

Managing Eutrophication in Nigeria Inland Waters

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ABSTRACT

Recently in Nigeria, cultural eutrophication is on the increase in water bodies. Observations from land use around riverine areas are predominantly for farmland and explain the high level of phosphate from runoff during the rainy season. Increased siltation, deforestation, flooding, lumbering activities and other land use perturbation are among the causes of eutrophication. Aquatic animals usually suffer hypoxia and anoxia and the anesthetic quality of water for recreational activities, like swimming, boating and picnic is reduced. The Federal Ministry of environment (FMENV) and River Basin Authority of Nigeria should ensure that all those involved in effluent discharge into water bodies follow the established frame work and existing guidelines. Point source and non-point sources of pollution should be monitored and the adoption of mathematic model which describes the overall nutrient runoff and the catchment model suitable for describing the overall transport of water and nutrient through the river basin should be encouraged as practiced in Poland.

Keywords: Eutrophication; Nigeria Waters; Pollution; Mathematical Model; Nutrient Management

1. Introduction

Eutrophication is a natural process whereby lakes, estuaries and slow-moving streams receive excess nutrients as a consequence of weathery of rocks and soil from the surrounding water shed [1]. The increased nutrient (nitrogen and phosphorus) leads to an increased growth of aquatic plants and organic production of the water body. [2] states that it takes thousands of years on the time scale for a water body (Oligotrophic) to turn into eutrophic water body through a natural process based on the nature of entrusted minerals and the rate of watershed weathering [1]. Although there is no single definition of eutrophication, certain parameters have been considered. In defining such phenomenon, [3] used phosphorus concentration, while [4] used the relationship between mineralized and production. Eutrophication is a threat to the water quality of rivers, lakes and reservoirs, hence their classification into oligotrophic, mesotrophic and eutrophic based on level of eutrophication [5].

Recently in Nigeria eutrophication rates in water bodies have increased dramatically as a result of alterations in nutrient cycles related to land use (Anthropogenic activities). The increasing demand for food and food insecurity which has the increased use of fertilizers on farmland has

been pointed out as contributing over 80% of eutrophication of water bodies' worldwide.

Cases of observed eutrophication in waters are on the increase as a result of domestic and industrial discharges into surface water bodies which vary in nature and quality thereby contributing significantly to chemical, biological and physical pollution of these water bodies [6]. Eutrophication may result if sufficiently large amount of nutrients through wastes are added over a long period to surface waters [7]. At the same time, siltation resulting from blockage or basal river flow with erection of a barricade to mimic water fall for improved water flow may enhance nutrient accumulation in certain sections of the river creating a eutrophic environment [8].

Domestic, agricultural and industrial effluence and waste discharge into rivers is a reason for the high pollution of water in the state [9]. Murdoch *et al.* [10] argues that high level of phosphate and nitrate can lead to eutrophication, which increases algae growth and ultimately reduces dissolved oxygen levels in the water. Raw Sewage is the source of nitrogen and phosphate in rivers [11,12]. [9] observes that land use around riverine areas in Nigeria is predominantly for farmland and this could be explanation for the high level of phosphate from runoff during rainy season in Ibadan River. As a consequence of unprecedented development human beings are

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responsible for choking several lakes to death [9].

Rivers in Nigeria are important ecosystem as they serve as a main nutrient source for aquatic organisms, source of water to neighbouring communities for domestic and industrial purposes. Therefore the water quality is important in drinking water supply, irrigation, fish production, recreation and other purposes. Current practices of Nigeria living in the southern part of the country observed by concerned environment are regular dumping of dirt and waste material in large quantities into water bodies and flood which eventually carry them into rivers.

Water quality deterioration in water bodies in the country resulting from excessive nutrient inputs (Eutrophication) needs to be checked as a result of the effect of such phenomenon on the social economic function associated with water bodies.

2. Causes of Eutrophication in Nigeria

Gromec [13] states that the causes of eutrophication are related to meteorological and climatic status anthropogenic activities. The aquatic environment, where fish and other aquatic organisms live, is subjected to different types of pollutants which enter water bodies through industrial, domestic and agricultural discharge systems thereby introducing stress to living creatures. The discharge of industrial effluents into receiving water bodies in Nigeria invariably results in the presence of high concentrations of pollutant in the water and sediment [14]. The constant flow of agricultural effluent discharge into water bodies often leads to a variety of pollutant accumulation, which becomes apparent when considering toxic pollution [15].

Nwaze *et al.* [16] indicated that indiscriminate use of fertilizers around Nike lake in Enugu, Nigeria is the major source of pollution causing Cyanophycean blooms and ecological disaster. Stirin [17] pointed out that the time frame for natural eutrophication to occur is about 1000 - 10,000 years as against cultural eutrophication of less than 10 years caused by human activities. Since the population boom in Nigeria in the 80's the use of N.P.K fertilizer has increased and led to the treat observed in water bodies located close to these farmland. When washed as a result of erosion, flooding increased the nutrient load of these water bodies. Other anthropogenic activities that can cause eutrophication in water bodies include increased silt, deforestation, lumbering activities and other land use perturbation.

Ekhaise and Anyansi [18], reported high counts of bacterial population in Ikpoba River in Benin City Nigeria receive brewery industrial effluent. Similar results were reported by [14] of the effect of brewery discharge into Ezianya River, Aba, Nigeria. Val AL, Paula da., Silva MN and Almeida-Val V MF [1], pointed out regardless of the origin of eutrophication, its end result

usually led to change within the aquatic communities.

3. Effect of Eutrophication

Lundberg, [19] stated that eutrophication will cause hypoxia and anoxia in aquatic life as a result of sedimentation associated with primary production. Eutrophication is related to physical, chemical and biological disturbances, increased production of algae biomass, the decreasing amount of silica and increased turbidity of the water bodies [14], foul smell and will eventually lead to the death of the water bodies. Nitrogen and phosphorus are the major causes of eutrophication. Eutrophication affects aesthetics on lakes, rivers and results in odour and appearance problems [15]. It reduces the anesthetic quality of water for recreational activities, like swimming, boating, and picnic.

The presence of high algal biomass occurring from eutrophication of the shallow tropical African reservoirs will jeopardize the effective functions of the reservoir in providing domestic and industrial water supply, fish production, irrigation, recreation as well as loss of biodiversity and other socio-economic functions of the reservoir [20]. Loss of biodiversity and socio-economic functions of the reservoir, poor water quality, anoxia, low transparency and disruption in food web interactions is some of the effects of cultural eutrophication in these lakes.

3.1. Managing Nutrient and Water Quality

Although in Nigeria, the Federal Ministry of Environmental is saddled with the responsibility of providing guide line for managing effluent discharge into the environment. This body provides the frame work for every industry involved in the utilization of water resources and hence ensures the protection of water bodies across the country. The main objective is to ensure all those involved in discharging effluent into water meet the requirement in order to protect water use.

It is therefore of paramount interest for FMENV (NESERA) to work with the River Basin Authorities in order to combine effort in controlling pollution and the self guideline to be followed strictly. Following the water quality standard set by [21] (NESERA) it is of interest that company's effluent must be checked regularly to see if they conform to the existing standard and to check the effect of population growth on their production which in turn, increases the waste discharge into the environment. Nutrient management is important to assess the impact of human activities from known sources (Point Sources) and from diffuse sources and other human activities [13].

The established water quality Criteria by [21] after the illegal dumping of toxins in Koko Port in the then Bendel State: Nitrate (NO_3) 20 mg/l for surface water, Phosphorus (PO_4^{3-}) 5 mg/l for surface water and 10 mg/l for land

use. The standards were adopted for monitoring water quality based on the method for water and waste water analysis by United States Environmental Protection Agency (USEPA) Department of Environment (DOE) UK, American Public Health Association (APHA).

If the above criteria and requirement must be meant, the state of the art equipment must be acquired by the industries involved. Effluent must be properly treated to meet these standards as point source of population.

Controlling non-point source has always been difficult as the cause and effect cannot be directly documented. In recent past, non point sources of nutrient from agricultural practices have been analyzed with the aid of mathematical models, based on the presentation of reliable and correct data. In Poland, such model has been developed and can be used in the Nigeria context [22]. In line with the above statement, the total nitrogen and phosphorus were calculated using data collected from point source and subtracting it from the total, the applied mathematical model method an agricultural field model which described the over-all nutrient runoff from the root zone and agriculture practice. Again a catchments model is suitable for describing the overall transport of water and nutrients through the river basin including different nutrient and concentration in different water compartment and lastly a full hydrodynamic and water quality model system as developed for rivers, lakes and wetland areas, describes water flow, transport and transformation of organic material and nutrient.

3.2. Mathematical Model for Measuring Pollution/Pollution Index

Value of Nitrogen/Phosphorus of a water body from non-point source = Mean Total value (MT) of Nitrogen/Phosphorus of the water body-Value of Nitrogen/Phosphorus from point source of the same water body.

3.3. Recommendation

A comprehensive systematic survey of the eutrophication status of Nigerian waters should be undertaken and national framework for managing eutrophication should be defined with the key elements of which are:

- A two-pronged approach whereby measures to reduce nutrient inputs to the water environment nationally are complemented by more comprehensive, catchment-based management action, within the context of a national framework, for waters most at risk from or affected by eutrophication;
- The promotion of a partnership approach, at both local and national level, since solutions are generally beyond the remit of any one regulatory body or other party;
- The adoption of a range of mechanisms (regulatory, voluntary, collaborative, educational and economic) by

the Agency and others, as appropriate, in order to reduce nutrient inputs to environmental waters and manage local problems;

- The development and adoption of consistent methodologies for assessing eutrophication in a water body;
- A review of the arrangements for measuring the extent of eutrophication in the different types of environmental waters and the impacts of discharges and land use on water quality;
- The prioritization of waters for management action: initial priorities will be waters where there are statutory requirements, or where water uses are adversely affected, or where wildlife conservation interest is at risk, where benefits can be delivered or deterioration prevented, with adequate confidence, at reasonable cost;
- The adoption of interim targets for eutrophication control in freshwaters and the continuing application of specific statutory and/or international commitments in relation to saline waters by regulatory bodies;
- Trials of the proposed tools, techniques and procedures through pilot catchment-based action plans, to refine the approach and its potential wider adoption within the country;
- The promotion of a wider understanding of the nature and significance of aquatic eutrophication;
- A programme of research and development to improve understanding of the eutrophication process within Nigeria should be set up.

4. Conclusion

For the effective management of Nutrient load of water bodies in Nigeria, both point and non-point sources of pollution must be taken into recognition and controlled. Strict compliance to the combined guidelines by NESE-RE and River Basin Authority must be met without compromises. The Federal Government and the Ministry of Environment must set huge amount from the ecological funds for proper evaluating by hydrobiologist and toxicologist in the nation. Land use coupled with other anthropogenic activities near this water must be monitored and in some cases relocated always from these water bodies. The threat of water pollution to man's existence has informed the adaptation strategies aimed at its control and one of such strategies according to Imhoff [23] is the provision of information on the quality and quantities of contaminant in a water body.

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