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Sulphate, phosphate-P and nitrate-N contents of Tlawng river, near Aizawl City, India

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ABSTRACT

Tlawng River is a major source of potable water in Aizawl District of Mizoram. Rapid increase in population and developmental activities increase pollutants in river water. The present study aims to assess the water quality of Tlawng River running near Aizawl city, Mizoram. The findings revealed that sulphate ranged from 1.1-6.9 mgL^{-1}, phosphate-P from 0-0.028 mgL^{-1} and nitrate-N from 0.02-0.32 mgL^{-1}. From the present observation, the water quality of Tlawng River is found to be of good quality. The values are within the prescribed limits laid down by various scientific agencies, however, there is an ample scope of treatment of water before supply, to remove much pollutants present in the water. The statistical analysis indicates significance and validity of results.

Key words: Water quality; sulphate; phosphate; nitrate; Tlawng River.

INTRODUCTION

In river basin, a variety of factors such as bedrock geology, mineralogy, hydrology, climate, vegetation and human activities regulate the elemental load.[1-3] The water pollution problem has now become a challenging task for environmentalists, as most of the surface water bodies are getting more polluted and intensity of pollutants increases with time. The usual measures are not effective, as implementation of management measures is rather poor in developing countries like India. In Mizoram, majority of people are using water of Tlawng river for various purposes such as drinking, bathing and recreational purposes. Keeping this in mind, present work was conducted with an aim to assess the quality of the river water.

The river Tlawng rises at a general altitude of 840 ft in an area having co-ordinate 23°45' E and 92°44'N (Map). Tlawng watershed is situated in the middle of the state and flows along Aizawl and Lunglei districts of Mizoram. It is largest river in the state with a length of 157.38 km. The river originates from Zobawk village at Lunglei district and flows from south to north and discharges into Barak Valley in Cachar, Assam. For present investigation, the water samples were collected from 6 different sites from upstream to downstream

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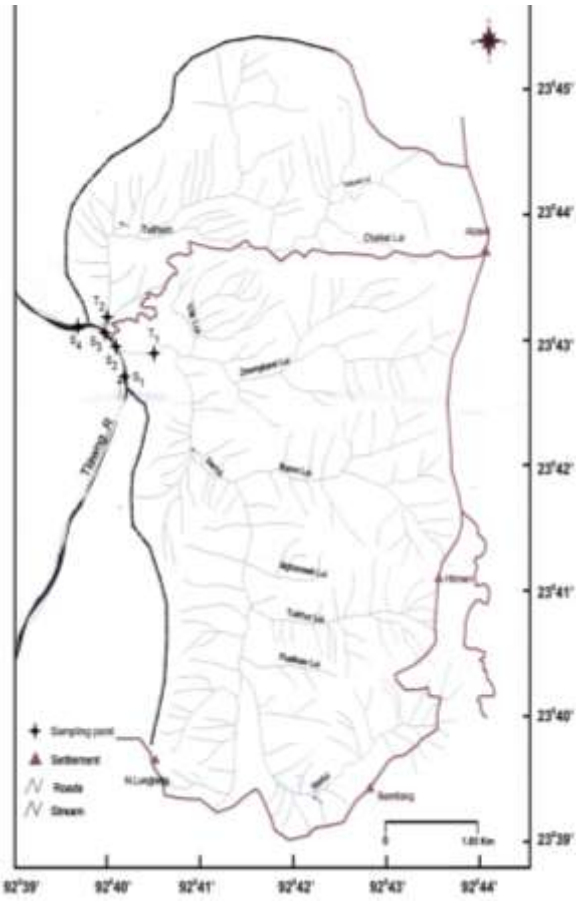
of Tlawng river along city of Aizawl and 1 PHE treated sample for comparision.

The study area was divided as Site 1 (S_1) demarcated as Tlawng river before tributary 1 (T_1) *i.e.* Serlui; Site 2 (S_2) demarcated as Tlawng river after tributary 1(T_1) *i.e.* Serlui; Site 3 (S_3) demarcated as Tlawng river before tributary 2(T_2) *i.e.* Tuithum; Site 4 (S_4) demarcated as Tlawng river after tributary 2(T_2) *i.e.* Tuithum; Site 5 (S_5) is the river water after treatment; Tributary 1 (T_1) is water from tributary 1 *i.e.* Serlui; and Tributary 2 (T_2) water from tributary 2 *i.e.* Tuithum.

MATERIALS AND METHODS

Water samples from Tlawng river were collected from seven different points at monthly intervals for various water quality analysis for a period of two years, *i.e.* from February 2007 to January 2009. The methods as outlined in the *Standards Methods for the Examination of Water and Wastewater*[4] and *Handbook of Methods in Environmental Studies. Vol 1: Water and Wastewater analysis*.[5] Colorimetric method was used for the analysis of sulphate content present in water sample, stannous chloride method was used for the determination of phosphate-P in the water sample, similarly, Phenol di-sulphonic acid (PDA) method was employed for determining nitrate-N present in the water sample. The values were expressed in mg/L. To check the validity of data and significance of results, two-way ANOVA and correlation co-efficient were analysed, statistical investigation offers more attractive options in environment science, though the results may deviate more from real situations.[6]



Map. Study site. Drainage of Tlawng.

RESULTS

Sulphate

During the study period, sulphate values ranged from 1.1-6.9 mgL^{-1}. It was found to be highest in the month of December 2008 at T_2 and lowest in the month of June and July 2007 at S_5. The values were higher in tributary water and lower in treated water.

A negative and significant ($P<0.05$) correlation for sulphate was observed with phosphate ($r = -0.1849$) and a negative correlation with nitrate ($r = -0.0423$). A positive and significant correlation for all the sites was observed. S_1 positively correlates with S_2 ($r = 0.9922$), S_3 ($r = 0.9807$), S_4 ($r = 0.9745$), S_5 ($r = 0.8362$), T_1 ($r = 0.9603$) and T_2 ($r = 0.9525$). S_2 showed a positive and significant correlation for S_1 ($r = 0.9922$), S_3 ($r = 0.9857$), S_4 ($r = 0.9817$), S_5 ($r = 0.8607$), T_1 ($r = 0.9614$) and T_2 ($r = 0.9530$). S_3 showed a positive and significant correlation for S_1 ($r = 0.9807$), S_2 ($r = 0.9857$), S_4 ($r = 0.9914$), S_5 (r

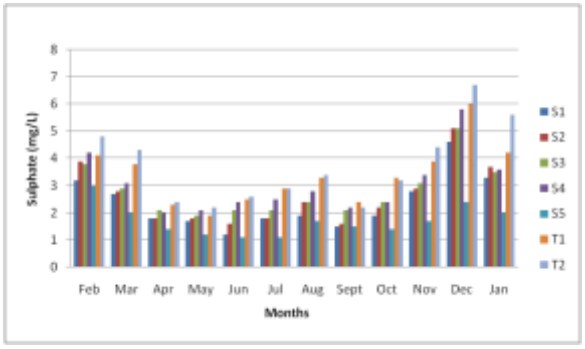


Figure 1. Monthly variation in sulphate content of Tlawng River water from Feb 2007-Jan 2008.

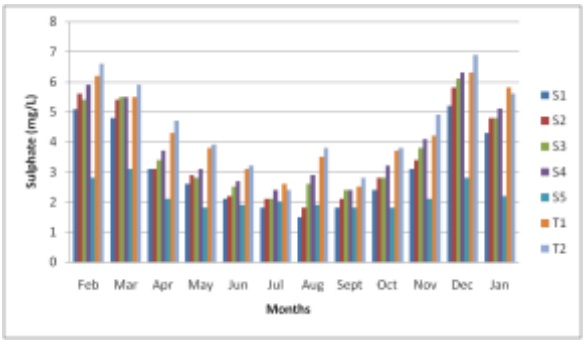


Figure 2. Monthly variation in sulphate content of Tlawng River water from Feb 2008-Jan 2009.

= 0.8546), T_1 (r = 0.9655) and T_2 (r = 0.9530). S_4 showed a positive and significant correlation for S_1 (r = 0.9745), S_2 (r = 0.9817), S_3 (r = 0.9914), S_5 (r = 0.8444), T_1 (r = 0.9755) and T_2 (r = 0.9605). S_5 showed a positive and significant correlation for S_1 (r = 0.9603), S_2 (r = 0.99614), S_3 (r = 0.9655), S_4 (r = 0.9755), T_1 (r = 0.8008) and T_2 (r = 0.8097). T_1 showed a positive and significant correlation for S_1 (r = 0.9603), S_2 (r = 0.9614), S_3 (r = 0.9655), S_4 (r =9755), S_5 (r = 0.8008), T_2 (r = 0.9739). T_2 showed a positive and significant correlation for S_1 (r = 0.9525), S_2 (r = 0.9530), S_3 (r = 0.9530), S_4 (r = 9605), S_5 (r = 0.8097), T_2 (r = 0.9739).

Analysis of variance revealed significant (P<0.01) variation between the first year (F = 19.09) and the second year (F = 8.73).

Phosphate

During the study period, phosphate value ranged from 0-0.028 mgL^{-1}. It was observed to be highest in the month of April 2007 at T_2 found to be lowest in the month of June, July, August and September 2008 at S_5.

A positive and significant (P<0.05) correlation for phosphate was observed with nitrate (r = 0.6802) and a negative and significant correlation with sulphate (r = -0.1849). A positive and significant correlation for S_1 was observed with S_2 (r = 0.8657), S_3 (r = 0.8599), S_4 (r = 0.9157), T_1 (r = 0.8119) and T_2 (r = 0.9166) and a negative correlation for

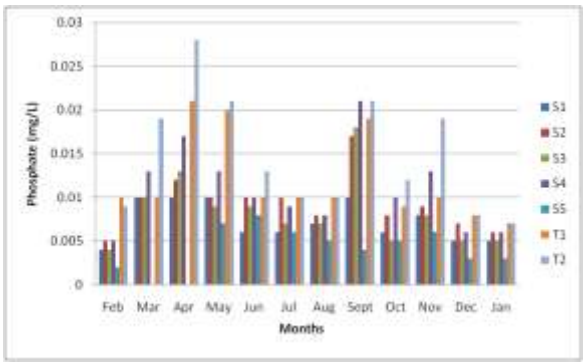


Figure 3. Monthly variation in phosphate content of Tlawng River water from Feb 2007-Jan 2008.

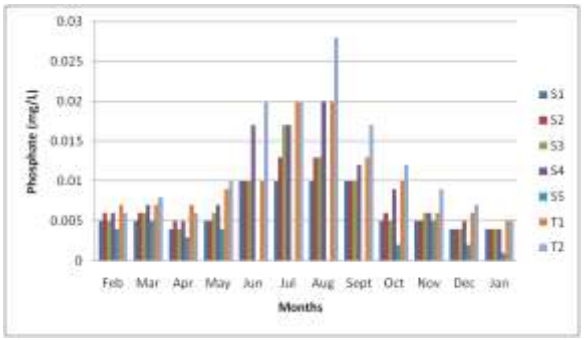


Figure 4. Monthly variation in phosphate content of Tlawng River water from Feb 2008-Jan 2009.

S_5 (r = -0. 3130) was observed. S_2 showed a positive and significant correlation for S_1 (r = 0.8657), S_3 (r = 0.9391), S_4 (r = 0.9340), T_1 (r = 0.8382) and T_2 (r = 0.8324) and a negative correlation for S_5 (r = -0. 1217) was observed. S_3 showed a positive and significant correlation for S_1 (r = 0.8599), S_2 (r = 0.9391), S_4 (r = 0.9212), T_1 (r = 0.8486) and T_2 (r = 0.8263) and a negative correlation for S_5 (r = -0. 2690) was observed. S_4 showed a positive and significant correlation for S_1 (r = 0.9157), S_2 (r = 0.9340), S_3 (r = 0.9212), T_1 (r = 0.8747) and T_2 (r = 0.9383) and a negative correlation for S_5 (r = -0. 2843) was observed. A negative correlation for S_5 was observed with S_1 (r = -0.3130), S_2 (r = -0.1217), S_3 (r = -0.2690), S_4 (r = -0.2843), T_1 (r = -0.2175) and T_2 (r = -0.3163). T_1 showed a positive and significant ($P<0.05$) correlation for S_1 (r = 0.8119), S_2 (r = 0.8382), S_3 (r = 0.8486), S_4 (r = 0.8747) and T_2 (r = 0.8773) and a negative correlation for S_5 (r = -0.2175) was observed. T_2 showed a positive and significant correlation for S_1 (r = 0.9166), S_2 (r = 0.8324), S_3 (r = 0.8263), S_4 (r = 0.9383) and T_1 (r = 0.8773) and a negative correlation for S_5 (r = -0.3163) was observed. Analysis of variance revealed significant ($P<0.01$) variation in the second year (F = 10)

Nitrate

During two years of study, nitrate value ranged from 0.02-0.32 mgL^{-1}. The value of nitrate was observed to be highest in the month of May, 2008 at T_2 and lowest in the month of October 2008 at S_5.

A positive and significant ($P<0.05$) correlation for nitrate was observed with phosphate (r = 0.6802) and a negative correlation was observed with sulphate (r = -0.0423). A positive and significant correlation for S_1 was observed with S_2 (r = 0.8576), S_3 (r = 0.8215), S_4 (r = 0.8259), T_1 (r = 0.7489) and T_2 (r = 0.7734) and a positive correlation with S_5 (r = 0. 1588) was observed. S_2 showed a positive and significant correlation for S_1 (r = 0.8576), S_3 (r = 0.9340), S_4 (r = 0.9424), T_1 (r = 0.8167) and T_2 (r = 0.7845) and a positive correlation for S_5 (r = 0. 2963) was observed. S_3 showed a positive and significant correlation for S_1 (r = 0.8215), S_2 (r = 0.9340), S_4 (r = 0.9527), T_1 (r = 0.7502) and T_2 (r = 0.7072) and a positive correlation for S_5 (r = 0. 2178) was observed. S_4 showed a positive and significant correlation for S_1 (r = 0.8259), S_2 (r = 0.9424), S_3 (r = 0.9527), T_1 (r = 0.8011) and T_2 (r = 0.7777) and a positive correlation for S_5 (r = 0. 2103) was observed. A positive correlation for S_5 was observed with S_1 (r = 0.1588), S_2 (r = 0.2963), S_3 (r = 0.2178), S_4 (r = 0.2103), T_1 (r = 0.3183) and T_2 (r = 0.2078). T_1 showed a positive and significant correlation for S_1 (r = 0.7489), S_2 (r = 0.8167), S_3 (r = 0.7502), S_4 (r = 0.8011) and T_2 (r = 0.9272) and a positive correlation for S_5 (r = 0.3183) was observed. T_2 showed a positive and sig-

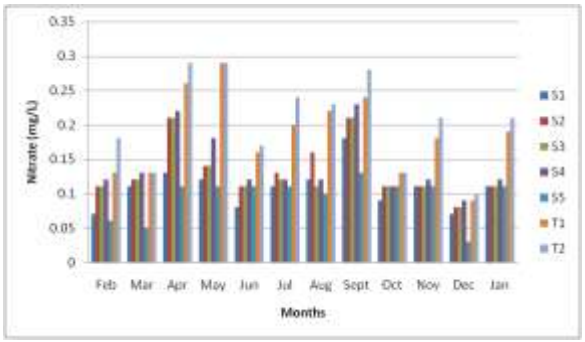


Figure 5. Monthly variation in nitrate content of Tlawng River water from Feb 2007-Jan 2008.

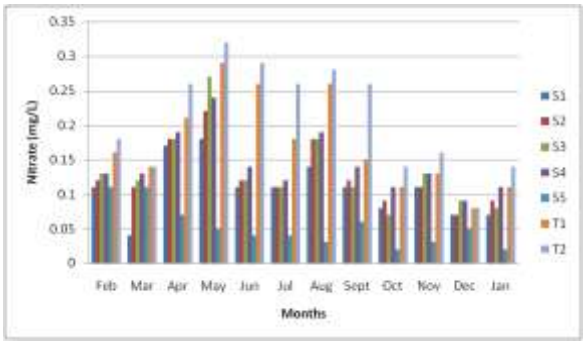


Figure 6. Monthly variation in nitrate content of Tlawng River water from Feb 2008-Jan 2009.

nificant correlation for S_1 (r = 0.7734), S_2 (r = 0.7845), S_3 (r = 0.7072), S_4 (r = 0.7777) and T_1 (r = 0.9272) and a positive correlation for S_5 (r = 0.2078) was observed. Analysis of variance revealed significant ($P<0.01$) variation in the second year ($F = 16.7$).

DISCUSSION AND CONCLUSIONS

During the study period, sulphate values are within the permissible limit given by WHO and BIS. Sulphate values are low during monsoon season and high during post-monsoon season. Higher values of sulphate during post-monsoon season may be due to low flow of river and increasing biological activity.[7-9] Sulphate doses of 100 to 2000 mg/L have a cathartic effect on humans, resulting in purgation of the alimentary canal. Sulphate is responsible for odour and sewer corrosion. Low concentration of sulphate restricts the growth of phytoplanktons. During the study period, phosphate values are within the permissible limit given by WHO and BIS. Phosphate values are high during pre-monsoon and monsoon season and low during winter season which may be due to anthropogenic source.[10,11] Phosphate is an essential plant nutrient and can play an important role in limiting factor and responsible for the growth of plants specially phytoplanktons in the water systems. During the study period, nitrate values are within the permissible limit given by WHO and BIS. Nitrate values are high during rainy season and low during winter.[12,13] Nitrates are used widely as inorganic fertilizers, explosives, as oxidizing agents in chemical industry and as food preservatives. Nitrate is an important nutrient for aquatic life. According to Royal Commission[14], the quality of River Tlawng in case of nitrate is very clean.

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