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Q. Define Eutrophication. What are the regsons of Algae bloom. Also explain the difference between natural and cultural Eutrophication? Discuss the methods of combating Eutrophication?

1) **Eutrophication (Introduction)**

"Man is a complex being; he makes deserts bloom and lakes die"

~ (Gil Stem)

Eutrophication is defined as an increase in the rate of supply of organic matter in an ecosystem. It is a phenomena caused by the abnormal growth of algae in a water body. As the algae die and decompose high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication that is caused by the normal proces of nature not interfered by human activities is termed as natural Eutrophication. Cultural Eutrophication is the alteration of nutrient inputs to water basins by human activities. By controlling the growth of algae through harvesting and

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limiting the amount of nutrients entering the lake have been recommended to slow down the Eutrophication process.

2) Steps of Eutrophication

Nutrients loadup → Plants flourish → Algae blooms → Depletion of oxygen → Decomposition → Death of the ecosystem.

Excessive nutrients from fertilizers are flushed from the land into rivers or lakes by rainwater. These pollutants cause aquatic plant growth of algae, duckweed and other plants. Algae blooms prevent sunlight reaching other plants. The plants die and oxygen in the water is depleted. Dead plants are broken down by bacterial decomposers, using up even more oxygen in the water. Oxygen levels reach a point where no life is possible. Fish and other organisms die.

3) Causes of harmful Algal outbreaks

Cyanobacteria commonly live in freshwater and are an important part of aquatic life. However excessive

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growth of these bacteria can release cyanotoxins; resulting in harmful Algal blooms, which cause damage to fresh water ecosystems, harm wildlife, livestock and pets, and threaten public health and drinking water supplies.

Causes

Environmental condition

- Abundant light
- High pH levels
- High temperature
- Excess nutrients
- Stagnant water

Climate Change

- Increase in water
- Increase in flooding
- Increase in salinity
- Increased amount of CO_2
- Sea level Rise
- Coastal upswelling

Sources of excess nutrients

Agriculture

- Fertilizers (N and P) and animal waste

Industry

- Chemical discharge and waste

Urban life

- Sewage and waste run off

Difference between Natural and cultural Eutrophication

Natural Eutrophication refers to the gradual nutrient enrichment of water bodies through natural process, while cultural Eutrophication arises

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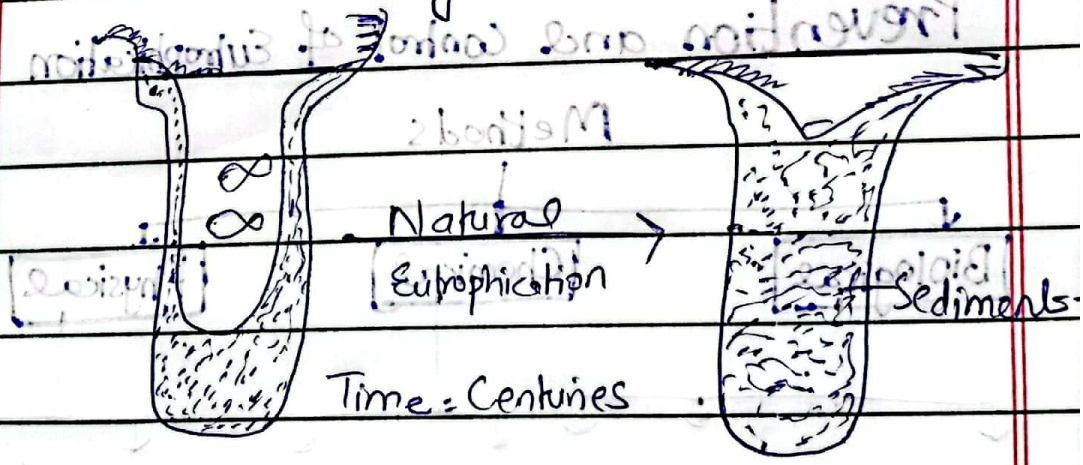
from human actions that introduce the excessive amount of nutrients.

- **Natural Eutrophication.**

It happens when a body of water becomes more nutrient-rich over time due to natural causes, like runoff from surrounding land, atmospheric deposition and decomposition of plant matter. This process takes centuries for its manifestation; however, human activities can expedite this process, leading to severe environmental issues like decreased oxygen levels, altered water chemistry and reduced biodiversity.



- **Cultural Eutrophication:**

Cultural Eutrophication is the overgrowth of algae and other aquatic plants caused by the introduction of excess

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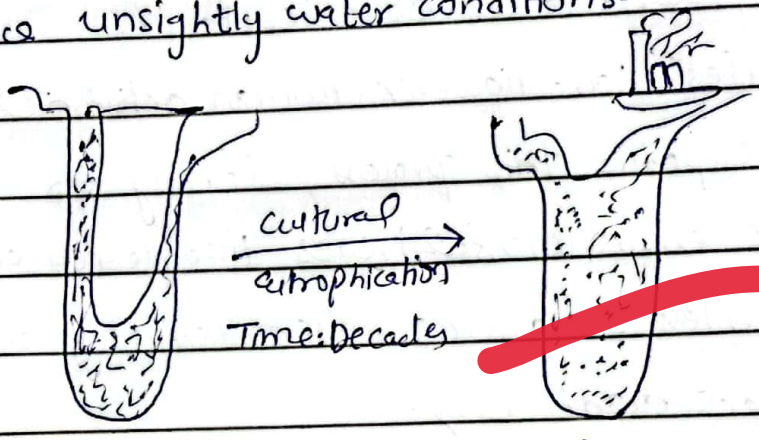
nutrients, primarly nitrogen and phosphorus into water body. This is primarily caused by human activities such as agriculture → wastewater discharge, industrial processes, and land use charges. When the excess nutrients enter a water body, they stimulate the growth of algae and plants, which can lead to oxygen depletion, fish kills and unsightly water conditions.



Prevention and Control of Eutrophication

Methods

- **Biological**
  - Bioaugmentation
  - Biomanipulation
  - Oyster reef restoration
- **Chemical**
  - Carbon based compound
  - Nitrogen reducing agents
- **Physical**
  - Dredging
  - Nutrient reduction technologies

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1) **Biological methods:**

There are several biological methods that can be used to prevent eutrophication by reducing the number of nutrients available to algae and other aquatic plants, improving water quality and restoring natural ecosystem.

a **Bioaugmentation:**

It involves adding microorganisms such as bacteria, fungi, algae and aquatic plants to the water, enhancing its natural ability to remove excess nutrients.

b. **Biomanipulation:**

It involves manipulating the species composition of an aquatic ecosystem to decrease nutrient levels. This can include introducing or increasing population of certain fish species that consume excess algae and reducing populations of other species that contribute to nutrient input, ultimately preventing the Eutrophication by altering the ecosystem

Species composition-

a) Oyster reef restoration

Oyster reefs act as natural filters removing nitrogen and phosphorus from water while also providing habitats for marine species, which enhances biodiversity and ecosystem health. Oyster reef restoration involves the placement of oyster shells or other materials in areas where populations have declined. This provides a substrate for larvae to settle and grow, ultimately facilitating the re-establishment of oyster populations.

2) Chemical Methods:

Chemical methods can be used to prevent or mitigate eutrophication, but they are typically not a first choice due to their potential environmental impact. However, some of the eco-friendly methods are listed below:

a- Carbon-based compounds

Carbon-based compounds can be used for the prevention of eutrophication through

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a process called carbon sequestration. Similarly, carbon-based compounds such as biochar, compost, and manure can be added to soil to increase its carbon content, which can help to reduce nutrient runoff and prevent the eutrophication of nearby waterways.

b. Nitrogen reducing agents

To prevent Eutrophication, nitrogen reducing agents can be used, including biological agents such as certain bacteria, such as Nitrosomonas and Nitrobacter, ... which can convert ammonia to nitrite and nitrite to nitrate, respectively. These bacteria can be added to wastewater treatment systems to help reduce nitrogen levels.

3) Physical Methods:

There are several Physical methods that can be used for the prevention of Eutrophication.

a. Nitrogen reduction technologies:

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1. **Nutrient reduction technologies:**

These are methods used to reduce nutrient levels in water bodies to prevent eutrophication. Bioreactors use denitrifying bacteria to convert nitrate to nitrogen gas, while constructed wetlands and sedimentation tanks remove the nutrients through vegetation and sediment settling. Nutrient scrubbers use artificial light and algae to consume nutrients, while ozone treatment breaks down organic matter. These technologies can be used individually or in combination to effectively manage nutrient levels and improve water quality.

2. **Dredging:**

Dredging is a process of removing sediment from water bodies to increase depth, remove pollutants, or create new land. Mechanical Dredging involves using excavators or bulldozers to physically remove the sediment, while hydraulic dredging uses high-pressure water jets to loosen the sediment

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while hydraulic dredging uses high pressure water jets to loosen the sediment and then pump it out. However, dredging is not always the most effective or appropriate solution for eutrophication prevention, and its use should be based on careful evaluation of circumstances and alternatives available.

Concise conclusion

Conclusion:

In summary, eutrophication is a significant environmental issue that can have severe impacts on aquatic ecosystems. While natural Eutrophication is a slow process that occurs over a long period, cultural Eutrophication is caused by human activities and can have a rapid and significant impact on water quality. However, there are several methods available to combat Eutrophication, and with continued efforts to reduce nutrient inputs and improve sewage treatment.

Good!
Focus on presentation
You understood question well
You have got potential. Good luck!

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