A STUDY ON "EUTROPHICATION AND NEED OF TAKING MEASURES TO PROTECT AOUATIC LIFE"

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INTRODUCTION

Definition: - The process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen. Eutrophication, which comes from the Greek eutrophos, "well-nourished", has become a major environmental problem. Nitrates and phosphates, especially from lawn fertilizers, run off the land into rivers and lakes, promoting the growth of algae and other plant life, which take oxygen from the water, causing the death of fish and mollusks. Cow manure, agricultural fertilizer, detergents, and human waste are often to blame as well. In the 1960s and '70s, the eutrophication of Lake Erie advanced so extremely that it became known as the "dead lake". And many areas of the oceans worldwide—some more than 20,000 square miles in extent—have become "dead zones", where almost no life of any kind exists.

Aim : A study on Eutrophication and need of taking measures to protect aquatic life.

Objectives:

1. To understand what is Eutrophication.
2. To study the effect of Eutrophication on environment.
3. To explore the solutions to reduce the effects of Eutrophication.

REVIEW OF LITERATURE

What is Eutrophication?

Eutrophication, which comes from the Greek eutrophos, "well-nourished", has become a major environmental problem. Nitrates and phosphates, especially from lawn fertilizers, run off the land into rivers and lakes, promoting the growth of algae and other plant life, which take oxygen from the water, causing the death of fish and mollusks. Cow manure, agricultural fertilizer, detergents, and human waste are often to blame as well. In the 1960s and '70s, the eutrophication of Lake Erie advanced so extremely that it became known as the "dead lake". And many areas of the oceans worldwide—some more than 20,000 square miles in extent—have become "dead zones", where almost no life of any kind exists.

Mechanism of Eutrophication: -

Eutrophication arises from the oversupply of nutrients, which leads to overgrowth 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 Encyclopaedia, "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. However, numerous literature report that nitrogen is the primary limiting nutrient for the accumulation of algal biomass

The sources of these excess phosphates are phosphates in detergent, 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

Terrestrial ecosystems.

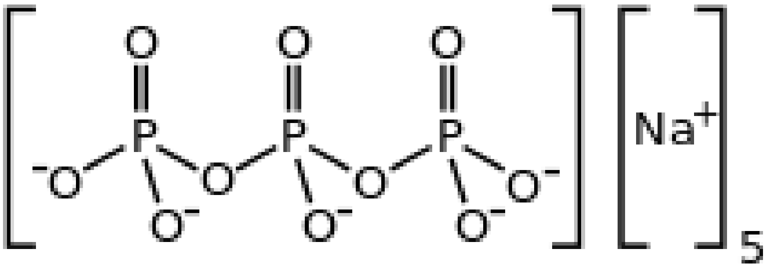
Terrestrial ecosystems are subject to similarly adverse impacts from eutrophication. Increased nitrates in soil are frequently undesirable for plants. Many terrestrial plant species are endangered as a result of soil eutrophication, such as the majority of orchid species in Europe. Meadows, forests, 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 reed grass species.

Forest undergrowth 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 N2, a gaseous form of nitrogen, is very stable and unavailable directly to higher plants. Terrestrial ecosystems rely on microbial nitrogen fixation to convert N2 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 phosphorus is 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.

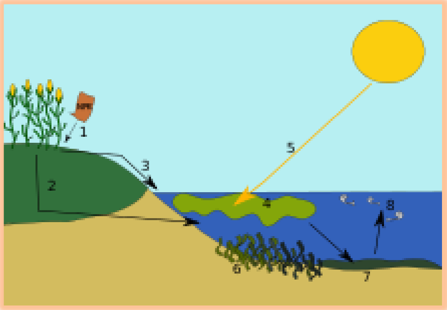
Cultural Eutrophication

Main article: Cultural eutrophication



Sodium triphosphate, once a component of many detergents, was a major contributor to eutrophication.

Cultural eutrophication is the process that speeds up natural eutrophication because of human activity. Due to clearing of land and building of towns and cities, land runoff is accelerated and more nutrients such as phosphates and nitrate are supplied to lakes and rivers, and then to coastal estuaries and bays. Extra nutrients are also supplied by treatment plants, golf courses, fertilizers, farms (including fish farms), as well as untreated sewage in many countries.



Excess nutrients are applied to the soil. 2. Some nutrients leach into the soil where they can remain for years. Eventually, they get drained into the water body. 3. Some nutrients run off over the ground into the body of water. 4. The excess nutrients cause an algal bloom. 5. The algal bloom blocks the light of the sun from reaching the bottom of the water body. 6. The plants beneath the algal bloom die because they cannot get sunlight to photosynthesize. 7. Eventually, the algal bloom dies and sinks to the bottom of the lake. Bacteria begins to decompose the remains, using up oxygen for respiration. 8. The decomposition causes the water to become depleted of oxygen. Larger life forms, such as fish, suffocate to death. This body of water can no longer support life.

Point sources

Nutrient pollution released to freshwater and coastal areas comes from many diverse sources including agriculture, aquaculture, septic tanks, urban wastewater, urban stormwater runoff, industry, and fossil fuel combustion. Nutrients enter aquatic ecosystems via the air, surface water, or groundwater

Nonpoint source

Point sources include discharges from industry and domestic wastewater treatment plants as well as agricultural point sources such as confined livestock units. ... Non-point sources of silt, organic matter and nutrients are often the largest cause of eutrophication around the world, primarily from agricultural activities.

Research Methodology :

During the formation process of water eutrophication, the water temperature (WT), illumination, total nitrogen, and total phosphorus have the greatest impacts on algae growth and reproduction. Accordingly, an experiment is designed to analyze these four factors, using an orthogonal approach to examine the degree of influence in the overall process of algae growth and reproduction and find the key factors that determine the input variables for evaluating water eutrophication.

Collection and Preparation of Water Samples

Experimental water samples were taken from Yuyuantan for the determination of total nitrogen and total phosphorus. After pretreatment and placing the water in a light incubator 20°C, at a light intensity of 6000 lx and a light dark ratio of 12 h : 12 h, the nitrogen was 1.445 mg/L and the phosphorus was 0.2 mg/L. Algae growth status and the cell density of algae were observed daily by microscope, and, when the algae cell density reached 106 cell/L, it could be used as the experimental algae (each group taken from the water samples).

Measurement of Chl_a

The experiment uses the M11 culture medium as a basis for media with a series of concentration gradients of nitrogen and phosphorus [24]. Calculating based on the algal cells' initial density of 105 cell/L, take a certain volume of algae species liquid to preculture in a 3500 r/min centrifuge for 5 minutes and then remove the supernatant and apply sterile water several times to remove the surface-adsorbed nitrogen and phosphorus. Then, centrifuge again, remove the supernatant, and repeat three times. Next, transfer the treated algae into the prepared culture medium and place in the light incubator. The orthogonal experiment conditions of each group are controlled according to Table 2, the light dark ratio is 12 h : 12 h, and the sterile water is supplied quantitatively twice daily [25]. The concentration of chlorophyll a is measured 2 times per day at 9 pm and 3 pm. In the experiment, the chlorophyll a concentration is measured using a YSI 6600 multifunction water quality on-line measuring instrument.

Design of Orthogonal Experiment

After preculture and preservation of the algae species, each factor level is chosen according to the numerical water quality of the urban rivers and lakes of the Beijing water system in recent years, and we select and design a set of L9 (34) experiments including four factors and three levels, as shown in Table 1.

Table 1: Factor level table for orthogonal experiment.

Table 2: Orthogonal experiment condition table for each group.

Based on the nine experimental plans in the orthogonal factor level table L9 (34), the experiment results are shown in Table 2.

Table 1: Factor level table for orthogonal experiment.

Number	Light intensity (lx)	Water temperature (°C)	TN (mg/L)	TP (mg/L)
1	6000	20	0.5	0.05
2	12000	28	2	0.1
3	18000	35	4	0.2

Table 2: Orthogonal experiment condition table for each group.

Number	Light intensity (lx)	Water temperature (°C)	TN (mg/L)	TP (mg/L)
1	6000	20	0.5	0.05
2	6000	28	2	0.2
3	6000	35	4	0.1
4	12000	20	2	0.1
5	12000	28	4	0.05
6	12000	35	0.5	0.2
7	18000	20	4	0.2
8	18000	28	0.5	0.1
9	18000	35	2	0.05

RESEARCH METHODOLOGY

The research is exploratory in nature; it focuses on Literature review, News Papers, Journals, websites and the other reliable sources.

DATA COLLECTION

Primary data: The primary data was collected from different pod of the agents of India.

Secondary data: Secondary data was collected by different websites.

DATA ANALYSIS

The researcher took the primary data and further analyzed that the process of euthrophication is extremely harmful and not only it can affect the fertility of the land but it can ruin the aquatic life as well. The analysis revealed that this process of euthrophication can controlled in a big way.

SUMMARY AND CONCLUSION

The water eutrophication process is a complex mechanism involving many factors. To determine main factors, an orthogonal experiment was designed to analyze the key roles of illumination. Water temperature, total phosphorus, and total nitrogen in water eutrophication can all have large effect on algae growth by analyzing range value. These factors are determined as main factor. Moreover, we analyze the monitoring data of water quality to further determine main factors. By utilizing principal component analysis, we can extract the larger contribution of the principal components to the water eutrophication. Its results ultimately confirm the eutrophication evaluation indexes including chlorophyll a, total phosphorus, total nitrogen, COD, and transparency. Finally, in view of the uncertainty in the process of evaluation, the application of Bayesian theory in eutrophication assessment was examined. Compared with single factor evaluation method, comprehensive evaluation method, and expert opinion, Bayesian method was found to offer higher accuracy of 96% in eutrophication assessment.

SUGGESTION AND RECOMMENDATIONS

Eutrophication poses a problem not only to ecosystems, but to humans as well. Reducing eutrophication should be a key concern when considering future policy, and a sustainable solution for everyone, including farmers and ranchers, seems feasible. While eutrophication does pose problems, humans should be aware that natural runoff (which causes algal blooms in the wild) is common in ecosystems and should thus not reverse nutrient concentrations beyond normal levels. Cleanup measures have been mostly, but not completely, successful. Finnish phosphorus removal measures started in the mid-1970s and have targeted rivers and lakes polluted by industrial and municipal discharges. These efforts have had a 90% removal efficiency.[40] Still, some targeted point sources did not show a decrease in runoff despite reduction efforts.

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