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A REVIEW OF EUTROPHICATION

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INTRODUCTION

Eutrophication is a natural process, derived from the Greek word 'eutrophos' meaning well nourished or enriched. This enrichment leads to other slow processes referred to as natural ageing of lakes (Fig.1). Weber C. H. described eutrophication as nutrient rich conditions used to determine the flora of German peat bogs as eutrophe, mesotrophe and oligotrophe. Eutrophication escalates speedily, however when abnormally high amounts of nutrients from industrial and municipal waste, fertilizers, domestic discharge, detergents, animal wastes and sediments enter water streams.

Fig.1: Eutrophic water body ((Web source))

Eutrophication is characterized by increased aquatic plant and algal growth due to the excessive availability of nutrients and fertilizers. It is a chief cause of destruction of many freshwater as well as salt water ecosystems in the earth. It occurs naturally over centuries as lakes age and are filled in with sediments. However, human activities have accelerated the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients. Lakes are often classified according to their trophy or degree of enrichment with nutrients and organic matter. They are classified by their trophic state with the main classes of oligotrophic, mesotrophic, eutrophic, and dystrophic. A lake starts its lifecycle as oligotrophic i.e., a clear body of water. With the introduction of nutrients through land runoff and growth and decay of aquatic life, the lake collects a good amount of organic substances. Eventually, there is algal bloom when the lake becomes marsh or perish. It will then turn into dry land.

Eutrophication is the persistent environmental hazards in the aquatic ecosystems causes' distinct decline of the surface water quality and represents severe hazard to the biotic components of the aquatic body. Eutrophication and siltation have severely stressed many fringing and offshore reefs that prefer to grow in nutrient-poor waters, and cause physiological changes in growth and skeletal strength, decrease of reproductive effort, and a reduced ability to withstand disease.

Types of Eutrophication

1. Natural Eutrophication (Fig.2a) – The process of lake ageing characterized by nutrients enrichment is called natural eutrophication.
2. Cultural Eutrophication (Fig.2b) – this process is generally enhanced by human activities.

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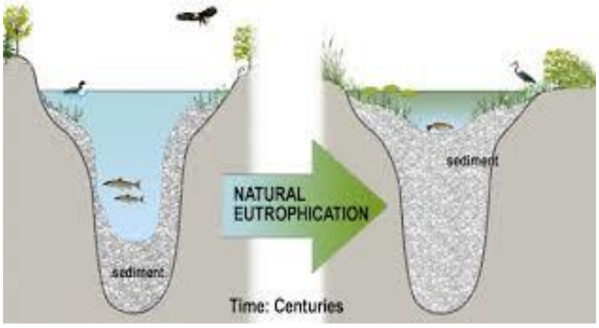

Fig. 2(a): Natural Eutrophication (Web source)

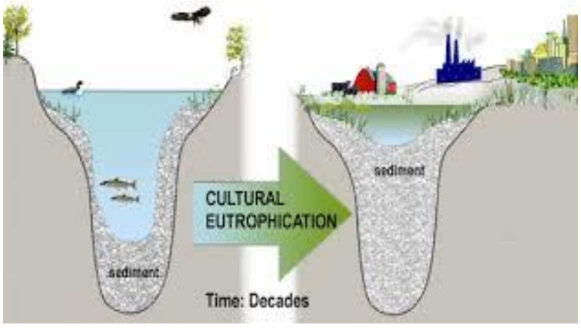

Fig. 2(b): Cultural Eutrophication (Web source)

CAUSES OF EUTROPHICATION

In recent years there has been an increased use of nutrients and fertilizers. Agricultural fertilizers generally contain one or more of the plant nutrients. Pollution problems can arise from excessive application rates. Plant nutrients, nitrogen and phosphorus stimulate the growth of algae and other aquatic plants. Excessive growth of these plants interferes with water uses as subsequent decay produces evil odours with a resultant increase in biochemical oxygen demand.

More plant available nutrients in the water imply increased algal growth. In the photosynthesis process, green plants need chlorophyll, sunlight, carbon dioxide, and nutrients in order to produce oxygen and biomass. The most important nutrients are nitrogen, phosphorus, and silicate, but micro-nutrients like potassium, sulfur, iron, and molybdenum are also needed. The deeper down the sunlight can penetrate the water, the deeper algae can grow. Green plants need chlorophyll to bind energy from the sunlight. By measuring the concentration of chlorophyll in water the quantity of microscopic algae can be determined in the water in winter, before the spring bloom (Finnish Institute of Marine Research, 2002).

The main causes of eutrophication is the large input of nutrients to a water body, and the main effect is the imbalance in the food web that results in high levels of phytoplankton microalgae, with a silicon skeleton (diatom) biomass in stratified water bodies which can lead to algal blooms. In addition to carbon, oxygen, and hydrogen that plants can find directly in the water and carbon dioxide in the atmosphere, two major nutrients are necessary for the development of aquatic life, namely nitrogen (N) and phosphorus (P). A third one, namely silicate is necessary for the development of diatoms. During eutrophication, the concentrations of nutrients in the water change. In some cases one out of the three nutrients may be totally bound to the aquatic life and will not be available for further growth of algae. Besides nutrient inputs, some physical conditions support eutrophication development. Thermal stratification of water bodies (such as lakes and reservoirs), temperature, and light influence the development of aquatic algae. Increased light and temperature condition during springs and summer explain why eutrophication is a phenomenon that occurs mainly during these seasons. Eutrophication itself affects the penetration of light through the water body because of the shadow effect coming from algae and other living organisms and this reduces photosynthesis in deep water layers (WHO 2002).

CONSEQUENCES OF EUTROPHICATION

The effects of eutrophication on the environment may have deleterious consequences on the health of exposed animal and human population through various pathways (WHO 2002). The following are the impacts of eutrophication.

- Increase in production and biomass of phytoplankton, attached algae and macrophytes.
- Shift in habitat characteristic due to changes in assemblage of aquatic plants
- Replacement of desirable fish by less desirable species
- Production of toxins by certain algae: Some algal
- Deoxygenating of water, especially after collapse of algal blooms, usually resulting in fish kills
- Infilling and clogging of irrigation canals with aquatic weeds
- Loss of recreational use of water

- Violations of water quality standards
- Water clarity or water transparency
- Impediments to navigation due to dense weed growth.
- Economic loss due to change in fish species, fish kills, and shellfish.
- The most conspicuous effect of cultural eutrophication is the creation of dense blooms of noxious, foul-smelling phytoplankton that reduce water clarity and harm water quality.
- Degradation of water quality
- Destruction of economically important fisheries
- Public health risks

CONTROLS OF EUTROPHICATION

Given the far reaching degree of water quality debasement related with supplement enhancement, eutrophication has and keeps on representing a genuine risk to consumable drinking water sources, fisheries and recreational water bodies. Water asset directors routinely utilize an assortment of techniques to limit the impacts of cultural eutrophication, such as Diversion of abundance or excess nutrients, Altering nutrients proportions or ratios, Physical blending or mixing, Shading water bodies with hazy or opaque liners or water-based stains and Application of potent or strong algaecides and herbicides. Another option for improving water quality in supplement rich lakes has been biomanipulation - the adjustment of a nourishment web to reestablish biological system wellbeing.

When all is said in done, these techniques have demonstrated to be ineffectual, expensive, or potentially illogical, particularly for huge, complex biological systems. Water quality can frequently be improved by diminishing nitrogen or potentially phosphorus contributions to sea-going frameworks, and there are a few notable models where base up control of supplements has extraordinarily improved water clearness. Nonetheless, supplement decrease can be troublesome (and costly) to control, particularly in farming zones where the algal supplements originate from nonpoint sources.

Several technical devices along with prevention of further in flow of effluents have been used to control eutrophication. For examples -

- The waste water must be treated before its discharge into water streams to limit the nutrient value
- Recycling of nutrients can be checked through harvest.
- Eutrophication can be minimized by removing nitrogen and phosphorus at the source, division of nutrient rich waters from the receiving bodies and dilation of the elements.
- Algal blooms should be removed upon their death and decomposition.
- Algal food web should be disrupted to stimulate bacterial multiplication.
- Physic-chemical methods can be adopted to remove dissolved nutrients.

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