Major Sources of Water Pollution

- ✓ Freshwater Stream Pollution
  - Flowing streams can recover from moderate level of degradable water pollution
  - Natural biodegradation process
  - Does not work if overloaded or stream flow reduced
  - Does not work against non-biodegradable pollutants

Two Worlds

- ✓ Developing Countries:
- ✓ Serious and growing problem
  - o Half of world's 500 major rivers heavily polluted
  - o Sewage treatment minimal
  - o Law enforcement difficult
  - o Economic growth with little to clean up
- ✓ **India's Ganges River**
  - o Holy River (1 million take daily holy dip)
  - o 350 million (1/3rd of pop) live in watershed
  - o Little sewage treatment
  - o Used for bathing, drinking etc.
  - o Bodies (cremated or not) thrown in river
  - o Good news is the Indian government is work on problem

Actions Taken by the Government of India for Cleaning and Recovery of River Ganga

1. **Ganga Action Plan (GAP – Phase I & II)**
   - **Started:** 1985
   - **Aim:** To reduce pollution in the river.
   - Steps taken:
     - Built **sewage treatment plants (STPs)**.
     - Stopped **industrial waste discharge** into the river.
     - Cleaned **riverfronts** and cremation ghats.
     - Created public awareness.
   - **Problem:** Maintenance and coordination were poor, so results were limited.

2. **National River Conservation Plan (NRCP)**
   - **Started:** 1995
   - Covered not only Ganga but also **other major rivers**.
   - Focused on **wastewater treatment** and **solid waste management**.

Actions Taken by the Government of India for Cleaning and Recovery of River Ganga

3. National Ganga River Basin Authority (NGRBA)

- **Formed:** 2009
- Headed by the **Prime Minister**.
- Planned **basin-wide management** for all Ganga states — to control pollution and ensure clean flow.

4. Namami Gange Programme

- **Launched:** 2014 (by Ministry of Jal Shakti).
- **Main goals:** Clean, rejuvenate, and protect the Ganga.
- **Major actions:**
  - Set up new **STPs** and upgraded old ones.
  - **Cleaned river surface** (removed floating waste).
  - **Monitored industries** for waste discharge.
  - **Afforestation** along riverbanks.
  - Improved **sanitation** in villages and towns.
  - Protected **Gangetic dolphins** and other aquatic life.

Actions Taken by the Government of India for Cleaning and Recovery of River Ganga

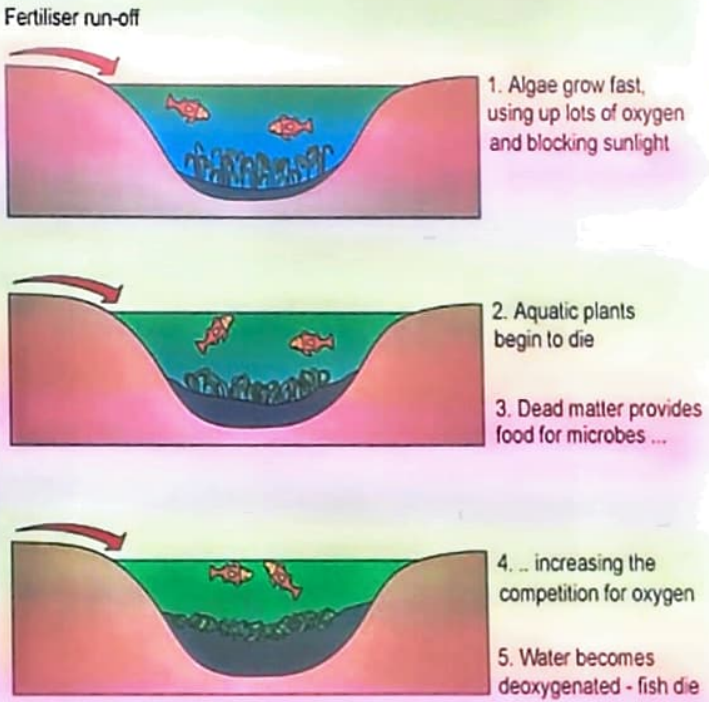
5. Arth Ganga Initiative (2020 onwards)
   - Focuses on linking economy with ecology.
   - Promotes **organic farming**, **eco-tourism**, and **reuse of treated water** near the river.
6. **Laws and Monitoring**
   - **Water Pollution Control Act (1974)** and **National Green Tribunal (NGT)** help regulate and punish polluters.
   - **Water quality monitoring stations** track the health of the river.

Results:

- Some stretches now show **better water quality** and **higher oxygen levels**.
- Still, challenges remain due to **urban sewage**, **industrial waste**, and public awareness.

Eutrophication

- ✓ **Eutrophication** is the process where a body of water becomes overly enriched with **nutrients**, primarily **nitrogen and phosphorus**, leading to excessive growth of plant life and algae, known as an **algal bloom**. This process often results in the depletion of dissolved oxygen in the water, which can be detrimental to aquatic ecosystems
  - Hot dry weather can lead to algae blooms
  - Decrease of photosynthesis
  - Dying algae then drops Do levels
  - Fishes die, bad odor



Effects of Lake Pollution

- ✓ **Loss of biodiversity:** Sensitive species die, invasive weeds (e.g., Eichhornia) spread.
- ✓ **Health hazards:** Contaminated water causes cholera, typhoid, dysentery.
- ✓ **Bioaccumulation:** Heavy metals enter food chain through fish.
- ✓ **Economic & aesthetic loss:** Reduces tourism and cultural value.

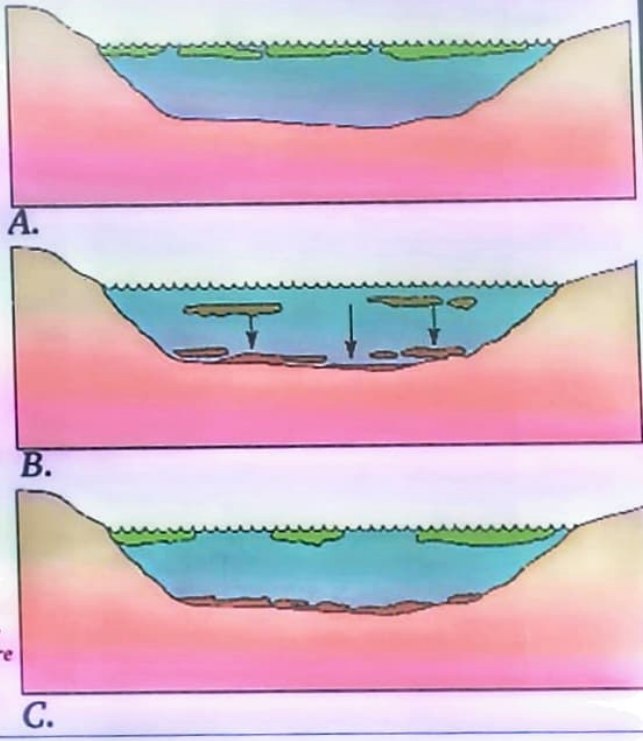
Lake Pollution: Control and Prevention Measures

- ✓ **Treatment Plants:** Install **STPs** (Sewage Treatment Plant) and **ETPs** (Effluent Treatment Plant) to remove sewage and industrial waste.
- ✓ **Agricultural control:** Reduce fertilizers; promote **organic farming** and **buffer zones**.
- ✓ **Solid waste management:** Prevent dumping of garbage and plastics into lakes.
- ✓ **Lake restoration:** Desilting, aeration, **bioremediation**, and **floating wetlands** to improve water quality.
- ✓ **Public awareness:** Community involvement and lake protection groups.
- ✓ **Government programs:**
  - National Lake Conservation Plan (NLCP)
  - National Wetlands Conservation Programme (NWCP)

Eutrophication in Lakes

✓ Solutions:

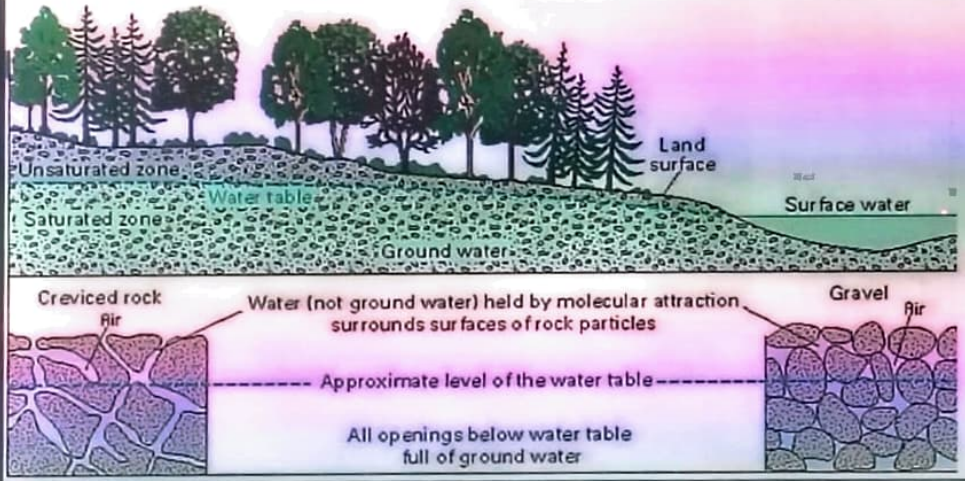
- Advanced sewage treatment (N, P)
- Soil conservation
- Remove excess weed build up
- Pump in oxygen or freshwater



Schematic Diagram showing effects of algal bloom on water quality. (A) Abundant growth of algae in sunlit shallow water when nutrients are abundant. (B) In colder weather, algae die and sink to the lake bottom. (C) The next growing season, more algae thrive at the surface while older material decays at the bottom, increasing BOD and releasing more nutrients to fuel new growth.

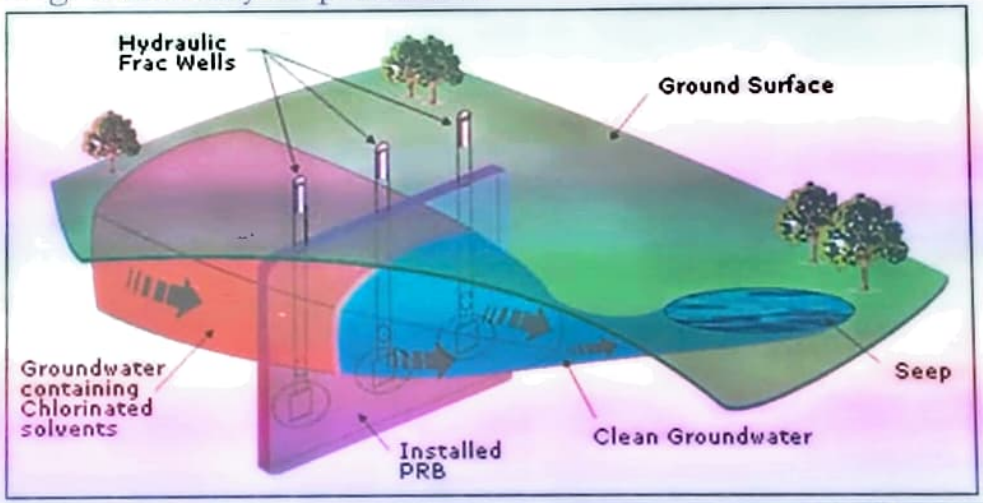
Groundwater

- ✓ Groundwater can become contaminated
  - o No way to cleanse itself
  - o Little dilution and dispersion
  - o Out of sight pollution
  - o Prime source for irrigation and drinking
  - o Removal of pollutant is difficult



Groundwater

- ✓ Pollution moves in plumes
- ✓ Soil, rocks, etc. act like sponge
- ✓ Cleansing does not work (low, low flow, cold)
- ✓ Nondegradable may be permanent



Groundwater Pollution: Causes

→ Low flow rates

→ Few bacteria

→ Low oxygen

→ Cold temperatures