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A Study of Eutrophication Phenomenon of a Lake of a Modern City of India

Shilpa[1]
[1](Student of Masters in Engineering in Environmental Engineering, Department of Civil Engineering, PEC University of Technology, Chandigarh, India)

Dr. Shakti Kumar Arora[2]
[2](Associate Professor, Department of Civil Engineering, PEC University of Technology, Chandigarh, India)

Abstract:- **Water eutrophication will become a worldwide environmental problem in coming years, so there is a need to understand its mechanism and sources. Many researchers has given many methods to estimate the level of eutrophication. Eutrophication in lakes forms green scum layer which creates condition of hypoxia and kills the aquatic animals and also affects human health. It also affects transparency of the lake. Water assessment of sukhna lake was done during six months period (December 2015- May 2016). Six sites were selected to test the eutrophic status of Sukhna Lake. At site 1 and 4 phosphates and nitrates were on higher side. pH was within permissible range. Transparency of the lake is also poor which shows that lake is highly polluted.**

(Keywords:- Eutrophication; hypoxia; phosphates; nitrates; water) .

INTRODUCTION

Water, a precious natural resource, is essential for multiplicity of purposes. Water constitute around 70-90% of all living cells. Today for most of the purposes water from natural resources like lakes, rivers, ponds, oceans is used. Lakes are valued as water sources and for fishing, water transport, recreation and tourism. Chandigarh is located near the foothills of the Shivalik range of the Himalayas in northwest India. It covers an area of approximately 114 km^2. It shares its borders with the states of Haryana and Punjab. The exact cartographic co-ordinates of Chandigarh are 30.74°N 76.79°E. Sukhna lake is a very famous lake of Chandigarh city. The Sukhna lake was created artificially in 1958 by constructing an earthen dam of about 3 kms length and 14m height on the sukhna choe. Sukhna lake is present on the North East corner of the city. Its total catchment area is around 4207 Hectares, out of which 3312 constitue the Shivalik hills and the the rest 895 hectares falls in three villages- Kaimbwala (Chandigarh), Kansal (Punjab), Suketri (Haryana). The length of the top dam is 23m and width of the walkway is about 3km. The climate of the area is semi arid with maximum mean temperature of 41.8^{0}C in June and minimum mean temperature of 5.10^{0}C in January.

Meaning of Eutrophication –

The word 'eutrophication' has its root in two Greek words: 'eu' which means 'well' and 'trope' which means 'nourishment'. The modern use of the word eutrophication is related to inputs and effects of nutrients in aquatic systems. Eutrophication is a phenomenon in which nutrient enrichment, especially phosphates and nitrates, in water systems promotes algal growth and also promotes higher forms of plant life, which further creates disturbance in the water system and disturbs aquatic life. The main causes of eutrophication could be run off of nutrients from soil and weathering of rocks, run off of inorganic fertilizers, manure from farms, from erosion etc.

Algae and controlling factors for eutrophication-

Water eutrophication is caused by the autotrophy algal blooming in water, which composes its bioplasm by sunlight energy and inorganic substances through photosynthesis. The process of eutrophication is described as follows-

$$106CO_2+16NO_3^-+HPO_4^{2-}+122H_2O+18H^+ \xrightarrow{\text{energy+microelement}} C_{106}H_{263}O_{110}N_{16}P \text{ (Bioplasm of algae)}+138O_2$$

From the above equation we can conclude that in eutrophication process we have inorganic phosphorus as the major controlling factor and inorganic nitrogen also plays important role as controlling factor (Yang et al., 2008).

MATERIALS AND METHODS

To test different parameters in the lake 6 sites were selected. From these sites samples were collected on first and third week of every month. Sample locations are marked, as shown in figure 1.

SR. NO	PARAMETERS	ABBREVIATION	UNITS	REFERENCE METHOD USED
1	pH	-	-	pH meter
2	Total Phosphates	TP	mg/l	APHA, 4500-P, D, 22nd edition
3	Nitrates	N	mg/l	APHA, 4500-NO_3^-, B, 22nd edition
4	Total suspended solids	TSS	mg/l	APHA,2540 D, 22nd edition
5	Dissolved Oxygen	DO	mg/l	APHA, 4500-0, B, 22nd edition
6	Transparency	-	M	Secchi disk
7	Trophic state index	TSI		Regression equation based on Carlson trophic index

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Figure 1: Site map of Sukhna Lake with the locations of different sampling points.

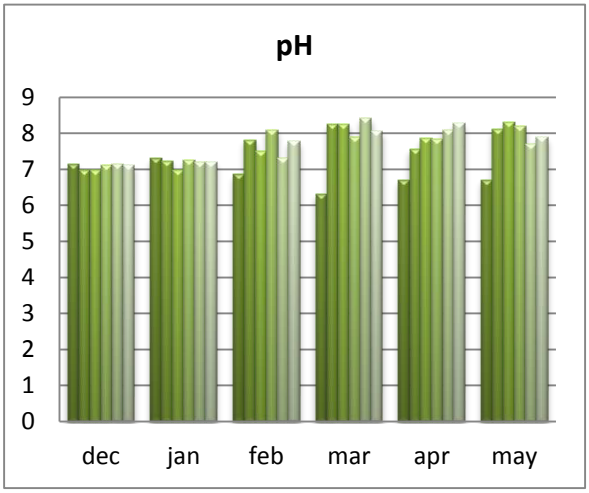
Samples were collected in the 1 litre plastic bottles. After collection samples were taken to the laboratory and tests were conducted within 48 hours. For testing different parameters procedures were followed as given in Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

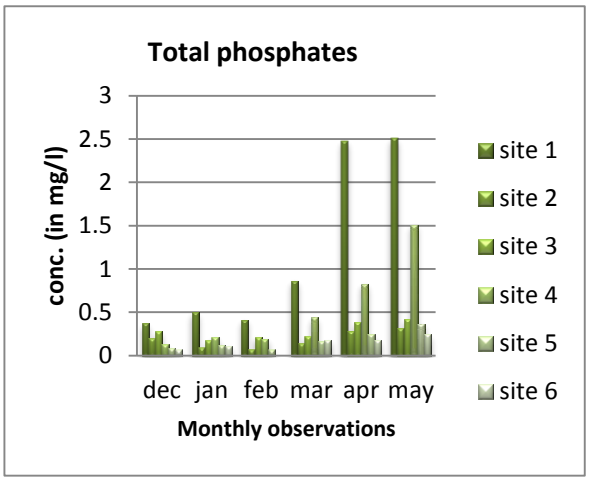
Table 1: Parameters, abbreviations , units and reference methods used

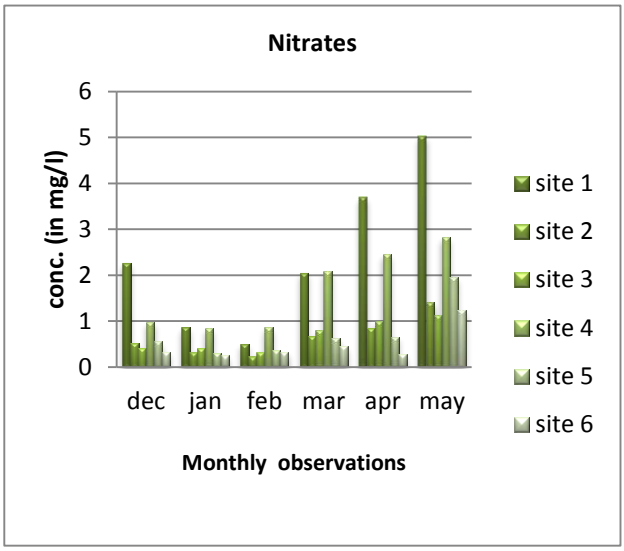
Total phosphates is the major controlling factor in the eutrophication process, it was calculated using stannous chloride method. Nitrate determinations were done using spectrophotometric analysis at 220nm. Standard curves were drawn for nitrates and phosphates analysis. Direct concentration values were taken from the double beam spectrophotometer beam 2202 software. Secchi disk was used to determine the transparency level in lake. Trophic state index which is based on regression equations according to Carlson's trophic index helps to determine the trophic status of the lake. This method has been widely used by various researchers (Xiangcan, 2003; French and petticrew, 2006; Rahul *et al*.,2013) to assess the status of the water system.

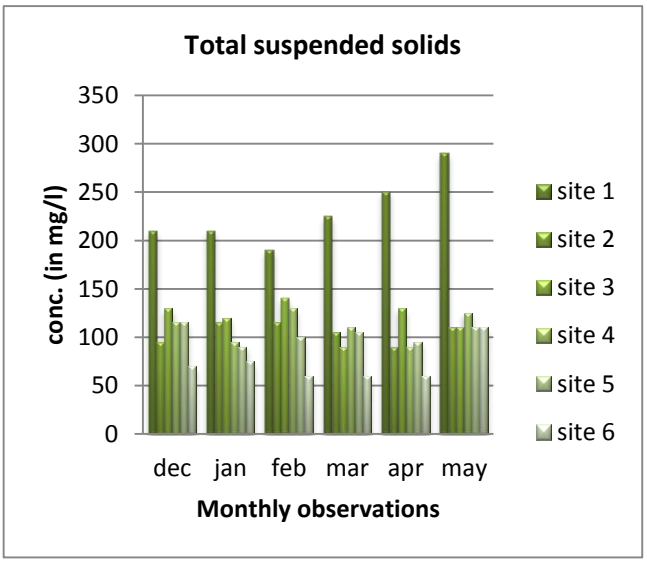
RESULTS AND DISCUSSION-

Samples were collected twice a month. The average of the monthly observations was done, average value was considered for the monthly data to generalize that value for the whole month. Graphs shown below are representing the values of different parameters for six months.









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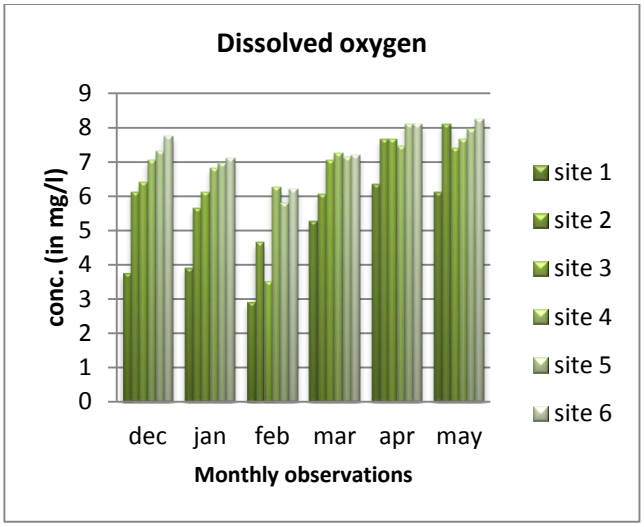
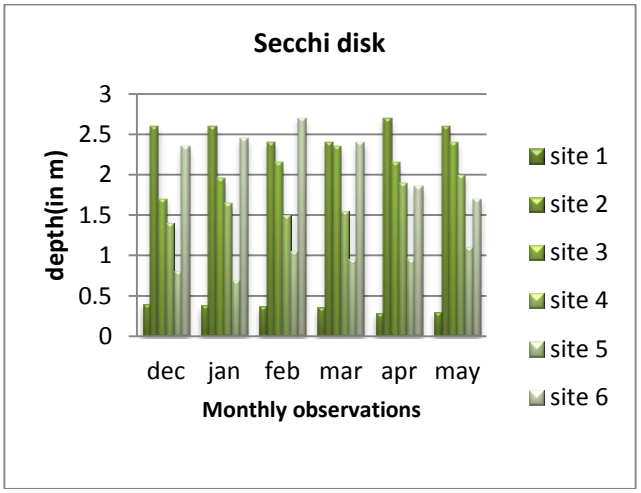




pH-

From all the observations it was seen that pH of the lake varies between 6.5- 8.5. The pH of the water is mostly neutral in this six months data.

pH of the lake is alkaline mostly in the months of february, march, april and may. The reason for this pH change could be rains, or the run off of agricultural wastes from the near areas, or the weed growth which was extreme in may month.

TOTAL PHOSPHATES (PO_4-P)-

By calculating the amount of phosphorus in the lakes we can easily determine the trophic status of the lake. For this determination standard curve was drawn at 690 nm.

From the above graphs it can be noticed that Site 1 has maximum phosphate values , which means this portion of the lake is highly sensitive for algal activities. Site 4 also seems more concentrated towards phosphate concentrations. All other sites have low concentrations of phosphates, but these are also increasing with time which is not a good sign. The reason for different concentrations at all these sites could be the extent of exposure to the wastes that are getting dispersed in the lake from various points.

NITRATES (NO_3- N)-

Nitrate concentrations plays important role in eutrophication determination. It is a limiting parameter in the whole process. Nitrate concentrations were directly determined on the spectrophotometer at 220nm. Nitrates are in excess amount at site 1 which shows that this is the most polluted site. Nitrates are also higher at site 4. The major reason for higher values at these sites could the more exposure of these sites to agricultural run offs.

TOTAL SUSPENDED SOLIDS-

Total suspended solids in the lake seems to be on higher side. Heavy siltation condition in the lake is the main reason. The concentrations values of total suspended solids is higher at site 1. This site is very muddy and contains many floated substances which is the reason for its higher value. Total suspended solids at all other sites is below 120 mg/l.

DISSOLVED OXYGEN (DO)-

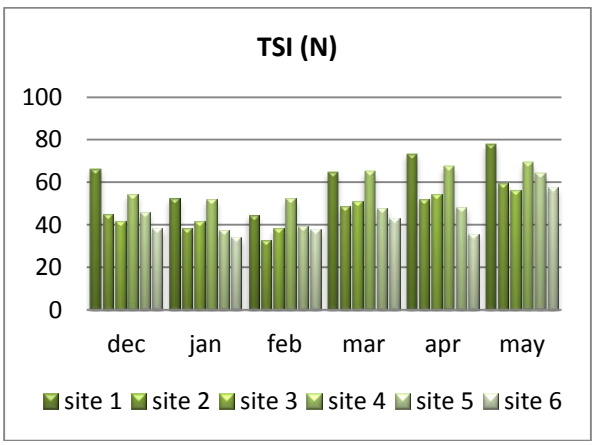
According to the Indian standard quality tolerances for fresh water for fish culture the minimum tolerance level for D.O is 4 mg/l and according to CPCB the drinking quality (class water) should have a D.O content of 6 or more. So it is very obvious that the D.O level in the lake is even less as far at some sites as the drinking standards or a suitable environment for fish is concerned. The DO range at all the sites is between 3-9 mg/l. DO variation is highly affected by temperature variations. It has major effects over aquatic life also.

SECCHI DISK DEPTH –

Secchi disk depths shows a great variation at different sites. At site 1 the depth is very less which means it has very poor transparency which is also a major factor to determine the eutrophic level in lakes. Low transparency tells about the bad quality of water and presence of high amount of suspended solids.

CARLSON METHOD-

Carlson model was used to find the trophic status of the lake. These graphs below shows the TSI calculations of Secchi disk, phosphates, Chlorophyll-a and total nitrogen.



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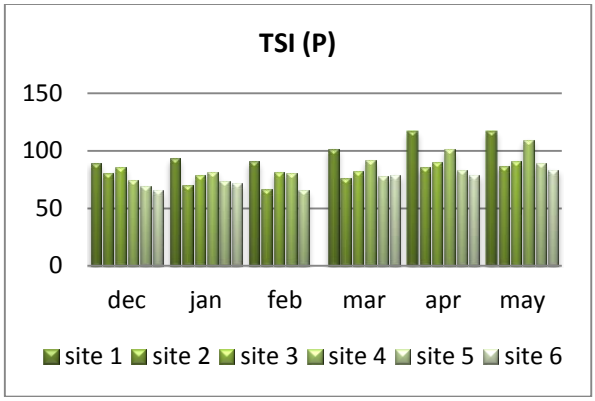

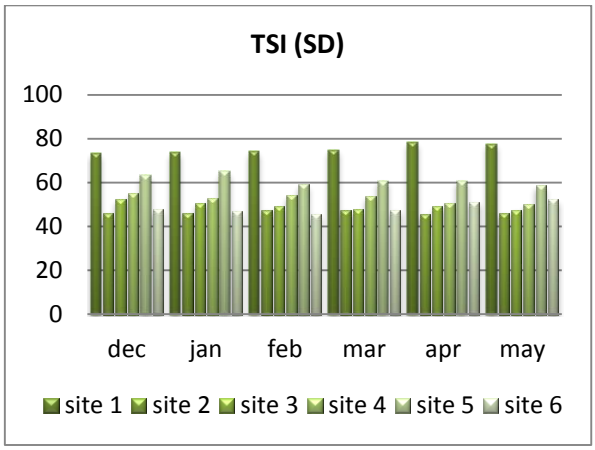

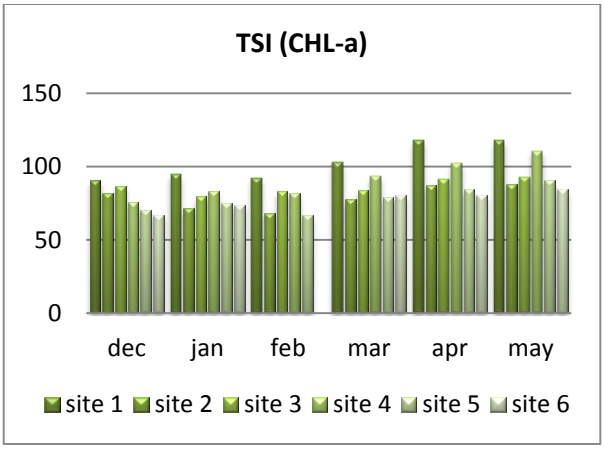

CONCLUSION

The reason for conducting this study was that there is very less information on Sukhna lake's eutrophication status. By calculating Trophic State Index (TSI) using Carlson's model, we observed that with most of the parameters lake is showing hypereutrophic nature at 3 sites. From all the data and graphs we can conclude that all the parameters are not in the controlled range. Their concentrations are very high for the aquatic life. The TSI values shows that the lake water is very harmful for drinking purpose. Its not even suitable for the fishes in the lake. Because when algal growth increases it will cover the whole surface of the water body and will not allow penetration of sunlight and oxygen which are necessary for fishes and will create hypoxia condition for them The parameters which are crossing the limit values they need to be control, otherwise the lake water will be of no use and with algal bloom growth, it will create foul smell in the area, which is unpleasant for everybody. . Lakes quality demands very extensive treatment of water. The more polluted the lake, the more is the cost of treatment, recreation is also not feasible at these sites which will be the reason of a big loss to many people who work and create their wealth from the tourists visits.

REFERENCES

[1] Andersen, J.H., Schluter, L., Ertebjerg, G. 2006. Coastal eutrophication: recent developments in definitions and implications for monitoring strategies. *Journal of Plankton Research* .28(7):621-628.

[2] Carlson,1977. A trophic state index for lakes. *Limnology and oceanography*, 22(2).

[3] Chaudhry, P., Sharma, M.P., Bhargave, R., Kumar, S., Dadhwal , P.J.S. 2013. Water Quality Assessment of Sukhna Lake of Chandigarh City of India. *Hydro Nepal*. 12:26-31.

[4] Drinking Water Standards of BIS (IS: 10500: 1991)

[5] French, Petticrew. 2006. Chlorophyll *a* seasonality in four shallow eutrophic lakes (northern British Columbia, Canada) and the critical roles of internal phosphorus loading and temperature,*Hydrobiologia* , 575:285–299.

[6] Rahul , Arvind, S.K. 2013.Assessment of Lake Water Quality by Using Palmer and Trophic State Index- a Case Study of Upper Lake, Bhopal, India. *International Research Journal of Environment Sciences.* 2(5): 2319–1414.

[7] Standard methods for the examination of water and wastewater.

[8] Kaur, S., C.I., A. 2011. Water quality analysis of sukhna lake, Chandigarh. *International Journal of Advances in Engineering Research*. 2(3): 2231-5152

[9] Kaur, S., Singh, I. 2012. Acceleralted phosphate & nitrate level: factors to blame for 'Eutrophication' in Yamuna river, Delhi, *India.International Journal of Plant, Animal and Environmental Sciences* . 2(3):2231-4490.

[10] Xiangcan, 2003. Analysis of eutrophication state and trend for lakes in China. *Bolsena Conference (2002). Residence time in lakes:Science, Management, Education J. Limnol., 62(2): 60-66.*

[11] Yang, Wu, Hao, He. 2008 Mechanisms and assessment of water eutrophication. *Journal of Zhejiang University SCIENCE B.* 9(3):197-209.