arid and semi-arid regions.
  3. **Industrial Applications:** Used in areas where surface water is unavailable.
- Over-extraction of groundwater leads to issues like aquifer depletion and land subsidence.

- **7. Freshwater and Marine Water Resources**

- ***Freshwater Resources:***

1. Rivers, Lakes, and Glaciers:

1. Glaciers store 68.7% of Earth's freshwater, while lakes and rivers account for 0.3%.

2. Groundwater:

1. Constitutes 30.1% of available freshwater.

3. Challenges:

1. Pollution, overuse, and climate change affect availability and quality.

- ***Marine Water Resources:***

1. Oceans and Seas:

1. Cover 97.5% of Earth's total water.
2. Serve as a major source of food, minerals, and renewable energy (e.g., tidal and wave energy).

2. Ecological Importance:

1. Regulate global temperatures through heat distribution.
2. Act as carbon sinks, reducing atmospheric CO<sub>2</sub> levels.

# Watershed Management and Conservation of Water Resources

Water is a critical natural resource that requires effective management to ensure its availability for future generations. Watershed management, along with conservation practices like rainwater harvesting and water storage systems, plays a pivotal role in maintaining water resources and ensuring sustainable use.

- **1. Watershed Management**

- **Definition:**

- Watershed management involves the sustainable development and conservation of land and water resources within a defined drainage basin to balance ecological and human needs.

- **Key Components:**

1. **Resource Assessment:**

1. Mapping soil types, vegetation, and water bodies.
2. Monitoring water flow and quality.

2. **Land Use Planning:**

1. Implementing agroforestry, crop rotation, and contour farming to reduce erosion.

3. **Water Conservation Measures:**

1. Check dams, percolation tanks, and bunding to enhance groundwater recharge.

4. **Afforestation and Vegetative Cover:**

1. Planting trees to reduce runoff and improve soil water retention.

5. **Community Participation:**

1. Engaging local communities in planning and maintaining watershed structures.

- **2. Conservation of Water Resources**

- **(a) Rainwater Harvesting System (RWH):**

- Rainwater harvesting involves collecting and storing rainwater for future use, reducing dependence on other sources.

- Techniques:

1. Rooftop Rainwater Harvesting:

1. Rainwater is collected from roofs and stored in tanks or directed to recharge pits.

2. Surface Runoff Harvesting:

1. Channels or ponds collect rainwater from land surfaces.

- Components of an RWH System:

1. **Catchment Area:** Roof or ground surface that collects rainwater.

2. **Conduits:** Pipes or gutters to transport water.

3. **Storage Units:** Tanks or reservoirs for water storage.

4. **Recharge Structures:** Pits or trenches for groundwater replenishment.

- Importance:

1. Reduces pressure on municipal water supplies.

2. Mitigates urban flooding.

- **3. Integrated Approach to Water Conservation**

- Combining watershed management, rainwater harvesting, and efficient water storage systems creates a sustainable water conservation framework.

- ***Steps for Effective Water Conservation:***

1. **Community Involvement:**

1. Educating people about the importance of conserving water resources.
2. Promoting local ownership of conservation projects.

2. **Policy and Governance:**

1. Implementing laws to regulate groundwater extraction.
2. Encouraging subsidies for rainwater harvesting and storage systems.

3. **Technology and Innovation:**

1. Smart irrigation systems to reduce water wastage in agriculture.
2. Sensors to monitor water levels in reservoirs and aquifers.

4. **Urban and Rural Integration:**

1. Urban planning with green infrastructure for water conservation.
2. Revitalizing traditional water storage systems in rural areas.

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