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NUTRIENT MANAGEMENT FROM LAKES IN THANE CITY (MAHARASHTRA)

Madhuri K. Pejaver and Nayana S. Raut
Department of Zoology, B. N. Bandodkar College of Science, Thane - 400 601, Maharashtra, India.

ABSTRACT

Though the existing water bodies have tremendous economical, ecological & aesthetic benefits, very little efforts have been made for the protection and conservation of aquatic ecosystems, particularly in the urban environment. Due to this most of the water bodies face the problem of eutrophication & ultimately vanish. Nitrogen and phosphorus are important contributors in the enrichment but sillicates also play a role in primary production. In the present paper some of the simple remedial measures are suggested to protect the lakes from eutrophication.

Keywords: *Eutrophication, Nutrients, Macrophyte, Remedial measures.*

INTRODUCTION

Freshwater is one of the scarce natural resource, conservation of which is assuming greater and greater importance. The immediate and future well being of all the countries depend on their abilities to manage water restoration more efficiently. Though the existing water bodies have tremendous economical, ecological and aesthetic benefits, very little efforts have been made for the protection and conservation of aquatic ecosystems, particularly in the urban environment (Kodarkar, 1995). Due to this most of the water bodies face the problem of eutrophication and ultimately vanish.

In ancient times, rivers and lakes were the important water sources satisfying all the needs of manking. But in the technological era, treated water from manmade reservoires is available at our doorstep by governing bodies of the town like Municipal Corporation. Due to this the need for conservation of local water supply sources like lakes is not understood and hence are being totally neglected. If protected, these water bodies have tremendous potential for nonpotable uses. Our country is fortunate enough to experience the wonderful rainfall in the costal areas among which one is the Thane City. It has unique location as it is bounded by creek on one side; by hill ranges on the other and within the city few sweet water lakes still exist from the historic 60 odd water bodies. The rest have disappeared due to urbanization, dumping of solid waste and enchrochment. In fact, even now some of these have reached a state of eutrophication and therefore management of these lakes is of extreme importance. Keeping this in mind a survey of various lakes was undertaken for last few years and the results are discussed in this paper along with some simple remedial measures.

MATERIALS AND METHODS

The water samples from lake Makhamali were collected. The physico-chemical analysis of water samples was performed as per procedures described in the Standard Methods (APHA, 1981). Similarly the macrophytes from this lake were also noted down.

RESULTS AND DISCUSSION

These lakes are facing the problem of eutrophication as faced by most of the lakes in the world. Eutrophication is defined as an increase in the rate of the income of nutrients. The increased nutrients add to the fertility of the lake, increasing the growth of phytoplankton, then growth of aquatic weeds damaging lower aquatic life.

Nitrogen and phosphorus are important contributors in the enrichment but silicate also play a role in primary production. During recent years great interest has been shown in the study of nutrients which are essential in minute quantity for the productivity of pond (Goldman, 1964 & 1965). Preventing the enrichment of nutrients in the lakes is an efficient primary step in preventing the eutrophication problem. This will prevent the subsequent over growth of phytoplanktons and aquatic weeds increasing the aesthetic value of lakes (Armstrong *et al.*, 1976).

Lake Masunda, is a historic lake about 400 yrs old and is present in the centre of the city. It is approximately 12354.10 sq.m. This lake faces the stress of Ganapati idol immersion and nirmalya (religious refuse like old floral offering to God) disposal. The quantum of nirmalya dumped into the Masunda lake is quite high during festivals (Ganesh Utsav and Navaratri). The nirmalya, decays and adds to the organic matter leading to eutrophication of the lake.

To save this lake from eutrophication, the Municipal corporation has taken certain measures, one of the which is to build an enclosure within the water body for the purpose of nirmalya disposal. The enclosure was built such that the water from the enclosure does not mix with the main lake. It has been made compulsory that the nirmalya should be disposed within this enclosure which is cleaned everyday.

During the study water samples were collected from nirmalya enclosures as well as the main lake seperately. It was seen that though the dissolved oxygen level of the enclosure was nil the dissolved oxygen from main lake ranged from 4.5-11.2 mg/l. The level of free carbondioxide was 1.19-6.6 mg/l in enclosure and 0-1.1 mg/l in main lake. SiO_3-Si was 6-58.90 mg/l, in nirmalya enclosure and 1.65-37.59 mg/l in main lake and PO_4-P was 0.0252-0.3135 mg/l in nirmalya enclosure and 0.0064-0.0876 mg/l in main lake which is found to be high in the enclosure samples as compared to the main lake (Somani *et al.*, 2001) (Table 1) This indicates that preventing the organic substances from entering in the main lake not only protects the main lake but also prevent eutrophication.

Table 1. **Monthly fluctuation of physico-chemical parameters of water from main lake and Nirmalya enclosure. M, Main lake : N, Nirmalya enclosure (Somani *et al.*, 2001).**

Months	pH		DO mg/l		Free CO_2 mg/l		SiO_3-Si mg/l		NO_2-N mg/l		PO_4-P mg/l	
	M	N	M	N	M	N	M	N	M	N	M	N
Jul.	7.4	7.5	9.5	0	0	1.98	1.65	4.9	0.1	0.05	0.0252	0.1404
Jul.	6.8	7.0	4.6	0	1.1	1.19	1.65	4.95	0.08	0.08	0.020	0.1452
Aug.	8.24	7.2	7.0	0.05	0	1.98	1.65	6.0	0	0.08	0.0392	0.1928
Aug.	7.97	7.96	11.2	0	0	1.98	6.6	14.85	0	0.08	0.0156	0.1452
Sep.	7.58	7.36	4.5	0	1.1	3.3	3.3	12.87	0.1	0.1	0.0112	0.204
Sep.	8.2	7.53	7.6	0	1.1	3.3	6.6	14.85	0.1	0.1	0.0392	0.173
Oct.	8.57	7.8	6.6	0	1.1	3.3	6.6	14.85	0.1	0.1	0.0392	1.240
Oct.	8.14	7.59	4.8	0	0.88	4.4	31.4	53.79	0.05	0.240	0.0064	0.3135
Nov.	8.31	7.8	6.2	0	0.88	3.96	37.59	45.51	0.140	0.180	0.0516	0.1032
Nov.	8.87	7.78	7.1	0	1.1	6.6	35.64	58.90	0.110	0.170	0.0876	0.4090
Dec.	7.25	7.4	6.7	0	1.1	2.2	9.9	9.9	0.088	0.10	0.0112	0.0252
Dec.	7.4	6.55	9.0	0	1.1	3.3	14.85	56.26	0.19	0.104	0.0064	0.078

Thus, this could be one of the remedial measures for the disposal of nirmalya and also to prevent the eutrophication of the lakes without hurting the religious sentiments of people. But other better measures can be keeping the earthen pots near the bank of the lake and making people throw the nirmalya in such pots without plastic bags which can be collected latter and processed for composting. This nirmalya enclosure can be used as a model to show the effects of decaying organic matter. Similar enclosures if made for idol immersion which can be desilted also will be useful preventing the lake from degradation. Similarly a compaign against the immersion of idols should be taken up by the local NGO's.

'Ambegosale', lake from Thane is facing the problem of eutrophication as year round growth of macrophytes like *Pistia stratiotes* and *Lemna minor* is observed in this lake. In studies of lake Ambegosale (Pejaver *et al.*, 2002) it was observed that the lake gets periodically infested by *Pistia stratiotes*, which is fully flourished upto December and by rainy season decays and sinks down to the bottom. Later the lake remains clean till September. In the study of nutrients it was seen that lower values i. e. 0.0476 mg/l of phosphates coincided with full growth of *Pistia stratiotes* while higher values i. e. 0.264 mg/l coincided with decaying of *Pistia stratiotes* and its sinking with rainfall (Table 2).

Table 2. **Physico-chemical parameters of 'Lake Ambegosale'. (Pejaver *et al.*, 2002).**

Season	pH	DO mg/l	Free CO_2 mg/l	SiO_3 Si mg/l	PO_4-P mg/l	NO_3 N mg/l
Summer	7.27	0.00	0.66	68.0	0.0476	0.052
Monsoon	7.84	11.0	0.00	23.1	0.264	0.176
Post-monsoon	6.8	5.8	17.6	21.3	0.1046	0.176
Winter	6.8	1.2	13.2	24.75	0.136	1.760

The macrophytes act as pollution indicators and play an important role in energy input, nutrient budget and recyling of nutrients in the water bodies. Different scientist have

worked on various species of macrophytes like *Eichhornia* sp., *Lemna* sp., *Azolla* sp., and *Vallisneria* sp. and shown their role in the recycling of nutrients like phosphates and nitrates.

A third lake known as 'Makhamali' gets periodically infested by *Lemna minor* and occasionally by *Eichhornia* sps. The mat formation of *Lemna minor* plant is rapid (Gupta, 1979) as compared to *Pistia stratiotes* and hence monthly variation is seen in the growth and spreasing of *Lemna minor* in this lake. Similarly periodical weeding is also done in this lake. But as seen in Table 3, in May 2001 *Lemna minor* growth is moderate when phosphates also show moderate values (0.049 mg/l) Latter due to weeding *Lemna minor*, is removed from the lake reducing the phosphate phosphorus values showing decline, while in November *Lemna minor* suddenly becomes black (reason unknown) which has made the plants decay in the lake releasing the phosphates back in water and hence a peak is observed. A peak of phosphate phosphorus in December, 2001 with large density of *Lemna minor* suggest some other source of phosphates in water, which can be decaying of large quantity of nirmalya thrown in water during Ganpati festival.

Table 3. **Physico-chemical parameters of " Lake Makhamali ".**

Season	pH	DO mg/l	Free CO_2 mg/l	SiO_3Si mg/l	PO_4-P mg/l	NO_3N mg/l
Summer	7.77	3.723	0.0	19.675	0.0029	0.310
Monsoon	7.92	3.06	14.66	3.135	0.0050	0.264
Post-Monsoon	7.21	1.53	836	49.83	0.0070	0.330
Winter	7.235	3.264	638	86.25	0.0074	0.150

Nitrate nitrogen shows little relation with *Lemna minor* similar to the case in *Pistia stratiotes* from lake Ambegosale (Figs. 1 & 2). The higher concentration of nitrates is an essential and governing factor for the growth of phytoplankton. (Saha *et al.*, 1971). Billore (1990) has shown the denitrifying roleof two dominant native plant species which are capable of removing nitrate-nitrogen from the pond almost completely (94 %) and hence has suggested the use of local species in denitrification process. In the above case it can be applied for phosphate removal, as most of these macrophytes seem to accumulate phosphates and lakes do not have heavy nitrate burden. Purposeful construction of wetland ecosystems is a new technology in which shallow water bodies are specifically engineering using macrophytes for water quality treatment. Small rafts with macrophytes can be liberated in water, which can be pulled out when the macrophytes grow fully, thus reducing the nutrients. These have now been recognized as an accepted low cost technology in developed countries especially beneficial to small towns (Billore *et al.*, 1998).

Hence we suggest the regular harvesting of *Pistia stratiotes*, or *Lemna minor* which are the native macrophytes for cleaning these lakes. This will help in reducing the phosphates and nitrates from the lakes, which are the main culprits for eutrophication and thus the lakes, can be revived back to mesotrophic. Similarly, we suggest the harvesting of *Nymphaea* sps and *Trapa bispinosa* which are edible. This will help to reduce the nutrient load as well as provide income source for acquaculturist. During the study of lakes one

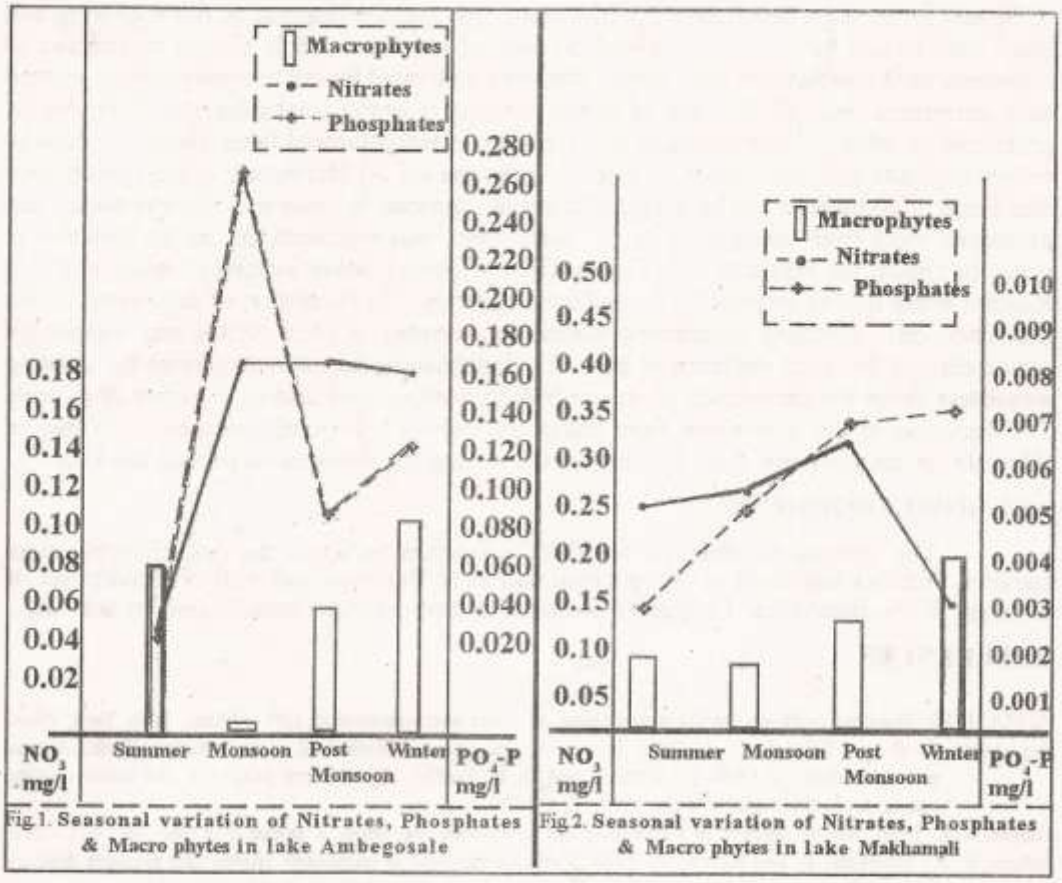

Fig.1. Seasonal variation of Nitrates, Phosphates & Macro phytes in lake Ambegosale

Fig.2. Seasonal variation of Nitrates, Phosphates & Macro phytes in lake Makhampli

more feature noticed was all these lakes have a small temple near by. Most of the Indian temples have a lake near it called 'Devtale' or 'Temple pond', which is used by the temple authority. Near some lakes a mosque is seen. In ancient time the lake was used by the temple or mosque and hence was always kept clean by the devotes. This helped in preserving the aquatic ecosystem of that area; similarly in acute water shortage the water could be used by the villagers. In present days even temples are getting tap water and they are separated from lakes due to encrochment. Due to this proper care is not taken of these lakes, which has resulted in their deterioration. Hence it should be made compulsory to the temple authorities to take proper care of the lakes.

Remedial Measures: After studying these and many other lakes from Thane city it is felt that with proper care even now many of these lakes can be saved from dying. Some of the remedial measures suggested are:

1) Survey of the lakes should be immediately undertaken and boundary lines should be clearly demarked. 2) Pitching of lake boundaries and plantation to prevent soil erosion, 3) Construction within the lakes, dumping of garbage and religious refuse should be prohibited,

4) Specific sites to be demarcated for idol immersion and for disposal of floral offering and these sites should be regularly desilted. 5) Size of immersion idols should be reduced to minimum, idols should be of clay, people should be motivated for not to immerse idols, instead have permanent ones. 6) Washing of cloths, bathing, washing vegetables should be strictly prohibited in lakes. 7) Harvesting of macrophytes in eutrophicated lakes should be done to reduce nutrients and they should be properly disposed off. 8) Harvesting of the hydrophytes like Trapa or Nymphaea can be assigned to private agencies to make use of water bodies and protecting them from eutrophication. 9) Small rafts with macrophytes can be liberated in water to reduce the nutrients. 10) Construction of proper sewer system in entire city. 11) Regular water quality monitoring by authentic agencies. 12) Formation of authorized "Lake protection cell" including government authorities, member of local NGOs and responsible senior citizens for strict vigilance of laws. 13) Establishing educational centres for creating awareness about the importance of an eco-friendly heritage and also as a source of income. 14) Recycling of the wastewater from nallas and use for non potable purpose. 15) Idea of 'Devtale' or temple pond should be inculcated among the devotees to protect the lake.

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