3. Water Pollution

Water pollution is one of the most serious environmental problems. Water pollution is caused by a variety of human activities such as industrial, agricultural and domestic. Agricultural run off related to excess fertilizers and pesticides, industrial effluents with toxic substances and sewage water with human and animal wastes pollute our water thoroughly.

3.1 Water on earth occurs in three forms:

1. As a vapour we see it as clouds, mist and steam.
2. As a fluid we see water as rain, in streams, lakes, dams, wetlands and the seas.
3. As a solid we see water as ice in glaciers, hail, snow and frost.

3.2 Types of Water

Ten Basic Types of Water:

1. **Hard Water:**

   Water that contains high levels of dissolved minerals, mainly calcium (Ca^{2+}) and magnesium (Mg^{2+}). It is common in rivers, lakes, and groundwater.

2. **Boiled Water:**

   Untreated water from natural sources such as rivers, lakes, wells, or springs. It may contain microorganisms, suspended solids, and contaminants.Raw water is generally not safe for drinking without treatment.

3. **Raw Water:**

Untreated water from natural sources such as rivers, lakes, wells, or springs. It may contain microorganisms, suspended solids, and contaminants. Raw water is generally not safe for drinking without treatment.

4. **Rain Water**

   Water condensed from atmospheric vapor. Pure rain is initially close to distilled water, but while falling it collects dust, pollutants, gases, and microorganisms from the air. In polluted areas, rain may contain harmful substances.

5. **Snow Water**

Frozen rain.Freezing does not kill all microorganisms.When melted, snow can contain dirt, minerals, and pollutants collected from the atmosphere.

6. **Filtered Water**

Water that passes through a physical filter. Filters can remove suspended particles and some impurities, but many viruses and dissolved substances may still pass through, depending on filter type. Filters require regular maintenance to remain effective.

7. Soft Water

Water with low mineral content, especially low calcium and magnesium. It produces more soap lather and does not form scale easily. It may still contain microorganisms or dissolved chemicals.

8. Reverse Osmosis (RO) Water

Water purified by forcing it through a semi-permeable membrane under pressure. RO removes most dissolved salts, metals, and contaminants. However, very small molecules may still pass through

9. De-ionized Water: Deionization ("DI Water" or "Demineralization") Simple means the removal of ions

Water treated to remove charged particles (ions) using ion-exchange resins. It removes minerals but does not effectively remove bacteria, viruses, or organic compounds. Commonly used in laboratories and industry.

10. Distilled Water

Water purified by boiling and condensing the steam. This process removes salts, minerals, and most contaminants. Distilled water is one of the purest forms of water, but production requires high energ

3.3 Types of water uses:

1. Municipal/public supply.
2. Domestic and commercial.
3. Industrial and mining.
4. Agricultural
5. Thermoelectric power.

❖ **<u>The average per capita (per person) use can vary greatly between communities for any number of reasons, including:</u>**

1. Climate differences.
2. The mix of domestic, commercial, and industrial uses.
3. Household sizes.
5. Public uses.

6. Income brackets.
7. Age and condition of distribution system.

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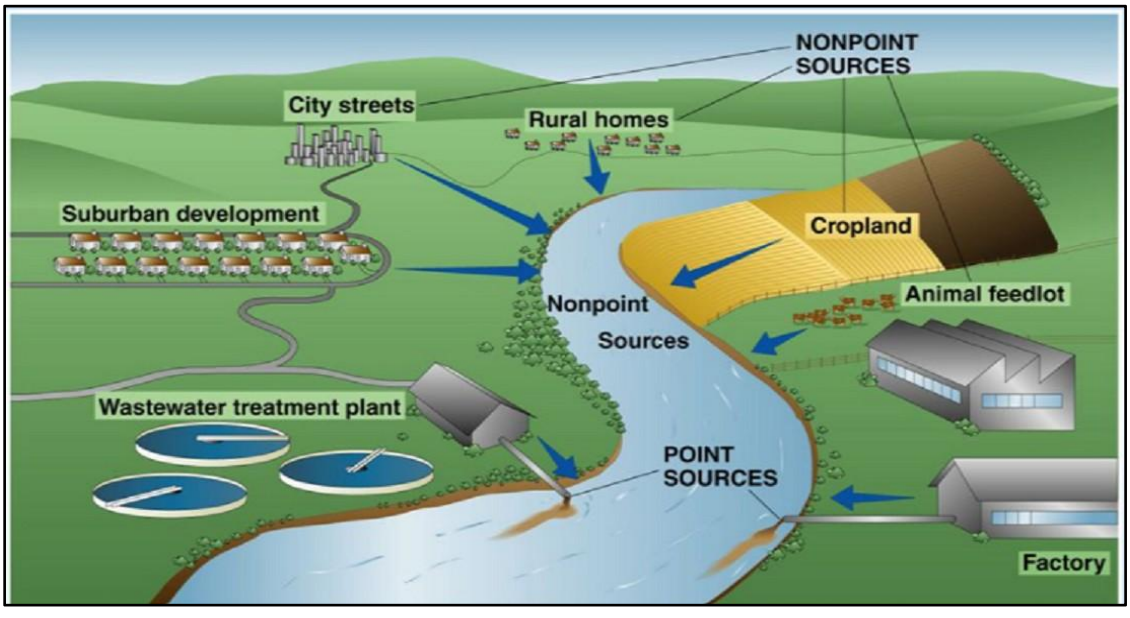
3.4 Sources of Water Pollution:

There are two main sources of water pollution: point sources and non-point sources.

(1) When pollutants are discharged from a specific location such as a drain pipe carrying industrial effluents discharged directly into a water body it represents **Point Source pollution. Point Sources** include factories, wastewater treatment facilities, septic systems, and other sources that are clearly discharging pollutants into water sources.

(2) **Non-Point Sources** are more difficult to identify, because they cannot be traced back to a particular location. Non-point sources include discharge of pollutants from diffused sources or from a larger area such as run off from agricultural fields, grazing lands, construction sites, abandoned mines and pits, roads and streets, sediment, fertilizer, chemicals and animal wastes from farms, construction sites and mines. Landfills can also be a non-point source of pollution, if substances leach from the landfill into water supplies.



3.5 The United States Environmental Protection Agency (EPA) divides water pollution into the following six categories:

1. **Biodegradable waste consists mainly of human and animal waste**. When biodegradable waste enters a water supply, the waste provides an energy source (organic carbon) for bacteria. Organic carbon is converted to carbon dioxide and water, which can cause atmospheric pollution and acid rain; this form of pollution is far more widespread and problematic than other forms of pollutants, such as radioactive waste. If there is a large supply of organic matter in the water, oxygen-consuming (aerobic) bacteria multiply quickly, consume all available oxygen, and kill all aquatic life.

2. **plant nutrients**, such as phosphates and nitrates, enter the water through sewage, and livestock and fertilizer runoff. Phosphates and nitrates are also found in industrial wastes. Though these chemicals are natural, 80 percent of nitrates and 75 percent of phosphates in water are human-added. When there is too much nitrogen or phosphorus in a water supply (0.3 parts per million for nitrogen and 0.01 parts per million for phosphorus), algae begin to develop. When algae blooms, the water can turn green and cloudy, feel slimy, and smell bad. Weeds start to grow and bacteria spread. Decomposing plants use up the oxygen in the water, disrupting the aquatic life, reducing biodiversity, and even killing aquatic life.

   This process, called **eutrophication**, is a natural process, but generally occurs over thousands of years. Eutrophication allows a lake to age and become more nutrient-rich; without nutrient pollution.

3. **Heat can be a source of pollution in water.** Increase in water temperature due to industrial cooling water discharge. Warm water holds less dissolved oxygen. Many aquatic species cannot survive temperature changes. Thermal pollution reduces aquatic diversity and disturbs ecosystems.

4. **Sediment is one of the most common sources of water pollution.** Sediment consists of mineral or organic solid matter that is washed or blown from land into water sources. Sediment pollution is difficult to identify, because it comes from non-point sources, such as construction, agricultural and livestock operations, logging, flooding, and city runoff. Sediment can cause

large problems, as it can clog municipal water systems, smother aquatic life, and cause water to become increasingly turbid. And, turbid water can cause thermal pollution, because cloudy water absorbs more solar radiation.

5. **Hazardous and toxic chemicals** Includes industrial chemicals, oil spills, pesticides, solvents, and household chemicals, Sources:

- Point sources (factories, oil spills).
- Non-point sources (urban runoff, domestic waste).

These substances may be toxic, carcinogenic, or persistent, causing long-term environmental and health damage.

6. **Radioactive pollutants** include wastewater discharges from factories, hospitals and uranium mines. These pollutants can also come from natural isotopes, such as radon and Uranium which is highly toxic chemical. The nuclear waste that is produced by radioactive material needs to be disposed off to prevent any nuclear accident. Nuclear waste can have serious environmental hazards if not disposed off properly. Radioactive pollutants can be dangerous, and it takes many years until radioactive substances are no longer considered dangerous.

7. **Other Pollutants:**

- Mining Activities

1. Release heavy metals and sulfides.
2. Cause acid mine drainage and metal contamination.

- Oil Spills

1. Oil does not dissolve in water.
2. Harms marine organisms and coastal ecosystems.

- Underground Leakage

1. Leaks from pipelines and storage tanks.
2. Contaminate soil and groundwater.

Mining activities: Mining is the process of crushing the rock and extracting coal and other minerals from

underground. These elements when extracted in the raw form contains harmful chemicals and can increase the amount of toxic elements when mixed up with water which may result in health problems.

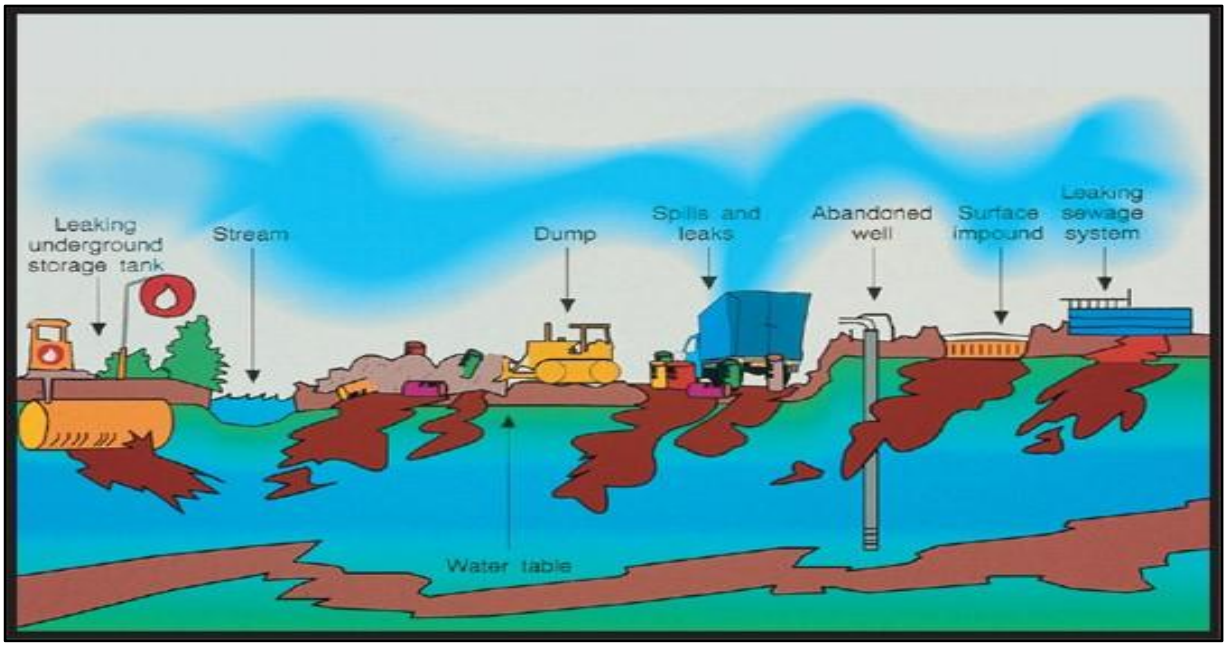
3.6 Effect of industrial activity and energy production on the water pollution

The water after it is used once for industrial purpose cannot be reused for the same purpose without treatment. Such water which emerges out after use from industries is called as the industrial effluents. Industrial activities are a significant and growing cause of poor water quality. Industry and energy production use accounts for nearly 20 percent of total global water withdrawals, and this water is typically returned to its source in a degraded condition. Industrial wastewater can contain a number of different pollutants, including:

1. Microbiological contaminants like bacteria, viruses, and protozoa.
2. Chemicals from industrial activities like solvents and organic and inorganic pesticides, polychlorinated biphenyls (PCBs), asbestos.
3. Metals such as lead, mercury, zinc, copper, and many others.
4. Nutrients such as phosphorus and nitrogen.
5. Suspended matter including particulates and sediments.
6. Temperature changes through the discharge of warm cooling-water effluent.
7. Pharmaceuticals and personal care products.

The production of energy also has significant effects on water quality mostly because of the vast quantities of water required for power-plant cooling and the extensive risk of contamination during the search for and production of fossil fuels. There are three major effects of concern:

1. The production of vast quantities of contaminated groundwater during the drilling of oil and gas wells.
2. The withdrawal of water for power plant cooling that reduces water available for ecosystems; and
3. The heating and subsequent discharge of cooling water, which raises the ambient water temperature in rivers, streams, and lakes, with effects on natural ecosystems.


Leaking underground storage tank
Stream
Dump
Spills and leaks
Abandoned well
Surface impound
Leaking sewage system
Water table