Study Material for B.Sc. 1st Year (Semester-II)
Subject: Environment and Water Management

Unit-II: Water Pollution

- **Effect of water pollution on water quality and aquatic life**

Some of adverse effects of water pollution are as follows:

Water pollution adversely affects the health and life of man, animals and plants alike. Polluted water is also harmful for agriculture as it adversely affects the crops and the soil fertility. Pollution of sea water damages the oceanic life.

1. Health Aspects of Water Quality:

Consumption of polluted water is a major cause of ill health in India. Polluted water causes some of the deadly diseases like cholera, dysentery, diarrhoea, tuberculosis, jaundice, etc. About 80 per cent of stomach diseases in India are caused by polluted water.

2. Effect of Organic Pollution on Water Quality:

All organic materials can be broken down or decomposed by microbial and other biological activity (biodegradation). Organic and some of the inorganic compounds exhibit a biochemical oxygen demand (BOD) because oxygen is used in the degradation process.

Oxygen is a basic requirement of almost all aquatic life. Aquatic life is adversely affected if sufficient oxygen is not available in the water. Typical sources of organic pollution are sewage from domestic and animal sources, industrial wastes from food processing, paper mills, tanneries, distilleries, sugar and other agro based industries.

3. Effect of Nutrients on Water Quality:

Water supports aquatic life because of the presence of nutrients in it. Here the primary focus is on fertilizing chemicals such as nitrates and phosphates. Although these are important for plant

growth, too much of nutrients encourage the overabundance of plant life and can result in environmental damage called 'entrophication'.

This can occur at both microscopic level in the form of algae and macroscopic level in the form of aquatic weeds. Nitrates and phosphates are contributed by sewage, agricultural run-off and run-off from un-sewered residential areas.

4. Effect of High Dissolved Solids (TDS) in Water Quality:

Water is the best solvent and can dissolve a large variety of substances which come in its contact. The amount of dissolved solid is a very important consideration in determining its suitability for drinking, irrigation and industrial uses. In general, waters with total dissolved solids of less than 500 mg/litre are most suitable for drinking purposes.

Higher amount of dissolved solids may lead to impairment of physiological processes in human body. Dissolved solid is a very important criteria for irrigation. This is due to the fact dissolved solid accumulates on the ground resulting in salinization of soil.

In this way it renders the agricultural land non-productive. Dissolved solids are harmful for industries also because they form scales, cause foaming in boilers, accelerate corrosion and interfere with the colour and taste of many finished products.

5. Effect of Toxic Pollutants on Water Quality:

Toxic pollutants mainly consist of heavy metals, pesticides and other individual xenobiotic pollutants. The ability of a water body to support aquatic life, as well as its suitability for other uses depends on many trace elements. Some metals e.g., Mn, Zn and Cu present in trace quantity are important for life as they help and regulate many physiological functions of the body. Some metals, however, cause severe toxicological effects on human health and the aquatic ecosystem.

6. Effect of Thermal Discharges on Water Quality:

The discharge of cooling water from industrial and commercial operations generally heats up the aquatic environment. Organisms may become physiologically stress or may even be killed when exposed to heated water. If water heating is supplemented by the summer heat, the impact on aquatic environment can be disastrous.

Effects of Water Pollution

- Groundwater contamination from pesticides causes reproductive damage within wildlife in ecosystems.
- Sewage, fertilizer, and agricultural run-off contain organic materials that when discharged into waters, increase the growth of algae, which causes the depletion of oxygen. The low oxygen levels are not able to support most indigenous organisms in the area and therefore upset the natural ecological balance in rivers and lakes.
- Old Roofs can cause pollution if they are not properly maintained. If water is being held on roofs the water can become polluted and then run down the home and cause more pollution to the water table. If you invest in a green roof from Allstate Roofing you can help reduce the water pollution from your home.
- Swimming in and drinking contaminated water causes skin rashes and health problems like cancer, reproductive problems, typhoid fever and stomach sickness in humans. Which is why it's very important to make sure that your water is clean and safe to drink.
- Industrial chemicals and agricultural pesticides that end up in aquatic environments can accumulate in fish that are later eaten by humans. Fish are easily poisoned with metals that are also later consumed by humans. Mercury is particularly poisonous to small children and women. Mercury has been found to interfere with the development of the nervous system in fetuses and young children.
- Ecosystems are destroyed by the rising temperature in the water, as coral reefs are affected by the bleaching effect due to warmer temperatures. Additionally, the warm water forces indigenous water species to seek cooler water in other areas, causing an ecological damaging shift of the affected area.

- Human-produced litter of items such as plastic bags and 6-pack rings can get aquatic animals caught and killed from suffocation.
- Water pollution causes flooding due to the accumulation of solid waste and soil erosion in streams and rivers.
- Oil spills in the water causes animal to die when they ingest it or encounter it. Oil does not dissolve in water so it causes suffocation in fish and birds.

❖ Concept of Eutrophication

Eutrophication (Greek: *eutrophia* (from *eu* "well" + *trephein* "nourish".); German: *Eutrophie*), or more precisely **hypertrophication**, is the depletion of oxygen in a water body, which kills aquatic animals. It is a response to the addition of excess nutrients, mainly phosphates, which induces explosive growth of plants and algae, the decaying of which consumes oxygen from the water. One example is the "bloom" or great increase of phytoplankton in a water body as a response to increased levels of nutrients. Eutrophication is almost always induced by the discharge of phosphate-containing detergents, fertilizers, or sewage, into an aquatic system.

Eutrophication arises from the oversupply of nutrients, which leads to over growth of plants and algae. After such organisms die, the bacterial degradation of their biomass consumes the oxygen in the water, thereby creating the state of hypoxia.

According to Ullmann's Encyclopedia, "the primary limiting factor for eutrophication is phosphate." The availability of phosphorus generally promotes excessive plant growth and decay, favouring simple algae and plankton over other more complicated plants, and causes a severe reduction in water quality. Phosphorus is a necessary nutrient for plants to live, and is the limiting factor for plant growth in many freshwater ecosystems. Phosphate adheres tightly to soil, so it is mainly transported by erosion. Once translocated to lakes, the extraction of phosphate into water is slow, hence the difficulty of reversing the effects of eutrophication.

The sources of these excess phosphates are detergents, industrial/domestic run-offs, and fertilizers. With the phasing out of phosphate-containing detergents in the 1970s, industrial/domestic run-off and agriculture have emerged as the dominant contributors to eutrophication

Although eutrophication is commonly caused by human activities, it can also be a natural process, particularly in lakes. Eutrophy occurs in many lakes in temperate grasslands, for instance. Paleolimnologists now recognise that climate change, geology, and other external influences are critical in regulating the natural productivity of lakes. Some lakes also demonstrate the reverse process (meiotrophication), becoming less nutrient rich with time. The main difference between natural and anthropogenic eutrophication is that the natural process is very slow, occurring on geological time scales.

Terrestrial ecosystems are subject to similarly adverse impacts from eutrophication. Increased nitrates in soil are frequently undesirable for plants. Many terrestrial plant species are endangered as a result of soil eutrophication, such as the majority of orchid species in Europe. Meadows, forests, and bogs are characterized by low nutrient content and slowly growing species adapted to those levels, so they can be overgrown by faster growing and more competitive species. In meadows, tall grasses that can take advantage of higher nitrogen levels may change the area so that natural species may be lost. Species-rich fens can be overtaken by reed or reedgrass species. Forestundergrowth affected by run-off from a nearby fertilized field can be turned into a nettle and bramble thicket.

Chemical forms of nitrogen are most often of concern with regard to eutrophication, because plants have high nitrogen requirements so that additions of nitrogen compounds will stimulate plant growth. Nitrogen is not readily available in soil because N_2, a gaseous form of nitrogen, is very stable and unavailable directly to higher plants. Terrestrial ecosystems rely on microbial nitrogen fixation to convert N_2 into other forms such as nitrates. However, there is a limit to how much nitrogen can be utilized. Ecosystems receiving more nitrogen than the plants require are called nitrogen-saturated. Saturated terrestrial ecosystems then can contribute both inorganic and organic nitrogen to freshwater, coastal, and marine eutrophication, where nitrogen is also typically a limiting nutrient. This is also the case with increased levels of phosphorus. However, because phosphorusis generally much less soluble than nitrogen, it is leached from the soil at a much slower rate than nitrogen. Consequently, phosphorus is much more important as a limiting nutrient in aquatic systems.

Eutrophication was recognized as a water pollution problem in European and North American lakes and reservoirs in the mid-20th century. Since then, it has become more widespread.

Surveys showed that 54% of lakes in Asia are eutrophic; in Europe, 53%; in North America, 48%; in South America, 41%; and in Africa, 28%.

Many ecological effects can arise from stimulating primary production, but there are three particularly troubling ecological impacts: decreased biodiversity, changes in species composition and dominance, and toxicity effects.

- Increased biomass of phytoplankton
- Toxic or inedible phytoplankton species
- Increases in blooms of gelatinous zooplankton
- Increased biomass of benthic and epiphytic algae
- Changes in macrophyte species composition and biomass
- Decreases in water transparency (increased turbidity)
- Colour, smell, and water treatment problems
- Dissolved oxygen depletion
- Increased incidences of fish kills
- Loss of desirable fish species
- Reductions in harvestable fish and shellfish
- Decreases in perceived aesthetic value of the water body