

Assessment of seasonal variation in chemical characteristics of Tamdil lake, Mizoram, Northeast India.

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Abstract: The present investigation was carried out to assess the chemical characteristics of Tamdil, Mizoram, North-east India, at monthly intervals for a period of two years, i.e. March, 2014 to February, 2016, and results are computed on seasonal basis i.e. pre-monsoon, monsoon, post-monsoon and winter seasons. It was found that dissolved oxygen ranged from 3.99mg/L to 7.9mg/L, biological oxygen demand value ranged from 0.06mg/L to 1.55mg/L, nitrate-N value ranged from 0.16mg/L to 0.89mg/L and phosphate-P value ranged from 0.03mg/L to 0.178mg/L. The results reveal that there is a significant seasonal variation in all the parameters and all the parameters are within the prescribed limits of water quality laid down by various scientific agencies. The data were subjected to correlation coefficient among different variables using SPSS version 16.0 software to check the validity and significance of the result.

Key words: Chemical characteristics, Dissolved oxygen, Biological oxygen demand, Nitrate-N, Phosphate-P, Water quality standards.

INTRODUCTION

The lakes and reservoirs, all over India without exception, are in varying degrees of environmental degradation, might be due to encroachments, eutrophication (from domestic and industrial effluents) and silt¹. There has been a quantum jump in population during the last century without corresponding expansion of civic facilities resulting in lakes and reservoirs, especially the urban ones, becoming sinks for contaminants. Most urban and rural lakes have vanished under this pressure with worldwide environmental concerns^{2,3}. Other anthropogenic activities such as illegal construction, litter, domestic discharge, and recreational use of lake water are major concerns for sedimentation and eutrophication of the lake water⁴. Of all the water quality issues facing lakes everywhere, eutrophication is of great concern. Eutrophication is the term used to describe the aging of the lake, resulting due to the accumulation of nutrients, sediments, silt and organic matter in the lake from the surrounding watershed⁵.

STUDY AREA AND STUDY SITES

Mizoram is one of the north-eastern states of India, having a total geographical area of 21,081 sq km with a population of 1,091,014, the density being 52 per sq km². Amidst the precipitous terrain of Mizoram, there are only a few natural lakes. They are formed at places, where hills and ridges serve as natural embankment on all sides. Lakes are locally called 'Dil'.

The large lakes to be mentioned are Palak Dil and Tamdil, which are included under National Wetland Conservation Programme in 2005. The other smaller lakes, which are tiny pools or marshy depressions, are Rengdil (0.6 sq.km), Rungdil (0.75 sq.km), Diltlang (0.5 sq.km), Hmawngbu (0.7 sq.km). Tamdil is the only lake that has been developed and created as the most important and productive fish pond by the state government.⁶

Tamdil, a freshwater lake is located at 12kms towards the north-west side of Saitual town, Aizawl District. Mizoram, North East India. The lake lies between 23⁰44'20.4"N Latitude and 92⁰57'10.8"E Longitude. It is situated at an altitude of 717m above sea level. The circumference of the lake is 890 running meters, with a maximum depth of about 7 meters; it has a catchment area of 13.5sq.km. The lake lies within Aizawl district and is about 110 kms from Aizawl city, the state capital of Mizoram, N.E.India. Tamdil lake is one of the two wetlands identified under National Wetland Conservation programme in Mizoram.

The water samples of Tamdil lake were collected from five sampling sites at monthly intervals for analysis of various water quality parameters for a period of two years. The selected sampling sites are as follows:

- Site 1 - inflow from Dilkhan village side.
- Site 2 - inflow from Tualbung village side.
- Site 3 - mid-Lake region.
- Site 4 - corner of the Lake near the outlet.
- Site 5 - outlet of the Lake.

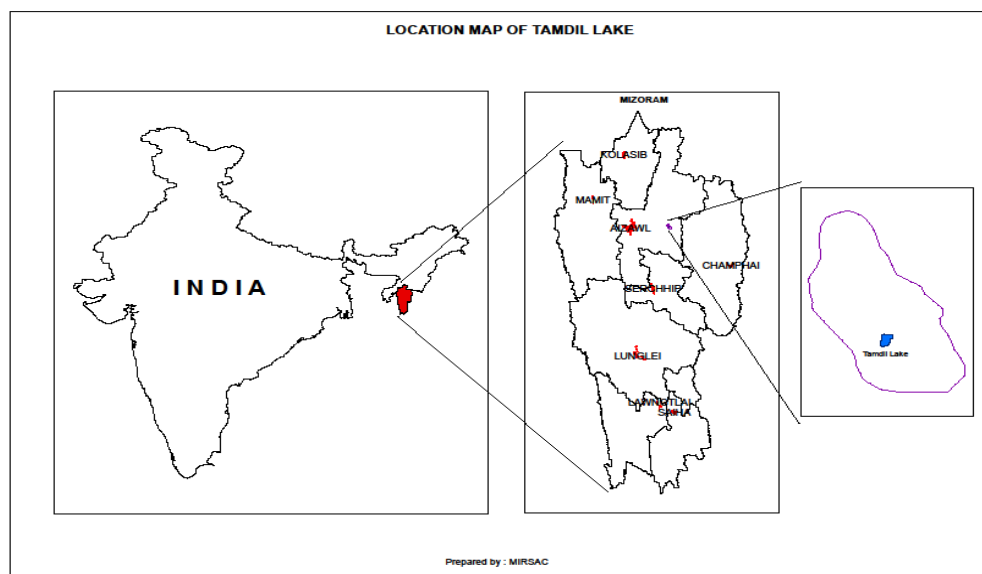


Figure 1 : Map showing Location of Study site



Figure 2 : Picture of Tamdil Tamdil



Figure3 : Google Earth picture of

MATERIALS AND METHODOLOGY

Water samples were collected at monthly intervals in triplicates from each sampling site for a period of two years (i.e., from March, 2014 to February, 2016) for analysis of chemical characteristics of water namely, DO, BOD, nitrate-N and Phosphate-P. Samples for DO were fixed at the sampling site. Samples for other water quality attributes were brought to the laboratory for chemical characteristics analysis. The methods outlined in the Standard methods for the examination of water and waste water⁷ and Handbooks of methods in environmental studies, water and waste water analysis⁸ were used for the analysis.

RESULT AND DISCUSSION

1. **Dissolved oxygen:** Dissolved oxygen is an important parameter in water quality assessment and reflects the physical, and biological processes prevailing in the water. The DO value indicates the degree of pollution in water bodies⁹. The dissolved oxygen varied from a minimum of 3.99mg/L at site 4 during September, 2014 to a maximum of 7.9mg/L at site 3 during February, 2016 (Figure 4). The site having most consistent values during the study period of two years was site 1 with minimum standard deviation of 0.64mg/L; while the site giving most varying dissolved oxygen was site 3 having maximum standard deviation as 0.83mg/L. There was a negative correlation between DO and BOD (-0.692), and a negative and significant correlation between DO and Nitrate (-0.790*) and between DO and Phosphate -P (-0.759**).

Figure 5 shows the seasonal variation in DO values, the dissolved oxygen was found to be maximum during winter season and minimum monsoon and post-monsoon seasons. The dissolved oxygen in water is temperature dependent. As it is required to all plants and animals for respiration, the high temperature and low dissolved oxygen during summer create favorable condition for the development of green algae¹⁰.

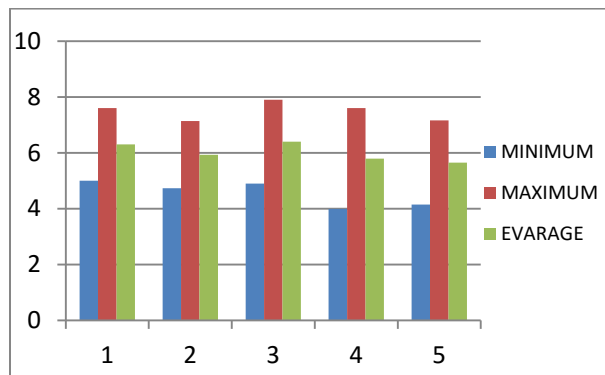


Figure 4: Minimum, Maximum and average DO (mg/L) values for 2 years data

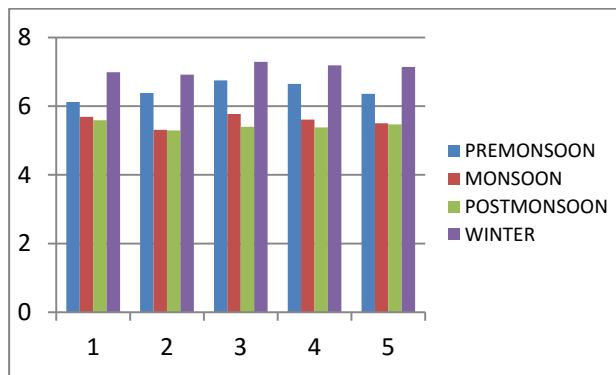


Figure 5: Seasonal Variation in DO (mg/L) values for 2 years average data

2. Biological Oxygen Demand: B.O.D determinate the amount of oxygen required for biological oxidation of organic matter with the help of microbial activities¹¹. According to WHO 2004, the BOD of potable water should not exceed 6mg/L¹². In the present study the BOD value varied from a minimum of 0.06mg/L at site 1 during March, 2016 to a maximum of 1.55mg/L at site 3 during September, 2014 (Figure 6).The site having most consistent values during the study period of two years was site 3 with minimum standard deviation of 0.16mg/L; while the site giving most varying dissolved oxygen was site 2 having maximum standard deviation as 0.23mg/L. There was a positive correlation between BOD and Nitrate value (0.682), and a positive and significant correlation between BOD and Phosphate-P (0.916**).

As shown in Figure 7, the seasonal BOD values were found to be higher during monsoon and post-monsoon periods and this may be due to input of organic waste and enhanced bacterial activity¹³.

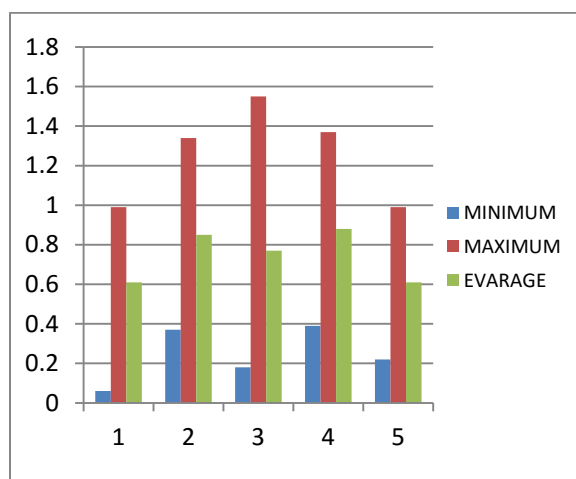


Figure 6: Minimum, Maximum and Average BOD (mg/L) values for 2 years

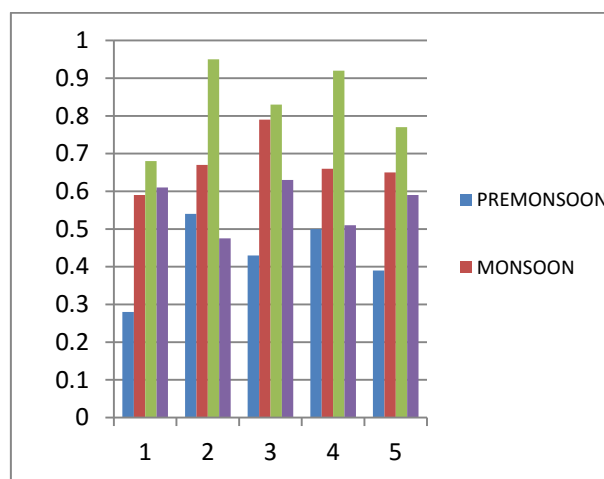


Figure 7: Seasonal Variation in BOD (mg/L) values for 2 years average data

3. Nitrate-N: Nitrate concentration depends on the activity of nitrifying bacteria which in turn get influenced by presence of dissolved oxygen⁵. From the present study the minimum values of nitrate obtained were 0.16mg/L during March, 2014 at site 3 and 5, and a maximum values of

0.89mg/L at site 5 during July, 2014 and at site 4 during July, 2015 (Figure 8). The site having most consistent values during the study period of two years was site 2 with minimum standard deviation of 0.178mg/L; while the site giving most varying nitrate value was site 4 having maximum standard deviation as 0.224mg/L. There was a positive correlation between Nitrate and Phosphate (0.635).

The seasonal variation in Nitrate value is given in Figure 9. There was a maximum concentration of nitrate during monsoon and post-monsoon periods. Higher values during rainy seasons may be due to discharge of waste through run off containing organic matter that results into high rate of organic matter decomposition¹⁴.

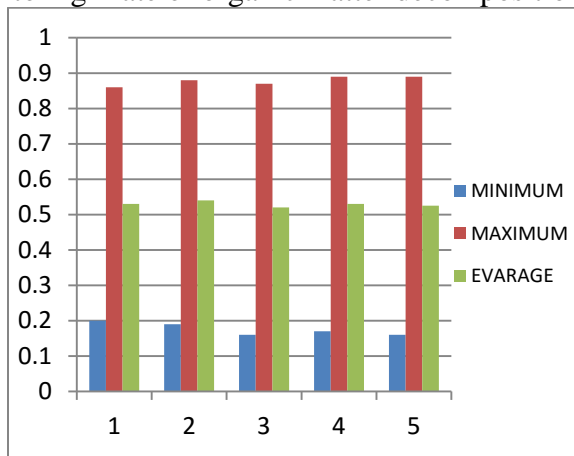


Figure 6: Minimum, Maximum and average Nitrate-N (mg/L) values for 2 years

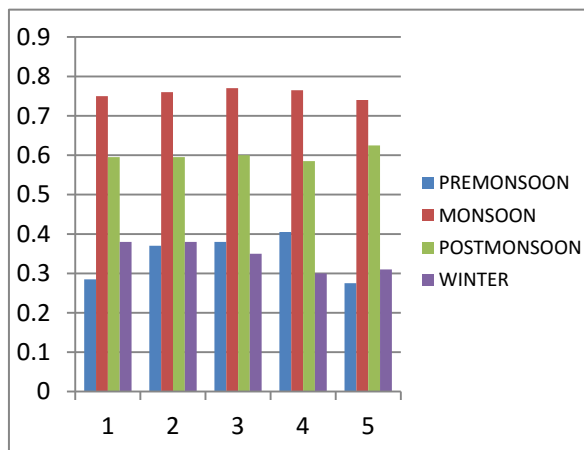


Figure 7: Seasonal Variation in Nitrate-N (mg/L) values for 2 years average data

4. Phosphate-P: Phosphate occurs in natural water in low quantity as many aquatic plants absorb and store phosphate many times their actual immediate needs¹⁵. In the present study, minimum value of 0.03mg/L Phosphate was found during January, 2015 at site 1 and 4 and maximum value of 0.178mg/L Phosphate was observed during November, 2016 at site 2 (Figure 10). The site having most consistent Phosphate values during the study period of two years was site 5 with minimum standard deviation of 0.008mg/L; while the site giving most varying Phosphate value was site 2 having maximum standard deviation as 0.029mg/L.

Figure 11 shows the seasonal variation in Phosphate values. Maximum value was seen during post-monsoon season and monsoon seasons in both the years. The increase in the concentration of phosphate during rainy season is the results of incoming water from the catchment area of human settlement and the entry of domestic sewage. The occurrence of fewer nutrients during winter may be due to their utilization in macrophytic growth¹⁶.

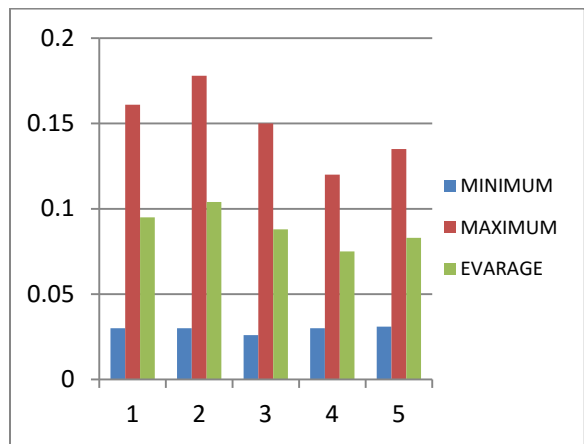


Figure 6: Minimum, Maximum and average Phosphate-P (mg/L) values for 2 years

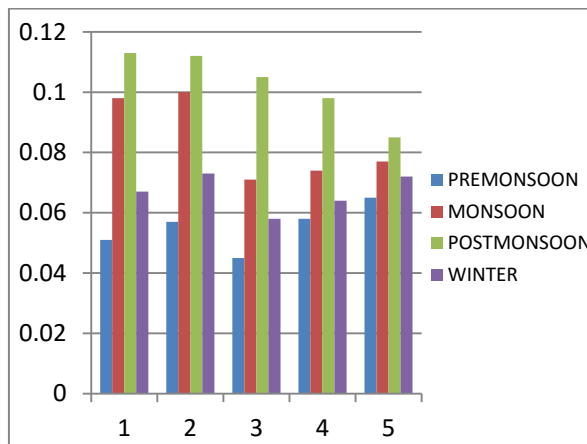


Figure 7: Seasonal Variation in Phosphate-P (mg/L) values for 2 years average data

CONCLUSION

The result obtained from the present study are compared with the standards for drinking water given by various scientific agencies like WHO standard (2004)¹², USPH¹⁷ (1962), ICMR (1996)¹⁸ and BIS (2012)¹⁹. It was found that all values were within the permissible limits given by different agencies. The findings of the present study on various water quality attributes are in conformity with the earlier work done so far²⁰⁻²². Tamdil lake is a good, nutrient rich ecosystem and has the ability to sustain tremendous diversity of flora and fauna. The results depict that lake water needs proper management to eliminate traces of pollutants within or above the prescribed limits.

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