RESEARCH ARTICLE

Estimation of nutrient load in a fresh water lake

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ABSTRACT

We live on a water dominated planet, surrounded inside and out with water. Water not a very complicated substance chemically, but its unique physical and chemical properties are responsible for the existence of life on this planet. The properties of water provide the frame work, parts and methods for interacting with living processes. Due to the open nature of the water bodies, a constant exchange of matter and energy goes on between the aquatic ecosystem and its surroundings, thus making water quality a dynamic factor. Lakes are the most important components of Global Water Cycle and have assumed greater significance in human survival. Anthropogenic activities add pollutants to the water body in the form of organic and inorganic waste which bring about eutrophication. An attempt has to be made to evaluate the problems having direct bearing on the limnological profile and to suggest measures to be undertaken to improve the status of the lake and conserve it for the future generations.

Key Words: Ecosystem, eutrophication, anthropogenic, pollutants, limnological profile.

INTRODUCTION

It is a well-established fact, since Vedic times that Nature and Human kind form an inseparable part of the life support system. Environment is the sum of physical, chemical and biological factors, which comprises the surrounding of man. However, man's need and greed to dominate, to exploit and to incorporate nature into its own infrastructure and to its own command is responsible for the current devastation of the environment, as a result of which the very survival of the planet is at risk. In recent years, environmental monitoring through regular assessment of water quality has become a crucial factor in the conservation of aquatic resources. There are a number of lakes but most of the water bodies are environmentally degraded or undergoing irreversible degradation. There is an urgent need to undertake remedial measures for the conservation of aquatic ecosystem. Increase in the phosphate and nitrate content is an indication of eutrophication. Human activities, run off from agriculture, pollution from septic systems and sewers increase the flux of both inorganic nutrients and organic substances into terrestrial, aquatic and coastal marine system (Sura *et al*., 2010). The effect of pollution on trophic and toxic level of water can be detected, estimated and quantified by physico-chemical methods (Warhate and Chavan, 2011).

MATERIALS AND METHODS

Total Phosphorus: Phosphates in water reacted with ammonium molybdate and formed a complex of heteropoly acid (molybdophosphoric acid), which got reduced to a complex of blue colour in the presence of $SnCl_2$. The absorption of light by this blue colour was measured at 690nm on a Spectrophotometer (Systronics). The concentration was calculated and expressed as mg/L.

***Nitrates*:** Nitrates react with phenoldisulphonic acid producing nitro derivatives, which in alkaline solution develop yellow colour. The absorbance of yellow colored product was read at 410 nm on a Spectrophotometer (Systronics). The value was expressed as NO_3 mg /L.

RESULTS AND DISCUSSION

Total Phosphorus:

In water phosphorous occurs in many forms such as particulate phosphorous, active phosphate, orthophosphate and organic phosphate as soluble and insoluble fractions. In water, with high biological activity depletion in orthophosphate occurs. However, the deeper water gain phosphate, due to the detritus fall, which is rich in phosphate. Phosphorus occurs in natural waters as well as waste waters. It is essential for the growth of organisms and can be a nutrient that limits the primary productivity of the water body. Phosphorus is an essential plant nutrient for terrestrial and aquatic plants (Khasawneh *et al*., 1980). Phosphorus which is discharged from agricultural fields, in dissolved and particulate form adheres to the soil sediments and is easily available for aquatic plant growth Voss and Griffth (1998). Major sources of phosphates are the domestic sewage, industrial effluents, agricultural run-off, detergents etc. Phosphates are normal constituents of human excreta (Koshay and Nayar,1999). Increased surface run-off and detergents contribute to the phosphate containing substances in fresh waters bodies, (Devi, 1985). The presence of phosphate is however, necessary for biological degradation of waste waters (NEERI, 1986).

Phosphorus though present in low concentrations, is one of the most important nutrients limiting growth of autotrophs and hence the biological productivity of the system. High uptake by phytoplankton is one of the reasons for the fast depletion of Phosphorus in water. Phosphorus, as such, is not harmful to the organisms. The quality criterion for Phosphorus in water is only to check nuisance growths of algae and process of eutrophication. Increase in the phosphate content is an indication of eutrophication.

During the year 2006 the monthly mean value of phosphate ranges between 0.011 to 0.066 mg/L. The value is observed to be 0.017 mg/L in the months of January which rises to 0.066 mg/L in the month of February. In the month of March a sharp fall is observed where the value is recorded to be 0.023 mg/L. Here after the value remains fairly constant showing slight peaks in the months of May, July and September when the value is recorded to be 0.031 mg/L. Through the months of October, November and December the value of Phosphate comes down gradually to 0.011 mg/L.

In the year 2007 through December the values of total Phosphorous rose to 0.081 mg/L after which the values showed a downtrend till the month of March when the value was found to be 0.023 mg/L. The values followed a rising trend till the month of May and remained fairly constant till the month of September when the value was recorded to be 0.030 mg/L. There after it reduced to 0.019 mg/L and again rose through November and December to 0.040 mg/L.

On comparing the values of Phosphorous in the two years it has been found that the values in the year 2007 were much higher in the month of January as compared to the values in the year 2006, similar results were found in the month of December also, when the values were recorded to be 0.011 mg/L and 0.040 mg/L in the year 2006 and 2007 respectively.

Nitrate:

Nitrogen is one of the most abundant elements. About 80 percent of air we breathe is nitrogen. It is a well-established fact that nitrogen is present in the cells of all living organisms and is required for the basic processes of life to make proteins which are required for growth and reproduction (Singh *et al*., 2008) . Inorganic nitrogen may exist in the free state as nitrogen gas, or as nitrate or ammonia. Nitrate represents the highest oxidized form of Nitrogen. The most important source of nitrate is biological oxidation of organic nitrogenous substances, which come in sewage and industrial waste water or are produced indigenously in the water. Run off from agricultural fields is also high in nitrate.

Algal flora in tropical waters use nitrogen as soon as it is formed. Hence, there is neither time nor free ammonia left for its conversion into nitrates. Concentration of nitrates beyond the level of 0.15mg/l leads to eutrophication (Swayer, 1966). Nitrogen occurs naturally in the catchment soils, being fixed from the atmosphere by both symbiotic and non-symbiotic microbes in soils associated with plant roots. Nitrogen is additionally washed out of the atmosphere by rainfall. (Hinga *et al*., 1991). It is also added up due to anthropogenic activities within the catchments, disposal

of domestic wastes, industrial effluents, live stock and addition of nitrogen and phosphorus fertilizers to the pastures. Venkateshwaralu (1969); and Mathew (1975), have reported high nitrate values during monsoon months due to addition of nitrates in runoff water. Sulbha and Prakasam, (2006) have reported that the high quantity of nitrates led to good population of blue-green algae.

The primary health hazard caused due to drinking water with nitrate or nitrogen occurs when nitrate is transformed to nitrite in the digestive system. The nitrite oxidizes iron in the haemoglobin of the red blood corpuscles to form methaemoglobin, which lacks the oxygen carrying ability of haemoglobin. This condition is known as methaemoglobinema, some times referred to as "blue baby syndrome".

In the year 2006 the monthly mean value for Nitrate was observed to be 0.135 mg/L in the month of January. This value showed a sharp increase through February and March to 0.305 mg/L in April. There was an initial gradual decrease in the month of June and then a sudden sharp decline to 0.030mg/L in the month of August. In the months of August and September, the nitrate value remained stable and then a sharp rise was observed in October and the value recorded was 0.206 mg/L; this was followed by a decline to 0.13 mg/L in November. The value was seen to be constant in December.

Table No. 1: Comparative Monthly Mean Values of Nitrate and Phosphates for samples of water collected from Wunna Lake during the period of study .

MONTHS	PHOSPHATES		NITRATE	
	2006	2007	2006	2007
	Mean Value A	Mean Value B	Mean Value A	Mean Value B
January	0.017±0.001	0.081±0.0000	0.135±0.00	0.135±0.00
February	0.066±0.001	0.071±0.0001	0.206±0.00	0.231±0.00
March	0.023±0.001	0.023±0.0001	0.245±0.05	0.300±0.00
April	0.027±0.001	0.018±0.0001	0.305±0.00	0.298±0.00
May	0.038±0.000	0.039±0.0001	0.281±0.00	0.289±0.00
June	0.021±0.000	0.033±0.0001	0.275±0.00	0.255±0.00
July	0.035±0.000	0.032±0.0001	0.191±0.00	0.143±0.00
August	0.030±0.000	0.030±0.0001	0.030±0.00	0.120±0.00
September	0.031±0.000	0.030±0.0002	0.031±0.00	0.135±0.00
October	0.019±0.001	0.019±0.0002	0.206±0.00	0.201±0.00
November	0.025±0.000	0.026±0.0001	0.130±0.00	0.292±0.00
December	0.011±0.000	0.040±0.0002	0.131±0.00	0.312±0.00

All values are in mg/L

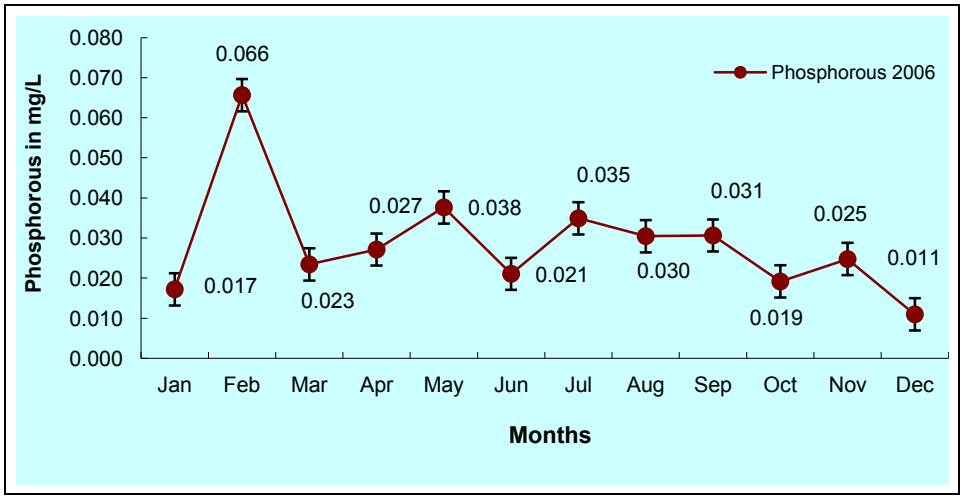

Figure No. 1 Monthly Mean Values of Total Phosphorus for samples of water collected from Wunna Lake during the period of study 2006.

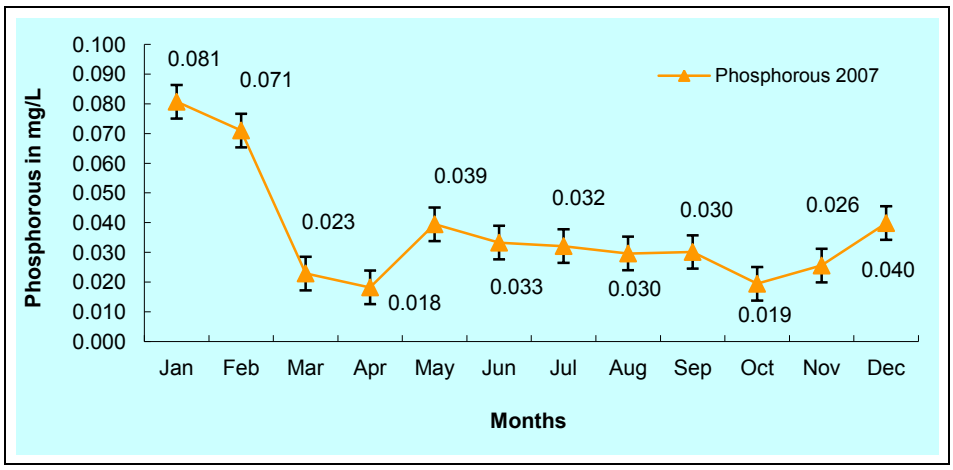

Figure No. 2 Monthly Mean Values of Total Phosphorus for samples of water collected from Wunna Lake during the period of study 2007.

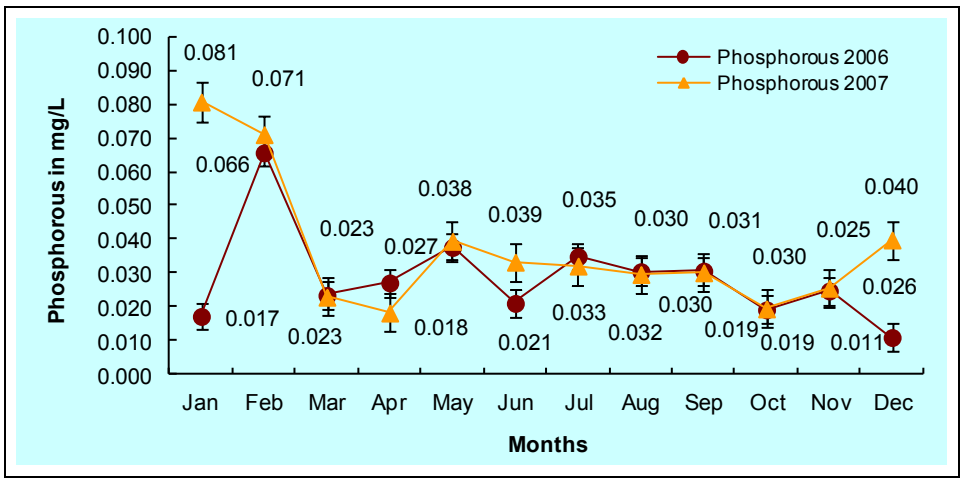

Figure No. 3 Comparative Monthly Mean Values of Total Phosphorus for samples of water collected from Wunna Lake during the period of study 2006 and 2007.

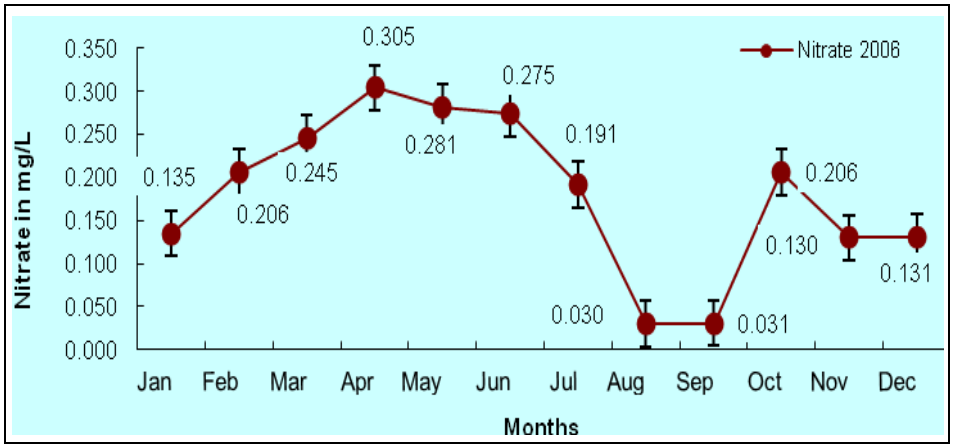

Figure No. 4 Monthly Mean Values of Nitrate for samples of water collected from Wunna Lake during the period of study 2006.

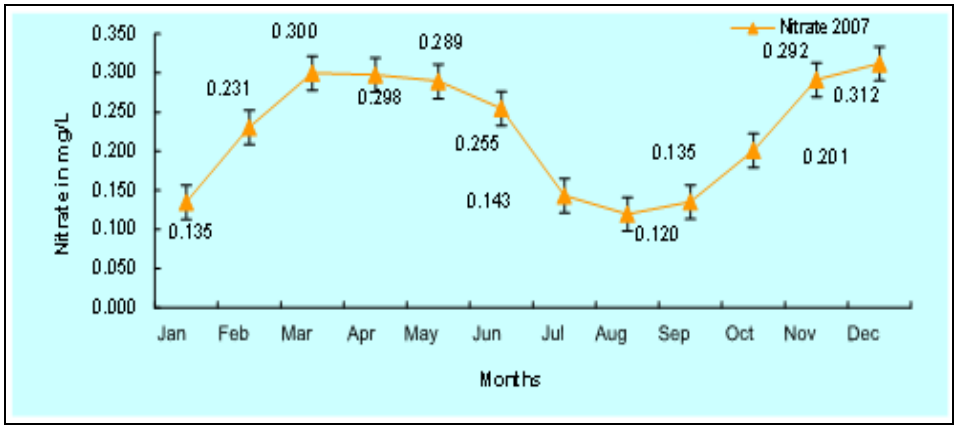

Figure No. 5 Monthly Mean Values of Nitrate for samples of water collected from Wunna Lake during the period of study 2007.

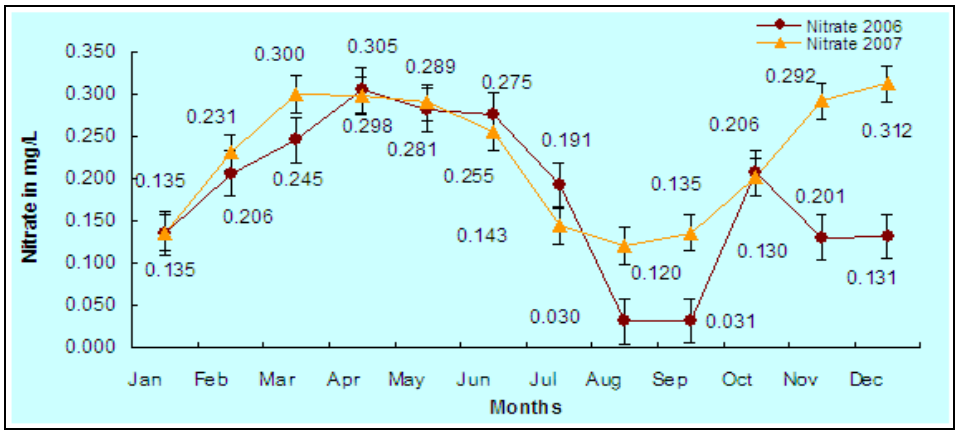

Figure No. 6 Comparative Monthly Mean Values of Nitrate for samples of water collected from Wunna Lake during the period of study 2006 and 2007

In the year 2007 in the month of January it was observed that there was no appreciable change in the mean value for nitrate, which remained at 0.135 mg/L. There was a gradual increase in the monthly values through the month of February, to 0.3 mg/L in March. It was observed that there was a gradual decline in mean values through April, to 0.289 mg/L in May. A sharp decrease was observed through June, to 0.143 mg/L in July, and 0.120mg/L in August. The mean values showed a sharp rise through September, October and November, to 0.312 mg/L in December.

The monthly mean values of nitrate in the year 2007 were seen to be higher than those in the corresponding months of the first year, i.e. February, March, May, August, September and November. The mean values in August, September, November and December (second year) showed an appreciable variation over the values in corresponding months in the year 2006.

Kunikone and Magara (1998) and Robertson *et al*., (1991) observed that nitrate contamination in India was due to human and animal waste, industrial effluents and silage through drainage system.

The nitrates were found to occur in water at a range from 0.030 mg/L to 0.312 mg/L over a period of 2 years. The presence of nitrates in the water body under study can be attributed to fixation by both symbiotic and non-symbiotic microbes in soils associated with plant roots or by being washed out of the atmosphere by rainfall or by anthropogenic activities within the catchments.

Concentration of nitrates beyond the level of 0.15 mg/L leads to eutrophication (Swayer, 1966). Values for nitrate over this given value were found in the period February to June in 2006 and in the months of February to July and again October to December in the year 2007, this is most probably due to the droppings of the

migratory birds which were observed in large number during this period.

A comparison between nitrate levels in the present study with prescribed drinking water standards showed that nitrate content of Wunna Lake is within the permissible limits. The low values seem to indicate that the water quality is not affected.

CONCLUSION

The nutrient load increases during peak summer months in case of both nitrates and phosphates, owing to evaporation leading to concentration of water. The situation is naturally remedied by the onset of the rains. In the present study it has been found that the values of phosphates and nitrates were very low indicating that there was no pollution through sewage or industrial waste making the water fit for drinking purpose.

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