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Seasonal variation in water quality of Tuirial River in vicinity of the hydel project in Mizoram, India

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Abstract

The present investigation deals with the analysis of important water quality parameters (pH, DO, and BOD) of Tuirial river (in vicinity of the Tuirial Hydel Project) in Mizoram have been analysed for a period of two years, i.e. from January 2008 to December 2009. The findings revealed that pH of water ranged from 7.19 at Site 2 during winter season of 2009 to 7.95 at Site 3 during rainy season of 2009; DO content of water ranged from 6.2 mgL^{-1} at Site 4 during rainy season of 2008 to 8.1 mgL^{-1} at Site 1 during winter season of 2008; BOD content of water ranged from 0.2 mgL^{-1} at Site 1 during winter season of 2008 to 1.2 mgL^{-1} at Site 4 during rainy season of 2008. The results indicate that all values are within the prescribed limit of water quality standard laid down by various scientific agencies like B.I.S, U.S.P.H and W.H.O. Successive increase in BOD content of water from Site 1 to Site 4 (upstream to downstream) showed cumulative effect of sewage discharge and marked increase in values at Site 3 and 4 may be due to discharge of sewage containing more organic matter.

Key words: BOD; DO; permissible limits; pH; Tuirial river; water quality.

Introduction

River water finds multiple uses in every sector of development like agriculture, industry, transportation, aquaculture, public water supply etc. In addition, since old times, river waters have also been used for cleaning and other domestic purposes. The growing problem of degradation of our river ecosystem has necessitated the monitoring of water quality of various rivers all over the country to evaluate their production capacity, utility potential and to plan restorative measures.[1,2] The majority of people in the Mizoram depend on surface water bodies for their day to day life, as underground water is hardly assessable in most of the parts of the state, due to predominance of hilly terrain. Major portion of domestic, agriculture and other wastes are directly or indirectly discharged into the rivers situated in the vicinity, as no proper drainage system has been developed in the state so far. Since there has been no systematic study on Tuirial river, the present study has been car-

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ried out with an objective to slowly important water quality characteristics. The outcome of this study would undoubtedly be a potential tool for determining management technique for abatement of water pollution.

Materials and Methods

The Tuirial Hydel Project is situated in the Aizawl District of Mizoram at latitudes 24°21.5' N and longitude 92°53.2' E. The catchment area is about 1861 sq. km with an annual rainfall of 2540 mm. The area has a mean daily minimum and maximum temperature of 11.3°C and 26.5° C, respectively. Four locations (from upstream to downstream) were selected for sampling, i.e. Site 1 (Reference); Site 2 (Diversion inlet); Site 3 (Powerhouse outlet) and Site 4 (Diversion outlet) (Fig. 1).

The water quality parameters such as pH, DO and BOD contents were analyzed following APHA (2005),[3] and the methods outlined in Maiti (2001)[4] and compared with standards given by WHO (2004),[5] BIS (1983)[6] and USPH (1962).[7] pH of water was measured with a digital 'hydrogen ion electrode'. D.O. content of water samples was measured by following Modified Wrinkler's iodide azide method. This method is a titrimetric procedure based on the oxidizing property of oxygen dissolved in water. For the estimation of BOD of water samples, initial and final DO contents of water samples were determined just after collection of sample and after 5 days incubation at 20°C in BOD incubator, respectively.

Figure 1. Location map of study site.

Results and Discussion

pH

The pH of water is an important parameter, as all chemical and biochemical reactions are governed by pH. The range of pH of water is significant for the biotic communities because most of the plant and animal species can survive in a narrow range of pH, i.e. from slightly acidic to slightly alkaline condition.[8] The pH of an aqueous system is a measure of the acid-base equilibrium achieved by various dissolved compounds, and in most natural waters pH is controlled by the carbon dioxide-bicarbonate equilibrium system.

The present investigation depicts prevalence of alkaline earth metals. pH of water ranged from 7.27 to 7.91 during 2008 (from 7.27 to 7.65 at Site 1, from 7.29 to 7.81 at Site 2, from 7.31 to 7.85 at Site 3 and from 7.29 to 7.91 at Site 4). Similarly, pH ranged from 7.19 to 7.95 during 2009; from 7.21 to 7.81 at Site 1, from7.19 to 7.92 at Site 2, from 7.24 to 7.95 at Site 3 and from 7.27 to 7.85 at Site 4.

The pH values at Site 1 were normally lower in all seasons with some exceptions. On the contrary, pH of water at Site 3 and Site 4 were normally higher than other sites in respective season. Winter season possessed lower values and higher values were recorded during rainy season (Fig. 2). The values recorded were within the

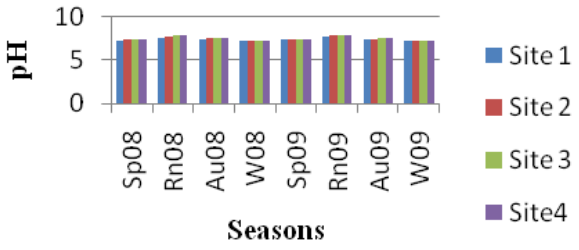

Figure 2. Seasonal variation in pH of water at selected study sites (January 2008 - December 2009).

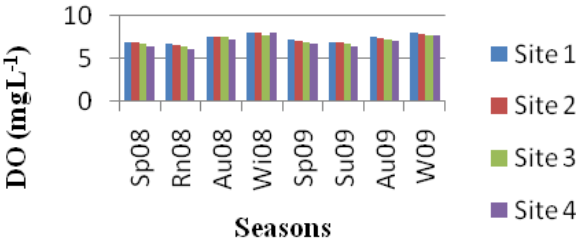

Figure 3. Seasonal variation in DO content of water at selected study sites (January 2008 - December 2009).

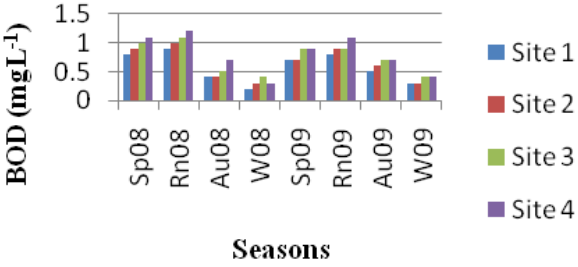

Figure 4. Seasonal variation in BOD of water at selected study sites (January 2008 - December 2009).

Table 1. Comparison of results with standards given by various scientific agencies.

Parameters	Range recorded during January 2008 - December 2009	STANDARDS		
		USPH	WHO	BIS
pH	7.19 - 7.95	6-8.5	6.5-8.5	6.5-8.5
DO (mgL^{-1})	6.2 - 8.1 mgL^{-1}	>4	-	>5
BOD(mgL^{-1})	0.2 - 1.2 mgL^{-1}	+	-	<3

- Not available
+No consensus on a single numerical value which is universally accepted.

prescribed limit laid down by various scientific agencies (Table 1). A positive correlation of pH was observed with BOD. On the contrary, a negative and significant correlation of pH was established with DO (-.732*). The water pH was slightly basic at all the sites and in all seasons. The pH values during rainy season were markedly higher, this could be attributed due to the leaching of rock material.[9] Site 1 possessed less alkaline water than other sites.

Dissolved Oxygen (DO)

Dissolved oxygen content plays a vital role in support of aquatic life, oxygen depletion often results during time of high community respiration and decomposition of organic matter. Hence DO content of water has been extensively used as a parameter delineating water quality and to evaluate the degree of freshness of a river.[9]

During the present investigation, dissolved oxygen content of water ranged from 6.2 mgL^{-1} to 8.1 mgL^{-1} during 2008 (from 6.8 mgL^{-1} to 8.1 mgL^{-1} at Site 1, from 6.9 mgL^{-1} to 8 mgL^{-1} at Site 2, from 6.5 mgL^{-1} to 7.8 mgL^{-1} at Site 3 and from 6.2 mgL^{-1} to 8 mgL^{-1} at Site 4). Similarly, DO content ranged from 6.5 mgL^{-1} to 8 mgL^{-1} during 2009 (from 7 mgL^{-1} to 8 mgL^{-1} at Site 1, from 6.9 mgL^{-1} to 7.9 mgL^{-1} at Site 2, from 6.8 mgL^{-1} to 7.8 mgL^{-1} at Site 3 and from 6.5 mgL^{-1} to 7.8 mgL^{-1} at Site 4). The Site 1 possessed higher values than the other sites in respective season. The DO content of water at all sites was observed higher during winter season and lower during rainy season (Fig. 3).A negative and significant correlation of DO was established with pH (-.723*) and BOD (-.998**). In the present investigation, low DO content during rainy season may be due to high rate of organic matter decomposition, as organic matter from surroundings is discharged into river water through surface runoff.[10] On the contrary, higher values during winter season may be due to low decomposi-

tion rate and increased photosynthesis. The values recorded were within the prescribed limit of USPH and BIS (Table 1).

Biological Oxygen Demand (BOD)

Biological oxygen demand is a measure of the oxygen required by the microorganisms for decomposition of organic matter present in water. The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand.[11] BOD directly affects the amount of dissolved oxygen in rivers and streams. The greater the BOD content, the more rapidly oxygen is depleted resulting into low oxygen availability for aquatic life.

In the present investigation, BOD content of water ranged from 0.2 mgL^{-1} to 1.2 mgL^{-1} during 2008 (from 0.2 mgL^{-1} to 0.9 mgL^{-1} at Site 1, from 0.3 mgL^{-1} to 1 mgL^{-1} at Site 2, from 0.4 mgL^{-1} to 1 mgL^{-1} at Site 3 and from 0.3 mgL^{-1} to 1.2 mgL^{-1} at Site 4). Similarly, BOD content ranged from 0.3 mgL^{-1} to 1.1 mgL^{-1} during 2009 (from 0.3 mgL^{-1} to 0.8 mgL^{-1} at Site 1, from 0.3 mgL^{-1} to 0.9 mgL^{-1} at Site 2, from 0.4 mgL^{-1} to 0.9 mgL^{-1} at Site 3 and from 0.4 mgL^{-1} to 1.1 mgL^{-1} at Site 4). The Site 4 possessed higher values of BOD than the other sites in respective season. On the contrary, lower values were recorded at Site 1 and Site 2. The BOD content of water at all sites was observed lower during winter season and higher during rainy season (Fig. 4). A positive correlation of BOD was observed with pH. On the contrary, a negative and significant correlation of BOD was established with DO (-.998**). The finding of the present study reveals that BOD content of water was within the permissible limits given by scientific agencies (Table 1). The higher values during rainy season and lower values during winter season may be due to increased metabolic activities of microbes present in the water bodies and low decomposition rate of organic matter, respectively.[12]

CONCLUSION

The findings of the present study reveal that pH values during rainy season were higher compared to winter season. The higher pH values during rainy season may be due to the leaching of rock material. Low DO content during rainy season may be due to high rate of organic matter decomposition. On the contrary higher content during winter season may be due to low decomposition rates and increased photosynthesis. The higher BOD values during rainy season and lower values during winter season may be due to increased metabolic activities of microbes present in the water bodies and low decomposition rate of organic matter respectively. pH, DO and BOD values recorded are all within the prescribed permissible limits laid down by different scientific agencies.[3-5] The water of Tuirial river seems to be unpolluted but regular monitoring is required to assess the health of river water to determine appropriate measure for control of water pollution. It is suggested that the river water should not be used for drinking purpose as traces of pollutants present in water may lead to harmful effects on human body. Thus, it is recommended that river water is properly treated before use.

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