

**CAI 334 IRRIGATION WATER QUALITY AND WASTE WATER MANAGEMENT  
UNIT III NOTES**



### **Eutrophication**

Eutrophication, defined as the addition of ‘excess’ nutrients to a water body, is a widespread environmental problem facing the world’s aquatic habitats.

*Eutrophication is the process in which a water body becomes overly enriched with nutrients, leading to the plentiful growth of simple plant life.* The excessive growth (or bloom) of algae and plankton in a water body are indicators of this process. Eutrophication is considered to be a serious environmental concern since it often results in the deterioration of water quality and the depletion of dissolved oxygen in water bodies. Eutrophic waters can eventually become “dead zones” that are incapable of supporting life.

### **Definition of Eutrophication**

Many lakes are naturally eutrophic and in some cases there is a progressive eutrophication as the lake matures. The term Eutrophication is more widely known in relation to human activities where the artificial introduction of plant nutrients has led to community changes and a deterioration of water quality in many freshwater systems. This aspect has become increasingly important with increases in human population and more extensive development of agriculture and eutrophication now ranks with other major anthropogenic effects such as deforestation, global warming depletion of the ozone layer and large scale environmental disturbance in relation to its potentially harmful effect on natural ecosystems.

Aquatic ecosystems are home to several plant and animal life forms – both simple and complex. The process of eutrophication destroys the balance in these ecosystems by favouring the growth of simple plant life. This greatly decreases the biodiversity of the ecosystem by killing off several desirable species.

### **Causes of Eutrophication**

The availability of nutrients such as nitrogen and phosphorus limits the growth of plant life in an ecosystem. When water bodies are overly enriched with these nutrients, the growth of algae, plankton, and other simple plant life is favoured over the growth of more complex plant life.

How do Water Bodies Become Overly Enriched?

Phosphorus is considered one of the primary limiting factors for the growth of plant life in freshwater ecosystems. Several sources also claim that the availability of nitrogen is an important limiting factor for the growth of algae.

Phosphates tend to stick to the soil and are transported along with it. Therefore, soil erosion is a major contributor to the phosphorus enrichment of water bodies. Some other phosphorus-rich sources that enrich water bodies with the nutrient include:

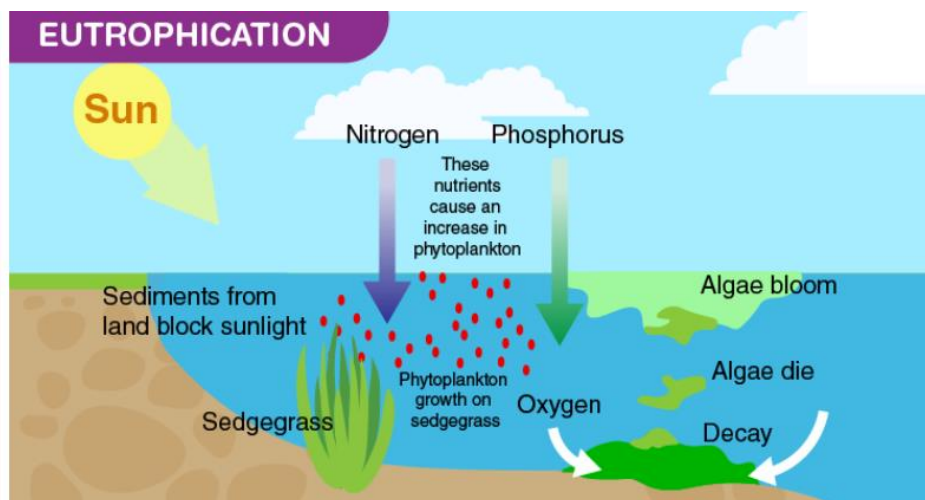
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- *Fertilizers*
- *Untreated sewage*
- *Detergents containing phosphorus*
- *Industrial discharge of waste.*

Among these sources, the primary contributors to eutrophication include agriculture and industrial wastes.

What Happens to the Huge Biomass of Algae in Eutrophic Waters?

The excessive growth of algae in eutrophic waters is accompanied by the generation of a large biomass of dead algae. These dead algae sink to the bottom of the water body where they are broken down by bacteria, which consume oxygen in the process.



### Classification of Eutrophication

The process of eutrophication can be categorized into two types based on its root cause. Both these types are explained in this subsection.

#### Anthropogenic Eutrophication

Anthropogenic eutrophication is caused by human activity – Agricultural farms, golf courses, lawns, etc. are supplied with nutrients by humans in the form of fertilizers. These fertilizers are washed away by rains and eventually find their way into water bodies such as lakes and rivers.

When introduced to an aqueous ecosystem, the fertilizers supply plentiful nutrients to algae and plankton, resulting in the eutrophication of the water body.

Overpopulation places a huge demand on industrial and agricultural expansion, which in turn leads to deforestation. When this occurs, the soil erodes more easily, resulting in increased soil deposits in water bodies. If the soil is rich in phosphorus, it can lead to eutrophication and severely damage the ecosystem in and around the water body.

When sewage pipes and industrial wastes are directed to water bodies, the nutrients present in the sewage and other wastes increase the rate at which eutrophication occurs.

### Natural Eutrophication

Natural eutrophication refers to the excessive enrichment of water bodies via natural events. For example, the nutrients from the land can be washed away in a flood and deposited into a lake or a river. These water bodies become overly enriched with nutrients, enabling the excessive growth of algae and other simple plant life.

The process of natural eutrophication is much slower when compared to the process of anthropogenic eutrophication. This process is also somewhat dependent on the temperature of the environment. It may even be complemented by the temperature changes brought on by global warming.

### Effects of Eutrophication

Primarily, the adverse effects of eutrophication on aquatic bodies include a decrease in biodiversity, an increase in toxicity of the water body, and a change in species dominance. Some other important effects of this process are listed below.

- Phytoplanktons grow much faster in such situations. These phytoplankton species are toxic and are inedible.
- Gelatinous zooplankton blooms fast in these waters.
- Increased biomass of epiphytic and benthic algae can be observed in eutrophic waters.
- Significant changes arise in the species composition of macrophytes and the biomass.
- The water loses its transparency and develops a bad smell and colour. The treatment of this water becomes difficult.
- Depletion of dissolved oxygen in the water body.
- Frequent fish kill incidents occur and many desirable fish species are removed from the water body.
- The populations of shellfish and harvestable fish are lowered.
- The aesthetic value of the water body diminishes significantly.

### Effects of eutrophication:

- Eutrophication leads to various physical, chemical and biological changes in water deteriorating its quality.
- Enriched nitrogen and phosphorus content in water bodies facilitates heavy growth of aquatic plants like algae causing algal bloom which prevents penetration of light into deeper layer.