

Nutrient Overloading of Few Lakes in Bangalore, Karnataka

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Abstract

Lake is large body of water surrounded by land and inhabited by various aquatic life forms. The main cause of excessive loading in to the system is phosphorous and nitrogen, resulting a high algal blooms. The study on nutrient overloading of Hebbal, Puttenahalli and Yelahanka lakes of Bangalore was conducted. The lakes were found to be highly eutrophic. The phosphate content of Puttenahalli lake water was found to be in the range of 0.35 to 2.93 mg/liter. Hebbal lake water found to be 0.55 to 0.97 mg/liter and Yelahanka lake water found to be in the range of 0.69 to 1.58 mg/liter of phosphate. The nitrate content of the Puttenahalli lake water was found to be in the range of 10.0 to 18.40 mg/liter Hebbal lake water 3.30 to 8.70 mg/liter and Yelahanka lake water 0.9 to 16.5 mg/liter. High phosphate and nitrate content in the Hebbal, Puttenahalli and Yelahanka lake water reveals that nutrient load in the lakes is high and hyper-eutrophic conditions are prevailing. The phosphate concentration in the lake water bodies was high as compared to the standard guidelines.

Key words : Nutrients, Phosphate, Nitrate, Eutrophic, Lakes.

A lake is a large body of water surrounded by land and inhabited by various aquatic life forms. They support all life forms through extensive food webs and biodiversity (1). They help regulate water levels within watersheds, improve quality, reduce flood and storm damages, provide habitat for important fish and wild life, support hunting, fishing, other recreational activities and perform some useful functions in the maintainance of ecological balance. As a consequence of unprecedented development, human beings are responsible for choking several lakes to death. Storm water runoff and discharge of sewage into the lakes are two common ways that various nutrients enter the aquatic ecosystems resulting in the death of those ecosystems (2). The eutrophication of a water body signifies the ageing of the lake. It caused by the accumulation of nutrients, sediments, silt and organic matter in the lake from the surrounding water shed. The eventual consequence of eutrophication is the growth of primary production to nuisance proportions (3). The main cause of excessive loading into the system is phosphorus and nitrogen, resulting a high algal biomass, dominance of cyanobacteria and loss of macrophytes (4). Although eutrophication is a natural process of aging of lakes and water bodies, human activities can greatly accelerate eutrophication. The

concept of nutrient overloading has a great impact on all subsequent eutrophication research and lake management (5). Eutrophication is accelerated as a result of human activities near the water body, generates residential wastes, untreated or partially treated sewage, agricultural runoff, urban pollutants, and so forth sewage or residential waste, consisting largely of phosphate containing largely of phosphate containing detergents. This creates conditions that interfere with the recreational use of lakes and adversely affect the diversity of indigenous fish, plant and animal populations. The study on the nitrate and phosphate fluctuations in the surface water of three lakes of Bangalore city was conducted to explore the nutrient overloading of the lakes.

Methods

The lakes of Bangalore occupy about 4.8% of the city's geographical area (640 sq km) covering both urban and rural areas. The study area selected was Puttenahalli Lake is located on 13°06' 42.45'' latitude and 77°34' 35.75'' E longitude is near BTS bus depot, Yelahanka and is fourteen km north of Bangalore. The lake is prominent because of various species of birds sighted during the breeding season. The "avifauna"

Table 1. Monthly variation in nitrate content (mg/liter) of different lakes during 2008—2010.

Months	2008				2009			2010	
	Puttenahalli lake	Hebbal lake	Yalahanka lake	Puttenahalli lake	Hebbal lake	Yalahanka lake	Puttenahalli lake	Hebbal lake	Yalahanka lake
Jan	11.70	4.80	11.24	13.50	3.90	10.58	13.40	4.02	9.71
Feb	12.19	4.70	11.38	14.50	3.80	9.43	16.10	5.90	9.52
Mar	11.63	4.70	11.67	12.30	3.70	10.76	12.80	6.70	8.81
Apr	12.40	4.60	11.10	12.50	3.70	10.37	12.90	6.90	9.43
May	12.80	7.30	11.14	12.70	3.80	11.28	12.80	8.10	9.33
Jun	13.21	7.50	13.18	13.30	3.10	11.25	13.50	7.50	9.37
Jul	11.84	7.60	13.95	11.90	4.20	11.00	12.60	6.80	9.45
Aug	12.31	3.90	13.95	12.40	4.40	11.81	12.50	4.90	10.3
Sep	15.30	7.60	14.54	16.50	4.10	13.10	18.40	8.70	10.50
Oct	11.40	3.10	13.23	11.30	5.40	11.45	11.40	6.40	9.30
Nov	10.50	3.40	10.71	10.30	3.50	11.91	10.60	3.30	9.00
Dec	10.00	3.30	10.20	10.80	3.80	11.50	10.90	4.40	9.80

of this lake also includes some of the endangered and migratory birds from the Northern Himalayas and Siberia. The lake receives sewage effluents from catchments areas of Yelahanka, Yelahanka new town, and wheel and axil industry and near by hotels. Hebbal lake is situated on 13°02' 48.18'' N latitude and 77°35' 13.44'' E longitude and is one of the large lakes of Bangalore and is located at Hebbal along the Bangalore—Bellary road in the northern part of Bengaluru. The lake is about 8 km from the heart of Bangalore city. It is one of the land marks of north Bangalore; it has been used and is still being used for irrigation, fish culture and recreation. This seasonal lake used to be filled during the monsoon and invariably is dry in summer. It has a variety of aquatic vegetation and a large number of birds inhabit it. Yelahanka lake is located on 13°06' 24.45'' N latitude and 77°35' 47.6'' E longitude and elevation 908 m. The lake is man made rainfed and used by people for anthropogenic and agricultural purpose. The lake receives sewage effluents from catchments areas of Yelahanka and wheel and axil industry.

The Bangalore enjoys an agreeable climate and is free from extremes, the dry season with clear bright weather extends from December to February. The summer season is from March to May followed by the southwest monsoon from June to September, while October and November constitute the post monsoon season. The marked thunder storm activity with occasional hailstorms occurred in April and May. Post-monsoon season during September to October predominant with low clouding and the more or less ste-

ady temperature with small diurnal variation and during October to February with an early morning dew and mist or fog.

Sampling

With considerations of the sources of inflow to the lake, ten different sampling sites were selected. All the water samples were collected in dilute acid washed polythene bottles. The samples were brought to the laboratory on the day of collection and kept into cool condition due to avoid unpredictable changes in physico-chemical parameters like nitrates and phosphates in the surface water were studied monthly for a period of three years. Sampling and physico-chemical investigation was carried out according to the slandered methods (6). Phosphate in the water was determined by the spectrophotometer and nitrate was determined by the spectrophotometer and phenol-disulphonic acid method.

Results and Discussion

Nitrate

In puttenahalli Lake, the nitrate content of the water ranges of 10.0 to 18.40 mg/liter. The highest concentration of nitrate in water was recorded in September-2010, while minimum was recorded in December-2008. Hebbal Lake the nitrate of the water ranges of 3.30 to 8.70 mg/liter (Table 1). The highest concentration of nitrate in water was recorded in September 2010, while minimum was recorded in December 2008.

Table 2. Monthly variation in phosphate content (mg/l) of different lakes during 2008—2010.

Months	2008			2009			2010		
	Puttenahalli lake	Hebbal lake	Yelahanka lake	Puttenahalli lake	Hebbal lake	Yelahanka lake	Puttenahalli lake	Hebbal lake	Yelahanka lake
Jan	1.44	0.79	0.92	1.54	0.85	0.93	1.67	0.83	0.95
Feb	2.41	0.84	0.96	2.51	0.87	0.96	2.64	0.88	0.98
Mar	0.51	0.82	0.71	0.78	0.83	0.74	0.75	0.84	0.71
Apr	1.54	0.88	0.81	1.53	0.89	0.82	1.55	0.92	0.83
May	1.87	0.91	0.95	1.88	0.94	0.93	1.87	0.97	0.68
Jun	2.04	0.98	0.89	2.05	0.99	0.88	2.07	0.73	0.90
Jul	0.35	0.55	0.76	0.43	0.57	0.77	0.38	0.64	0.78
Aug	0.56	0.90	1.00	0.58	0.93	1.34	0.59	0.83	1.58
Sep	2.89	0.56	0.78	2.90	0.58	0.78	2.93	0.74	0.78
Oct	1.34	0.75	0.82	1.58	0.76	0.73	1.40	0.78	0.83
Nov	0.58	0.72	0.74	0.59	0.71	0.69	0.54	0.70	0.74
Dec	0.89	0.77	0.89	0.40	0.73	0.69	0.70	0.75	0.68

In Yelahanka Lake, the nitrate content of the water ranges of 9.0 to 16.50 mg/liter. The highest concentration of nitrate in water was recorded in September 2008, while minimum was recorded in November 2010.

Nitrate is the most highly oxidized form of nitrogen compounds commonly present in natural waters, the raw sewage is the source of nitrates in water and nitrate was generated by heterotrophic microbes as a primary end product of decomposition of oxygenic matter directly from organic compounds (7). Excessive nitrate in water is due to manmade domestic activities and fertilizers from fields.

Phosphates

In Puttenahalli Lake, the phosphate content of the water ranges of 0.35 to 2.93 mg/liter (Table 2). The highest concentration of phosphate in water was recorded in September 2010, while minimum was recorded in July 2008. In Hebbal Lake the phosphate of the water ranges of 0.55 to 0.97 mg/liter. The highest concentration of phosphate in water was recorded in May 2010, while minimum was recorded in July 2010. In Puttenahalli Lake, the phosphate content of the water ranges of 0.68 to 1.58 mg/liter. The highest concentration of phosphate in water was recorded in May 2010, while minimum was recorded in August 2010.

Phosphorus is a nutrient required by all organisms for the basic processes of life. In lakes, phosphorus is often found to be the growth limiting nutrient,

because it occurs in the least amount relative to the needs of plants for phosphates, 0.08 ppm was the critical level for occurrence for eutrophication in lakes (8).

There are various sources of phosphate to the lake water, such as rock deposit, runoff surface catchments and interaction between the water and sediment from dead plant and animal remains at the bottom of the lakes. Phosphate is considered to be the most significant among the nutrients responsible for eutrophication of lakes, as it is the primary initiating factor. Phosphate enters the lakes in domestic waste water, accounting for the condition of eutrophication. Atmospheric input may account for a significant proportion of the influx of nutrients to the lakes.

Conclusion

High phosphate content in the Puttenahalli, Hebbal and Yelahanka lake water reveals that nutrient load in the lakes is high and hyper-eutrophic conditions are prevailing. The phosphate concentration in the water bodies was high as compared to the standard guidelines. The concentration of nitrates in the water was within the acceptable limits although it tends to increase considerable in three years time. The deterioration in the quality of Puttenahalli, Hebbal and Yelahanka lake water and rise nutrient level is alarming. The periodic monitoring and preventive measures are required to save the lakes from eutrophication.

References

1. Mitsch W. J. and J. G. Gosselink. 1993. *Wetlands*. van Nostrand Reinhold, New York, USA.
2. Sudhira H. S. and V. S. Kumar 2000. Monitoring of lake water quality in Mysore city. Pp. 1—10. In T.V. Ramachandra, M. C. Rajasekara and N. Ahalya (eds). *Int. Symp. on restoration of lakes and wetlands. Proc. Lake 2000*. Bangalore, India. Center for Ecol. Sci. Indian Inst. Sci., Bangalore, India.
3. Marsden M. W. 1989. Lake restoration by reducing external phosphorus loading. The influence of sediment phosphorus release. *Fresh Water Biol.* 21 : 139—162.
4. Jana B. B. and S. K. Das 1995. Phosphorus in aquatic systems : An overview. In P. C. Mishra, N. Behera, B. K. Senapati and B. C. Guru (eds). *Advances in ecology and environmental sciences*. Ashish Publ House New Delhi, India.
5. Vollenweider R. A. 1976, Advances in defining critical loading levels for phosphorus in lake eutrophication. *Hydrology* 33 : 53—83.
6. American public Health Association, American water Works Association and Water Pollution Control Federation. 1995. *Standard methods for the examination of water and wastewater*. 19th edition. APHA, Washington DC, USA.
7. Wetzel R. G. 1983. *Limnology*. 2nd edition. Saunders Coll Publ., NY, USA.
8. US Environ. Prot. Agen. 1976. *Quality criteria from water USEPA*. Report No EPA-440/9-76-023. Washington DC, USA.