



EUTROPHICATION PROCESS AND WATER QUALITY INDICES

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Abstract:

The paper recent by indices of water quality and effects of eutrophication, Water is one of the most widely distributed substances across the world's surface and is crucial for a variety of aspects of human health, development and well-being as well as for the functioning of natural ecosystems. Eutrophication is an environmental process enrichment of waters by inorganic nutrients, especially these nutrients are nitrogen and phosphors and results from primary productions. On the other hand, Pollution by eutrophication due to the problems in lakes, rivers and marine habitat. Water quality is important for our health and well-being, can be used for diffident purposes.

Keywords: Water Quality; Pollution; Eutrophication; Lake; Phosphors; Nitrogen.

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1. Introduction

Water quality refers to the chemical, physical, biological, and radiological characteristics of water [1]. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose [2]. Fresh water is a very valuable resource, and getting more valuable every day. Each day, our limit water supplies have to be shared by a larger population. Humans need at least about fifty liters of water a day to stay healthy (e.g. for drinking, cooking, sanitation, washing). With increasing populations and increasing technological growth, the ecosystems we depend on are under greater stress. The Earth's supply of accessible fresh waters is especially at risk. One third of people in the developing world do not have access to safe drinking water [3]. Good water quality in lakes is essential for maintaining recreation and fisheries and for the provision of municipal drinking water. These uses are clearly in conflict with the degradation of water induced by agricultural use and by industrial and municipal waste disposal practices. The management of lake water quality is usually directed to the resolution of these conflicts. Nowhere in the world has lake management been a totally successful activity. However, much progress has been made particularly with respect to controllable point source discharges of waste. The more pervasive impacts of diffuse sources of pollution within the watershed, and from the atmosphere, are less manageable and are still the subject of intensive investigations in many parts of the world [4]. Pollution is an earnest and growing problem of the aquatic environment. Increasing numbers and amounts of industrial, agricultural and commercial chemicals discharged into the aquatic environment have led to various deleterious effects on aquatic organisms. Aquatic organisms,

including fish, accumulate pollutants directly from contaminated water and indirectly from contaminated water and indirectly via the food chain [5]. Eutrophication can be defined as the enrichment of waters by inorganic plant nutrients. These nutrients are especially nitrogen and phosphorus and result in an increase in primary production. Artificial or culture eutrophication results from an increase in nutrients due to human activities, Natural eutrophication results from an increase caused by non-human process, such as forest fire [6]. The management of lake water quality is usually directed to the resolution of these conflicts. Nowhere in the world has lake management been a totally successful activity. However, much progress has been made particularly with respect to controllable point source discharges of waste. The more pervasive impacts of diffuse sources of pollution within the watershed, and from the atmosphere, are less manageable and are still the subject of intensive investigations in many parts of the world [4].aim of the study is to collect baseline date of water quality indices and examine the formation process of eutrophication.

2. Water Quality Indices

A water quality (WQI) may be a single dimensionless number communicating the water quality in a basic form by aggregating the measurements of chosen parameters. A WQI has been proposed as early as in 1965, to characterize the state of water quality in a waterway (Horton 1965)[7].In common, water quality indices are categorized into four fundamental groups:**1. Public indices:** these indices disregard the kind of water consumption within the assessment process and utilized for common water quality, such as National Sanitation Foundation Water Quality Index (NSFWQI).**2. Specific consumption indices:** here, the classification of water is on the premise of the kind of utilization and application (drinking, industrial, ecosystem preservation, etc). The foremost imperative and applicable of these indices are the Oregon and British Columbia indices.**3. Designing or planning indices:** This category is an instrument, aiding decision making and planning in water quality management projects. **4. Statistical indices:** In these indices statistical methods are used and personal opinions are not considered. Statistical approaches are used here for evaluating the data. Validation from a statistical point of view in regard to certain assumptions of water quality observations is another essential part in statistical approach. First three indices are also called as expert opinion (EO) approach. The EO approach is a subjective approach due to the different weights for the same variables given by various panels of experts. Chances in lessening objectivity and comparability are still present in the different ratings given by the experts. So, many alternative indexes were developed. However, the subjectivity assumptions in developing the indices can be reduced by using statistical approaches. The statistical approaches can also be used to identify important parameters in determining the quality of a water body as well as the extent of their significance [8].

2.1. Different Types of Water Quality Index:

1. National Sanitation Foundation Water Quality Index (NSFWQI).2. Oregon Water Quality Index (OWQI).3British Columbia Water Quality Index (BCWQI).4. Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI)[9].

Table 1: water quality values as per different water quality indices

National Sanitation Foundation Water Quality Index (NSFWQI)	
WQI Value	Rating of Water Quality
91-100	Excellent water quality
71-90	Good water quality
51-70	Medium water quality
26-50	Bad water quality
0-25	Very bad water quality
Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI)	
95-100	Excellent water quality
80-94	Good water quality
60-79	Fair water quality
45-59	Marginal water quality
0-44	Poor water quality
Oregon Water Quality Index (OWQI)	
90-100	Excellent water quality
85-89	Good water quality
80-84	Fair water quality
60-79	Poor water quality
0-59	Very poor water quality

2.2. Water Quality Indices Can Be Utilized For The Following Purposes

To supply an overall status of water quality to the water authorities and the more extensive community b) To consider impacts of administrative approaches and natural programs on natural quality To compare the water quality of diverse sources and locales, without making exceedingly specialized appraisal of the water quality information. d) To help arrangement creators and the open to dodge subjective appraisals and ensuing one-sided suppositions[7].

3. Pollution

Freshwater ecosystems are contaminated by a variety of human activities, from large-scale agribusiness and industry to everyday behaviors, such as driving cars and fertilizing gardens. Large amounts of contamination regularly enter freshwater systems from point sources, such as mechanical or municipal sewage outflows; for illustration, 23.4 billion tons of sewage and mechanical squander was dumped into the Yangtze Stream in 2001, undermining human wellbeing and the survival of the imperiled Yangtze Waterway dolphin [10].

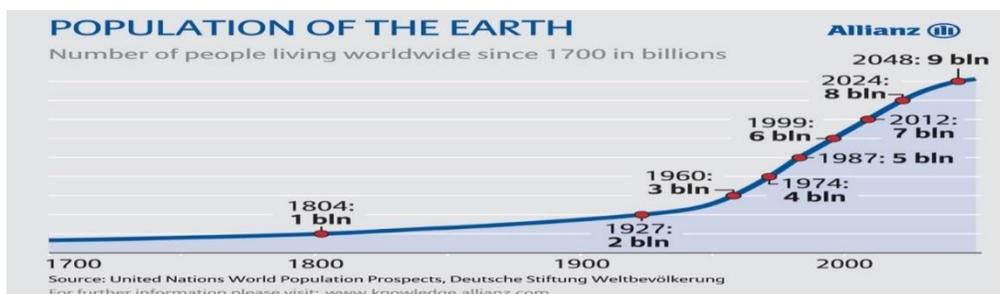


Figure 1: population of the earth in years (United Nations,2008)

3.1. Types of Pollutants

3.1.1. Organic Matter/ Residues

Organic matter maybe to the large pool of carbon-based compounds found within natural and engineered, terrestrial and aquatic environments on the other hand it is matter composed of organic compounds that has come from the remains of organisms such as plants and animals and their waste products in the environment [11].

3.1.2. Heavy Metals

It is naturally occurring element having a high atomic weight and high density which is five times greater than that of water, heavy metals are usually present in trace amounts in natural waters but many of them are toxic even at very low concentrations. Metals such as arsenic, lead, cadmium, nickel, mercury, chromium, cobalt, zinc and selenium are highly toxic even in minor quantity. Increasing quantity of heavy metals in our resources is currently an area of greater concern; especially since a large number of industries are discharging their metal containing effluents into fresh water without any adequate treatment Heavy metals can emanate from both natural and anthropogenic processes and end up in different environmental compartments (soil, water, air and their interface [12].3.1.3. PESTICIDES and 3.1.4. Oil spills and 3.1.5. radioactive substances.

Table 2: Some contaminate characteristic and recommend level (EPA, 2002)

Contaminant/characteristic	Recommended level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 color units
Copper	1 mg/L
Corrosivity	Non-corrosive
Fluoride	2 mg/L
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5 to 8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total dissolved solids	500 mg/L
Zinc	5 mg/L

Source: U.S. Environmental Protection Agency, www.epa.gov.

4. Trophic States of Lakes

Lakes are often classified as oligotrophic, mesotrophic, or eutrophic, depending mainly on their productivity and amount of organic matter produced also we can explain Oligotrophic Lakes by general characteristic: 1- Clear water, low productivity 2- Very desirable fishery of large game fish rich in DO, low plant (phytoplankton) biomass, low concentration of nitrogen, phosphorus, algal groups etc. (Fig. 2). Mesotrophic Lakes: • Increased production, accumulated organic matter, occasional algal bloom, Good fishery (Fig. 2). Eutrophic Lakes: Very productive, May experience oxygen depletion, Rough fish common (Fig. 2)[13].

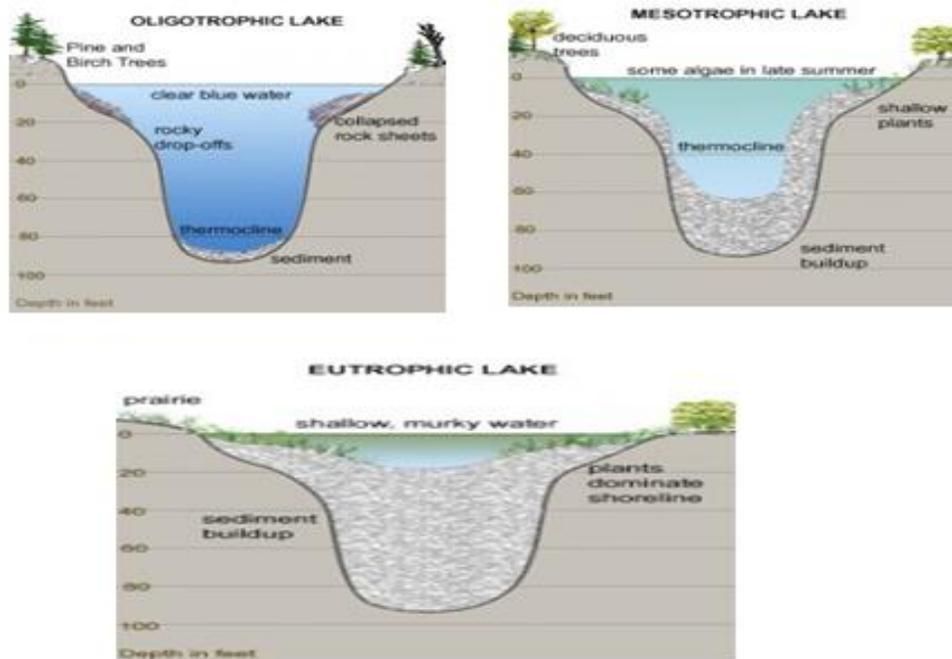


Figure 2: trophic states of lakes

5. Eutrophication

Eutrophication is the process of excessive nutrient enrichment of waters that typically results in problems associated with, algal or cyanobacteria growth[14]. Man-made sources causing eutrophication can be divided into two types: -Point Source contamination (Fig.3) comes from a single and defined source, such as industrial waste water ,waste water treatment plant ,discharge of municipal waste water, and among the point source loadings the largest loading is domestic wastewater which contain 33% COD , 34% nitrogen and 45% phosphorus because of large amount of detergent in their content . A Non-Point Source (Fig.4) comes from a wide variety and undefined sources such as: - Agricultural runoff and animal wastes Urban and suburban runoff, atmospheric deposition, forestry and mining operation, marinas and boating activities and coastal wastes [15].



Figure 3: Point source pollution.

Urban and suburban runoff



Figure 4: Non-point sources

5.1. Eutrophication Process

Basically, over-fertilization of water causes algae to grow on the surface. When fertilizer enters into the water, this becomes food for algae. From here, algae reproduce and cause a thick green bloom in the water. Because algae absorb sunlight, it prevents it from reaching the bottom. When algae grow to such an extreme level, it entirely stops light reaching plants in the water. Ventrally, plants that need sunlight cannot photosynthesize and die (Figure 5) [16].

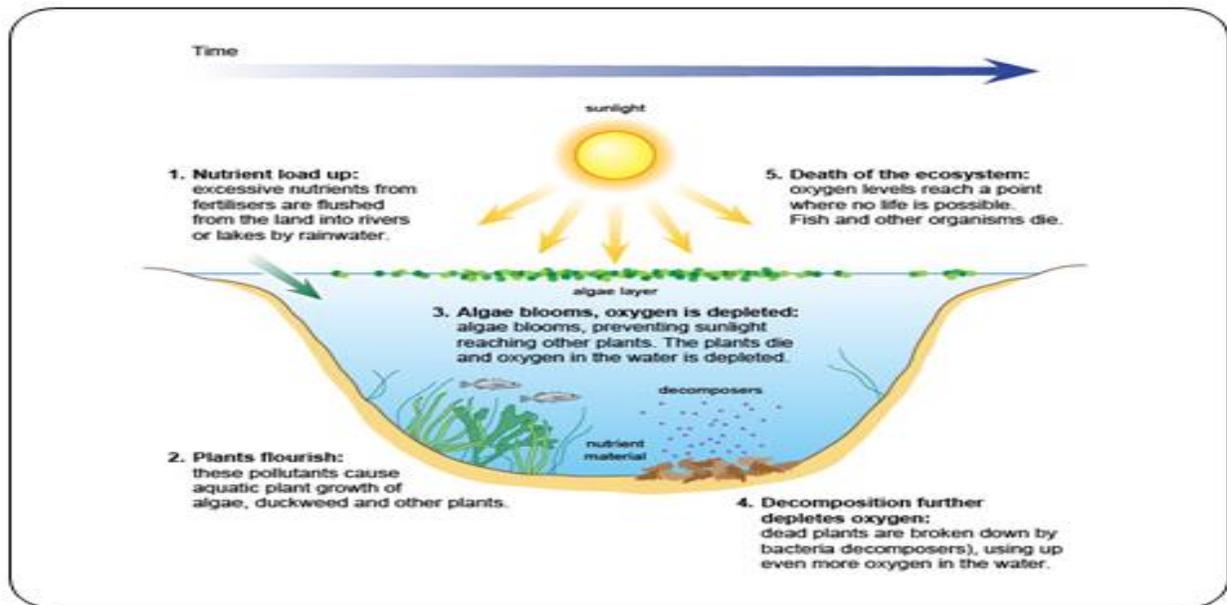


Figure 5: Eutrophication process.

5.2. The Main Effects Caused By Eutrophication Can Be Summarized As Follows:-

The main effects caused by eutrophication in lakes can be summarized as follows; 1. Species diversity decreases and the dominant biota changes. 2. Plant and animal biomass increase. 3. Turbidity increases. 4. Rate of sedimentation increases, shortening the lifespan of the lake. 5. Anoxic conditions may develop. 6. Reduces the recreational value of lakes, particularly for swimming and boating [6].

5.3. Solutions

Limiting use of fertilizer in agriculture by following way, 1-Start a compost pile and recycle yard waste 2-Maintain your septic system 3-Algae filtration by skimming surface algae4- Ultrasonic filtration5-Control runoff and soil erosion by tree planting. The chemical Treatment: Aluminum sulfate (alum) $[Al_2(SO_4)_3]$ when added to lake water removes phosphates through precipitation. But it is expensive way and causing increase of sludge volume by 40%.The Biological Treatment: Biological phosphorous removal uses the ability of some microorganisms (algae) to take up phosphorous and store it within the cells in the form of polyphosphates Wastewater operators prefer Biological phosphorus removal because it has lowest costs and reduces the problem of eutrophication [17].

6. Conclusions and Recommendations

1-Study of water quality indices about various water bodies can be use water for diffident purposes.2-Eutrophication is due to the pollution in lakes, river and marine habitat.3. Decreasing the amount of the domestic and industrial sewage discharges directly into.4. Establish a wastewater treatment plant to remediate the sewage discharges before enter the Lake inlets to mitigate the load of pollutants in the lake.5. More attention must be pay, to nations and farmers living in Lake Watershed, in quantity and quality of fertilizer they use for agriculture.6. Establish of a modern meteorological station in Lake and its tributaries and connect remotely to the station, daily physical and chemical properties of water especially bottom layer must be obtained during the summer and autumn season.5.Maintenance of distribution system of water quality and methods must be planned [18].

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