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Causes and Consequences of Eutrophication, which are leading to Water Pollution

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Introduction

Excessive plant and algal growth is a symptom of eutrophication, which is caused by increased availability of one or more limiting growth sources for photosynthesis, such as sunlight, carbon dioxide, and nitrogen fertilizers. As lakes age and sediment fills in, eutrophication occurs naturally over centuries. However, through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems (i.e., cultural eutrophication), human activities have accelerated the rate and extent of eutrophication, with dramatic consequences for drinking water sources, fisheries, and recreational water bodies. Aquaculture scientists and pond managers, for example, frequently eutrophy aquatic bodies by adding fertilizers to boost primary productivity and the density and biomass of recreationally and commercially important fishes through bottom-up impacts on higher trophic levels [1].

Eutrophication Types

Natural Eutrophication: Natural eutrophication is the accumulation, flow, and addition of nutrients to water bodies that results in changes in primary production and community species composition. It's been going on for millennia.

Cultural Eutrophication: Cultural eutrophication is a phenomenon that aids in the acceleration of natural eutrophication caused by human activity. More nutrients such as phosphates and nitrate are given to lakes and rivers as a result of land clearing, followed by coastal estuaries and bays. Furthermore, fertilizers used in farms, including fish farms, golf courses, treatment facilities, and untreated sewage, provide additional nutrients [2].

Natural eutrophication (the process of nutrient enrichment of water) can also occur naturally. Human activity, on the other hand, frequently boost it considerably (anthropogenic or cultural eutrophication).

Causes of Eutrophication

Fertilizers (nitrates and phosphates): Because of their reliance on nitrate and phosphate fertilizers, humans are the primary source of eutrophication. Phosphate and nitrate nutrient accumulation is aided by agricultural methods and fertilizer use on lawns, golf courses, and other fields. When these nutrients are poured into lakes, rivers, oceans, and other surface waters by surface runoff during rainstorms, hungry plankton, algae, and other aquatic plant life are well nourished, and their photosynthetic activity increases. This results in a dense proliferation of algal blooms and plant life in aquatic habitats, such as water hyacinths.

Concentrated animal feeding operations: CAFOs are also the primary source of phosphate and nitrogen fertilizers, both of which contribute to eutrophication. Intensive animal feeding operations typically discharge high amounts of nutrients into rivers, streams, lakes, and seas, where they collect in high proportions, causing cyanobacterial and algal blooms to plague the water bodies [3].

Sewage and industrial waste discharged directly into bodies of water: Sewage water is released directly into water bodies such as rivers, lakes, and seas in some regions of the world, particularly in impoverished countries. As a result, it introduces large amounts of chemical fertilizers, causing algal blooms and other aquatic plants to grow densely, and endangering aquatic life in a variety of ways. Although some countries clean sewage water, they nevertheless discharge it into bodies of water after treatment. Regardless matter how well the water is treated, it can still lead to the accumulation of surplus nutrients, resulting in eutrophication. Direct discharge of industrial wastewater into bodies of water has similar consequences.

Aquiculture: Aquiculture is the practise of producing shellfish, fish, and even aquatic plants in water containing dissolved nutrients without the use of soil. It ranks as a leading contributor to eutrophication because it has become a widely accepted practise in recent years.Unconsumed food particles combined with fish waste can drastically raise nitrogen and phosphorus levels in the water, resulting in dense growth of microscopic floating plants if aquiculture is not adequately maintained [4].

Natural events: Floods and the natural flow of rivers and streams can also sweep extra nutrients from the land into the water systems, causing algal blooms to flourish excessively. Furthermore, as lakes age, sediments as well as phosphorus and nitrogen fertilisers accumulate naturally, contributing to the explosive growth of phytoplankton and cyanobacterial blooms.

Consequences

The most visible result of cultural eutrophication is the formation of dense blooms of toxic, foul-smelling phytoplankton, which impair water clarity and quality. Algal blooms reduce light penetration, limiting plant development and triggering plant die-offs in littoral zones, as well as diminishing the success of predators that require light to pursue and catch prey. Furthermore, eutrophication's high rates of photosynthesis can deplete dissolved inorganic carbon and elevate pH to dangerously high levels throughout the day. By diminishing chemosensory skills, elevated pH can 'blind' organisms that rely on sense of dissolved chemical cues for survival. When these dense algal blooms die, microbial breakdown depletes dissolved oxygen, resulting in a hypoxic or anoxic "dead zone" where most species are unable to survive. During the summer, dead zones can be seen in many freshwater lakes, including the Laurentian Great Lakes. Hypoxic events are also more common in marine coastal habitats near big, nutrient-rich rivers (e.g., the Mississippi River and the Gulf of Mexico; the Susquehanna River and the Chesapeake Bay) and have been proven to influence approximately 245,000 square kilometres in over 400 near-shore systems. Eutrophication-induced hypoxia and anoxia continue to pose a danger to profitable commercial and recreational fisheries around the world [5].

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