

Definition of Eutrophication

Eutrophication may be defined as the inorganic nutrient enrichment of natural waters, leading to an increased production of algae and macrophytes.

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.

An image detailing the excessive growth of algae in a eutrophic water body is provided below.

Eutrophication

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.

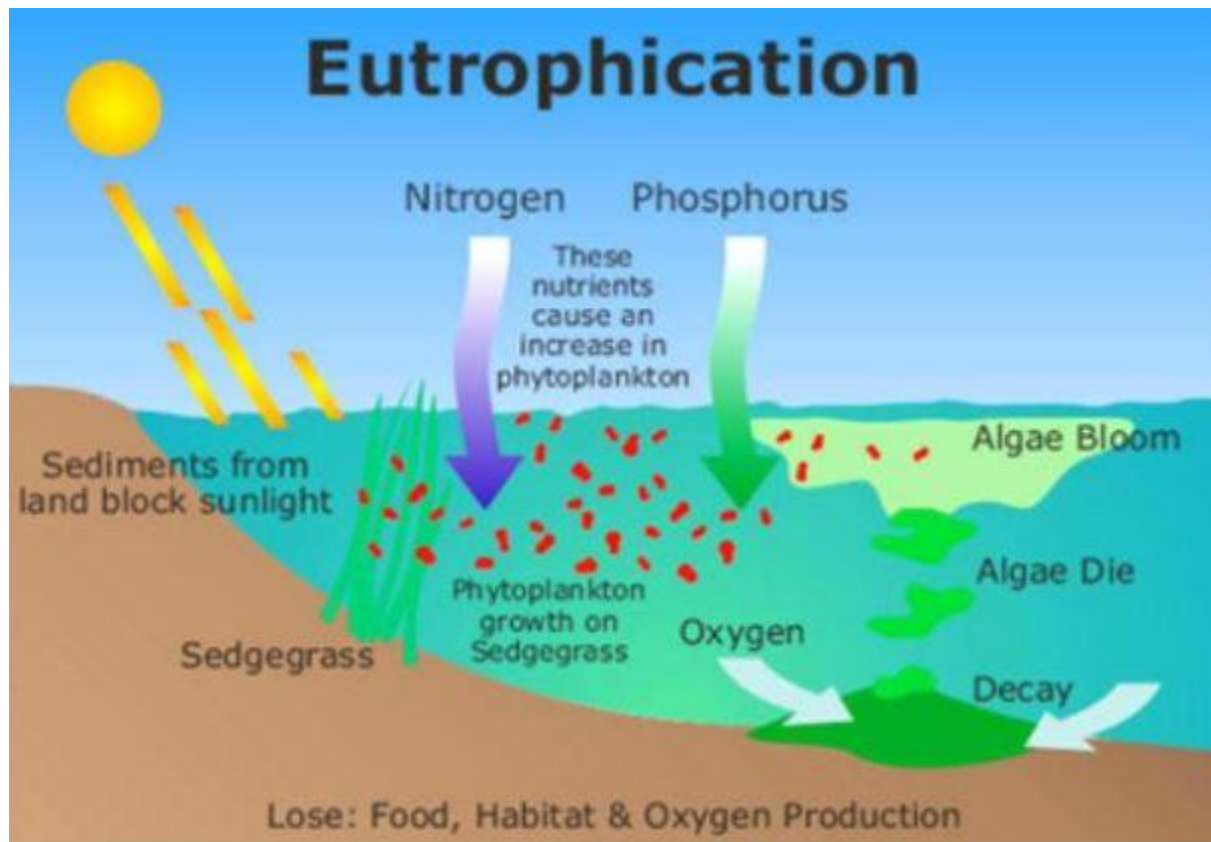
Phosphates tend to stick to the soil and are transported along with it. Therefore, soil erosion is a major contributor to the phosphorus enrichment of water bodies. Some other phosphorus-rich sources that enrich water bodies with the nutrient include:

- 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.



Process of Eutrophication

The overconsumption of oxygen leads to hypoxic conditions (conditions in which the availability of oxygen is low) in the water. The hypoxic conditions at the lower levels of the water body lead to the suffocation and eventual death of larger life forms such as fish.

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 dependant 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, increase in toxicity of the water body, and 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.



Eutrophication of Water Bodies

An image detailing the change in the quality of water in eutrophic water bodies is provided above.

Ecological Effects of Eutrophication

Natural standing waters range from ultra oligotrophic to eutrophic with progressive increase in productivity and related parameters. In addition to such general changes, eutrophication also affects the vertical structure of lakes with further implications for the biology of freshwater organisms. The transition from eutrophic to hypertrophic status is usually the result of human activities, and ultimately affects the whole ecological balance of the freshwater system.

Decrease in Biodiversity

When an aquatic ecosystem is enriched with nutrients by either natural or artificial means, the conditions become extremely beneficial to primary producers. Commonly, algae and other similar species utilize these nutrients and a huge increase in their population (algal bloom) is observed.

These algal blooms hinder the flow of sunlight to the bottom of the aquatic body and also cause wide swings in the dissolved oxygen levels in the water.

When the dissolved oxygen in the water reduces to an amount below the hypoxic level, many marine animals suffocate and die. This reduces the effective biodiversity of the water body.

Increase in Water Toxicity

A few algae are toxic to many plants and animals. When these algae bloom in eutrophic waters, they release neurotoxins and hepatotoxins. These toxins can also move up the food chain via shellfish or other marine animals and lead to the death of many animals.

Toxic algal blooms can also be harmful to humans and are the root cause of many cases of neurotoxic, paralytic, and diarrhoetic shellfish poisoning.

Invasion of New Species

A limiting nutrient corresponding to a water body can be made abundant by the eutrophication process, leading to a shift in the species composition of the aquatic body and the ecosystem surrounding it.

If a nitrogen deficient water body is suddenly enriched with it, many other competitive species might relocate to the water body and out-compete the original inhabitants of the ecosystem. One such example of a new species invading eutrophic conditions is the common carp, which has adapted to these conditions.