WATER RESOURCE

Dr. Anuj Dalal

1.1. Water Physical Attributes

Water is found in three states

Liquid

Solid

Gas

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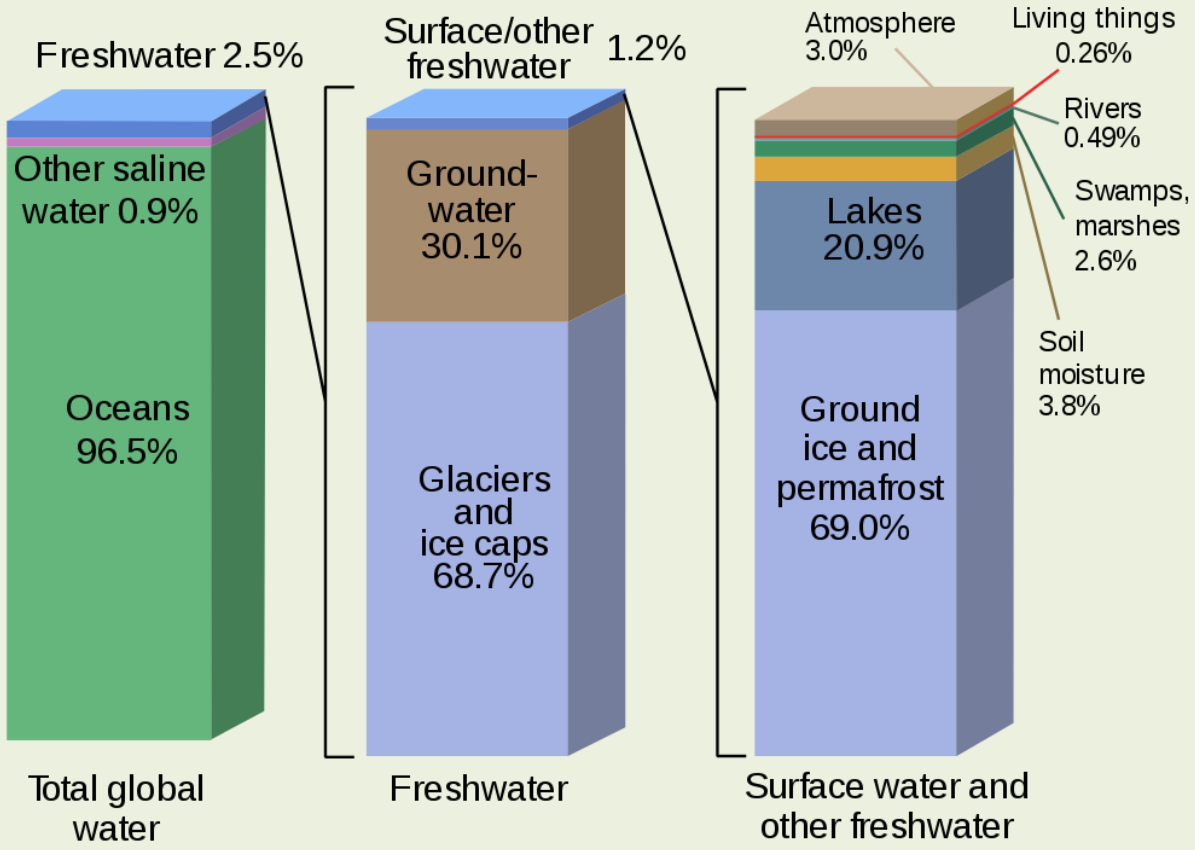
Water Resources

- Water availability



Properties of water and its effects

- It has the highest specific heat, due to which it warms up and cools down very slowly without causing shocks of temperature jerks to the aquatic life.
- It has a high latent heat of vaporization Hence, it takes a huge amount of energy for getting vaporized. That's why it produces a cooling effect as it evaporates.
- It is an excellent solvent for several nutrients. Thus, it can serve as a very good carrier of nutrients, including oxygen, which are essential for life. But, it can also easily dissolve various pollutants and become a carrier of pathogenic microorganisms.
- Due to high surface tension and cohesion it can easily rise through great heights through the trunk.
- It has an anamolous expansion behaviour. It is because of this property that even in extreme cold, the lakes freeze only on the surface. Being lighter the ice keeps floating, whereas the bottom waters remain at a higher temperature and therefore, can sustain aquatic organisms even in extreme cold.

Importance of water

- Water is the basic component of every living cell.
- Water is one of the input required for agriculture.
- Industries consume water for cooling, heating and other processes.
- Electricity generation
- Waterways are used for inland transport.
- Water may be used for obtaining common salt.
- Water provides habitat to aquatic flora and fauna.

Water usage

- Agriculture – 70%, Municipal – 11%, Industrial – 19%
- Average requirement is 20 – 40 liter per head per day (Twice of the usage 50 years ago)
- About 30% of fresh water is used by US (4% of world population) where, middle east (5% of world population use 1% of fresh water).
- More than 1 billion people don't have fresh water supply.
- Presently 31 countries facing water scarcity.
- By 2025, 48 countries will face water shortage (including India).
- By 2050, 4 billion people will suffer water shortage.

3.1. Off-Stream Uses

- Agriculture
- Thermoelectric
- Industrial
- Mining
- Domestic
- Commercial

3.2. In-Stream Uses

Hydropower

Recreation

Navigation

Ecosystem Support

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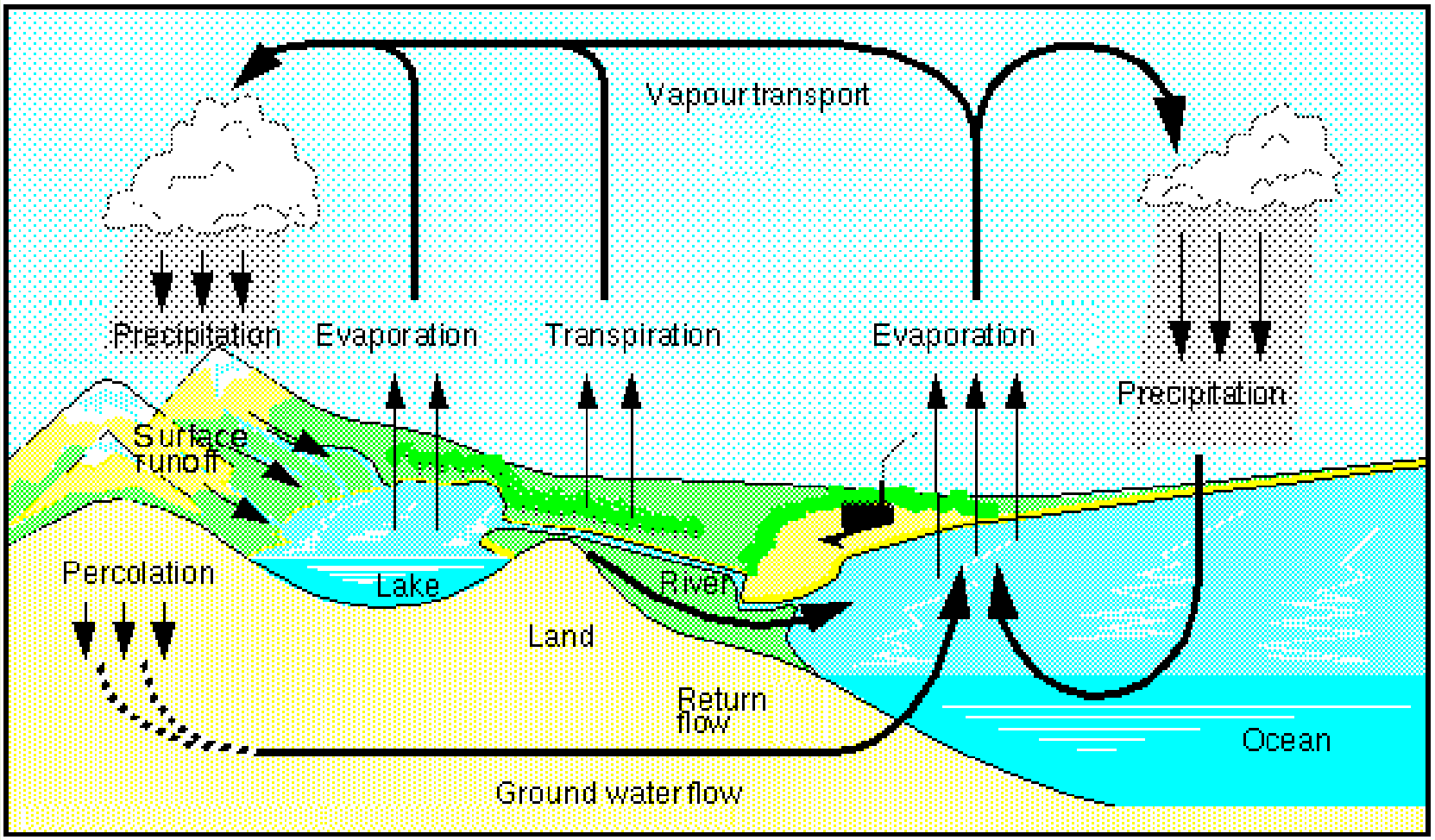
Conflict over water

- Tigris and Euphrates conflict (Turkey – Syria – Iraq)
- Nile conflict (Egypt – Ethiopia – Sudan)
- Jordon river conflict (Israel - Lebanon – Jordon – Palestine)
- Aral sea conflict (Kazakhstan – Uzbekistan – Tajikistan – Turkmenistan)
- Indus water treaty (Jhelum - Chenab: Pakistan, Satluj, Ravi, Beas: India)
- Kaveri dispute
  - Origins in brahmagiri hill (Karnataka)
  - Then enters Tamil Nadu
  - First agreement in 1892
  - Mettur dam was built in 1970 – Tamil Nadu raised objection
  - 1991 a tribunal is formed – Karnatake opposed
- Satluj-Yamuna Link (SYL) canal dispute (Punjab – Haryana)

Water cycle



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Source of water

2.1. Oceans

- Is the largest area and volume of water.
- Contain more than 97% of the earth's water.
- Contain an average of 35g salt per liter.
- Can be used after being desalinated.

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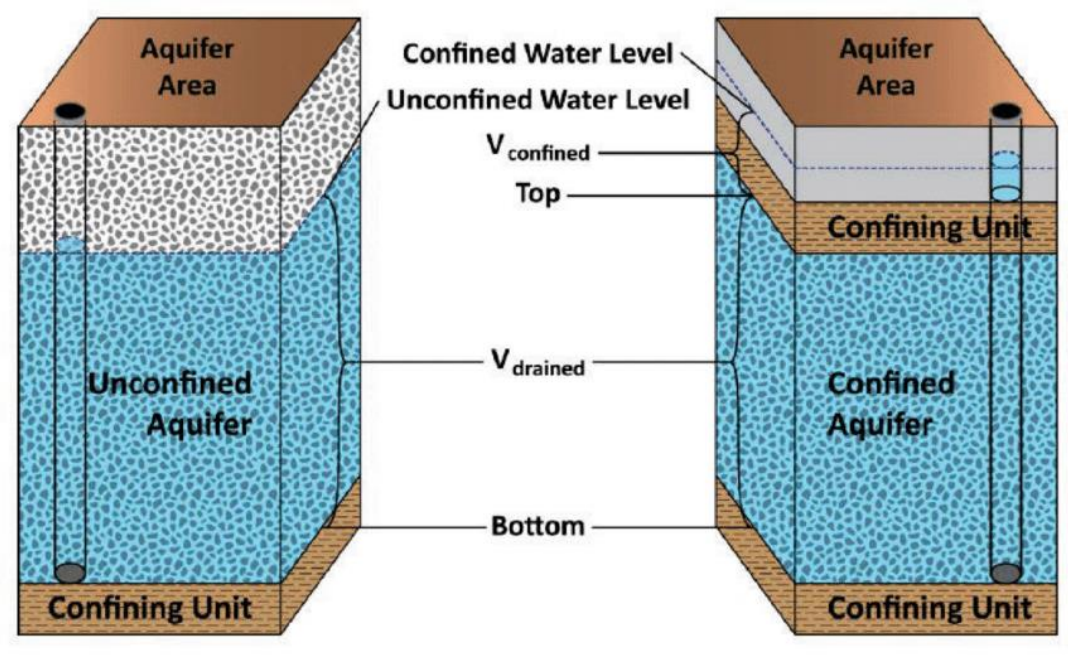
2.2. Ice and Snow

- Contain almost 90% of freshwater.
- Is as much as 2km thick.
- Situate mostly in Antarctica (85%), Greenland (10%), and other snow mountain (5%).

2.3. Groundwater

- Groundwater is water in the rock and soil layer beneath Earth's surface.
- Absorb excess runoff rain and snow on ground.
- Return to lakes, streams, rivers and/or marshes.
- Is readily available for use and drinking.

- Ground water
  - Confined aquifer
  - Unconfined aquifer



- Aquifer
  - An aquifer is a body of porous rock or sediment saturated with groundwater. Groundwater enters an aquifer as precipitation seeps through the soil. It can move through the aquifer and resurface through springs and wells.

Confined Aquifers	Unconfined Aquifers
• It is one kind of aquifer that is below the earth's surface (saturated with groundwater) • It can generally be found at a very deep level below the ground • Most of the time confined aquifers are not generally affected by drought • These types of aquifers form at a slower pace than unconfined ones	• It is one kind of an aquifer whose water table is generally at the level of atmospheric pressure • It is gnarly closer to the surface of the earth • Unconfined aquifers are significantly affected by drought • These types of aquifers form at a very fast speed

2.4. Lakes

- Lakes are created from variety of geological events:
  - Tectonic-basin lake
  - Volcanic lake
  - Glacial lake
  - Groundwater-discharge lake
- Lakes generate water from:
  - Collection of water in low areas
  - Natural or man-made dam(s)
  - Rivers and streams
  - Groundwater

2.4. Lakes (cont.)

- Freshwater lakes
  - Contribute 91,000km³ (about 0.007% of total Earth's water)
  - Provide water for agricultural irrigation, industrial processes, municipal uses and residential water supplies.
  - Major freshwater lakes: Caspian Sea (Central Asia), Baikal Lake (Russia), Tanganyika Lake (Eastern Africa), Lake Superior (U.S), and Malawi Lake (Eastern Africa)

2.4. Lakes (cont.)

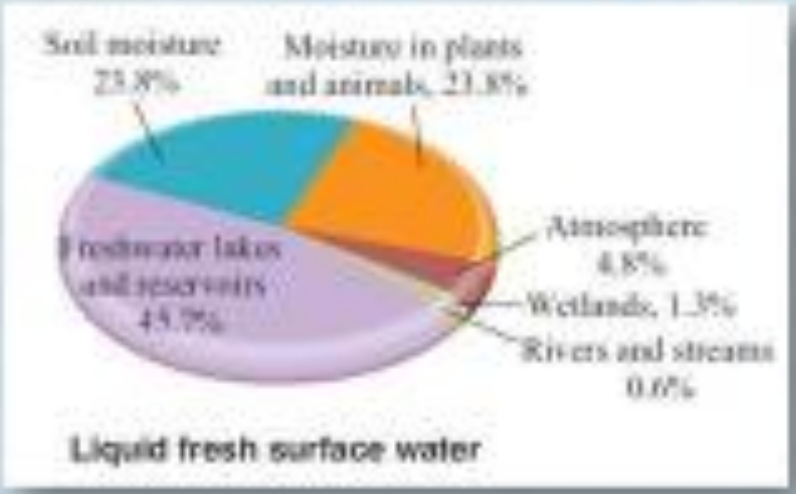
- Saline lakes
  - Possess 85,000km³ (about 0.006% of total Earth's water)
  - Saline lakes' water cannot be used due to high salinity.
  - Major saline lakes: Caspian Sea (Central Asia), The Great Salt Lake (U.S.), The Dead Sea (between Jordan & Israel), and Aral Sea (between Kazakhstan and Uzbekistan).

The Great Salt Lake

The Dead Sea

2.5. Rivers and Streams

- Rivers and streams are bodies of flowing surface water driven by gravity.
- Rivers and Streams contain only 2,120km^3 (about 0.6% of liquid fresh water surface and around 0.0002% of the Earth's water.)



Liquid fresh surface water

2.6. Wetlands and Soil Moisture

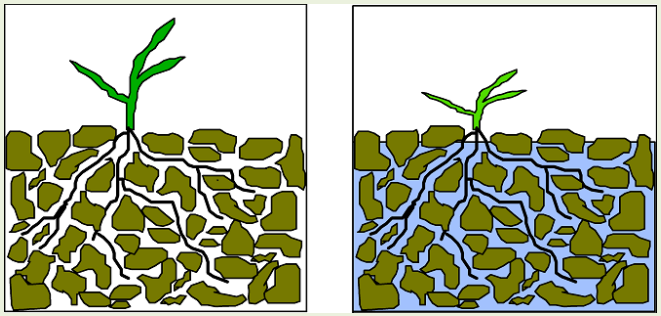
- Wetland are areas of land where water covers the surface for at least part of the year.
- They are not as important as lakes and rivers for water storage.
- However, they play vital roles in:
  - Erosion protection
  - Flood reduction
  - Groundwater replenishment
  - Trapping nutrient and sediment
  - Water purification
  - Providing fish and wildlife habitat

5.7. Atmosphere

- Atmosphere contains about 0.001% of total Earth's water.
- It is around 4% of air volume in the atmosphere.
- Movement of water through atmosphere provide mechanism for distributing freshwater to terrestrial reservoir (in form of rain, snow, hail...).

Effects of over exploitation of ground water

- Ground subsidence
- Lowering water table
- Reduced surface water flow
- Increased power consumption
- Water logging
- Ground water pollution



Water calamities (Flood)

- Types
  - Flash flood: Heavy rainfall, dam failure, river obstruction
  - River flood: Precipitation over large catchment area, melting of snow
  - Coastal flood: Hurricanes, tropical cyclone, tsunami
- Causes
  - Upslope factors
    - Melting of snow
    - Intense rainfall
    - Time of concentration
  - Downslope factors
    - Dams and reservoirs
    - Tides
    - Natural events: Tsunami, Storm

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Water calamities (Flood)

- Effects
  - Negative effects: Loss of life and property, damage to crops, damage to power transmission, water-born diseases, difficulty in health facilities, decline in tourism
  - Positive effects: Distribution of nutrients, relocation of fishes

Water calamities (Drought)

- Types
  - Meteorological drought: Less rainfall
  - Hydrological drought: Low stream flow
  - Agricultural drought: Low soil moisture
- Causes
  - Dry season
  - Climate change
  - Erosion and human activity

Water calamities (Drought)

- Effects
  - Decrease in crop growth
  - Dust storm
  - Famine and mal nutrition
  - Habitat change
  - Mass migration
  - Reduced electricity
  - Wild fire

Dams

- Benefits
  - Electricity generation
  - Employment
  - Irrigation water supply
  - Drinking water supply
  - Reduction in famine
  - Flood control

Dams

- Problems
  - Displacement of tribal people
  - Loss of forest
  - Changes in aquatic environment
  - Waterlogging near reservoir
  - Breeding of vectors
  - Microclimatic changes
  - Reduced water flow
  - Flash flood
  - Salt water intrusion
  - Sediment carrying nutrients get deposited in reservoir.
  - Outbreak of vector-borne diseases like malaria.

Thank You

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