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Assessment on Water Quality of Tuirial River Aizawl, Mizoram North-East India

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ABSTRACT

Tuirial river is one of the most important rivers in Aizawl Mizoram that provides water for drinking, washing and household activities for the people who lived near the river. In order to understand the water quality of the river, the physico-chemical characteristics such as pH, Temperature, Alkalinity, Dissolve Oxygen (DO) and Biological Oxygen Demand (BOD) were analyzed for a period of one year on monthly basis from September 2019- August 2020. Altogether, five sampling stations have been selected and the study reveals that all the analyzed water samples were within the standard range prescribed by various scientific agencies. During the study, the intensity of pollutants level increases from upstream towards downstream which may be due anthropogenic activities on and around the river water.

Keywords Water quality, pH, DO, Tuirial river, Physico-chemical.

INTRODUCTION

Water is one of the most important natural resources on which the survival of all life on earth depends. It is absolutely necessary for drinking, domestic purposes, irrigation, industrial activities, hydropower generation and also for recreation. Besides of the above mentioned daily uses of water, water also play a critical role for plants as well as animals and moreover the ecological balanced of the ecosystem has been maintained and determined by the quality and quantity of water. However, although plenty amount of water is found on earth, all the available water is not accessible for sustenance of life. Surface water like rivers are the main sources of water for human utilization in domestic, irrigation and industrial purposes (Shil *et al.* 2019). But unfortunately, this great source of water has been deteriorated and degraded seriously both by natural process and anthropogenic activities (Vadde *et al.* 2018). Although, natural processes like precipitation inputs, erosion of soil and weathering of rocks due to climatic conditions degrades the river water but it is mainly through the input of human activities such as urbanization, industrialization and agriculture that deteriorates much of the river water Carpenter *et al.* (1998).

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Water quality refers to the assessment of physical, chemical, biological and bacteriological characteristics of water. Assessing on water quality provide a useful and necessary information regarding the water quality and its potential harm to various uses. Evaluation of river water quality is important, in consideration of human health and well-being of society as well as with the concern of economic growth. Surface water especially of rivers, are at the utmost concern because almost 70% of Indian rivers are contaminated with several kinds of pollutant (Martin 1998). Since river, is the main source of fresh water to man for use in different purposes, it is necessary to control and protect from pollution and having reliable information on water quality is effective in water management (Shil *et al.* 2019). Therefore, the present study was conducted with an aim of analyzing the water quality of Tuirial river from upstream to downstream by selecting a different point for serious examination. Acknowledging the status of our precious surface water is essential, since they serve as the main source of water that we use daily for drinking, domestic and other purposes.

MATERIALS AND METHODS

Description of the study site

Tuirial river is one of the most important rivers in Mizoram, Northeast India. It is 117 km in length originating from North Chawilung hills in Aizawl districts that flows in northern direction and join Barak river in Cachar district, Assam. The river flows through rural and residential regions that are crowded with people. The following five sample stations have been chosen along the river, from upstream to downstream, for a thorough study.

Site 1: The first sampling station is selected at the upstream with the least anthropogenic activities which is taken as a control or reference point.

Site 2: The second sampling site is selected in the upstream after meeting with chite stream.

Site 3: The third sampling station is selected at the point where the river receives waste from human settlement area.

Site 4: Towards downstream where river receives agriculture run off.

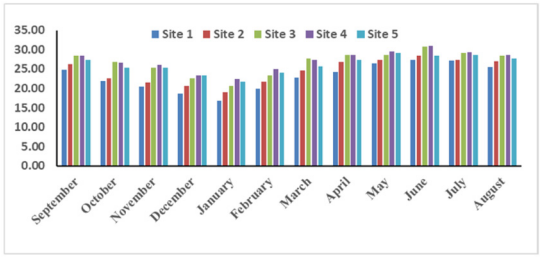

Fig. 1. Monthly water temperature from Sep 19-Aug 20.

Site 5: At the point where river receives waste from dumping ground of municipal solid waste.

Collection of water sample and water quality analysis

For assessing the physical and chemical characteristics of water, the water samples were collected from selected study sites at monthly intervals (in triplicates) for a period of one year (Sep 2019- Aug 2020) using wide mouth plastic bottles. Analysis of water quality parameters such as Temperature, pH, Total Alkalinity (TA), Dissolve Oxygen (DO) and Biological Oxygen Demand (BOD) was carried out with following the method as outlined in the `Standard Methods for the Examination of Water and Wastewater` APHA (2005). The water temperature and pH were measured on spot and for DO estimation, the water samples were fixed immediately at sampling sites and the remaining parameters were measured at the laboratory with necessary precautions and preservatives.

RESULTS AND DISCUSSION

The findings of the present study for different physical and chemical parameters at various stations along with their ranges were illustrated from Figs. 1–8 respectively.

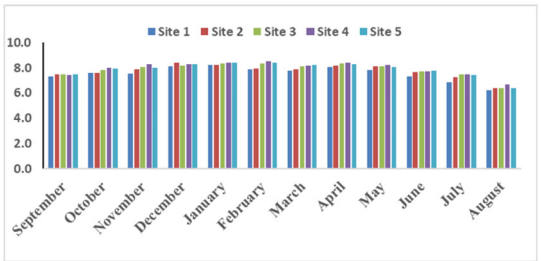

Fig. 2. Monthly variation in water pH from Sep 19-Aug 2020.

Fig. 3. Monthly variation in total alkalinity of water from Sep 19-Aug 2020.

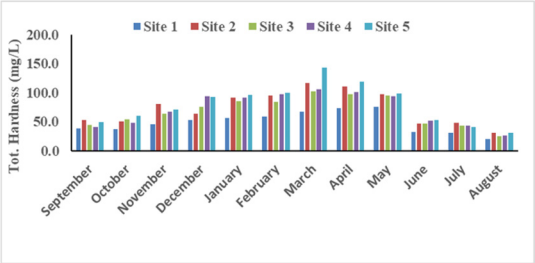

Fig. 4. Monthly variation in total hardness of water from Sep 19-Aug 2020.

Temperature

The temperature of water is one of the most important parameters in water quality as it affects all the chemical and biological processes in water bodies. In the present study the water temperature ranged from 16.9°C – 27.33°C in site1, 19.03°C – 28.47°C in site2, 20.67°C – 30.73°C in site3, 22.47°C - 30.93°C in site4 and 21.67°C – 29.2°C in site5. The minimum value 16.9°C was obtained from site1 in the upstream in January while the maximum value 30.93°C was recorded from site 4 towards the downstream in June. The difference in temperature value during the study can be related with the temperature of the atmosphere, weather conditions and the time of measurement (Muhammad *et al.* 2008). The average temperature values were generally higher during rainy periods in all respective sites. Increased value during rainy months may be due to discharge of organic matter through surface runoff and chemical reactions (Table 1). Similar results were reported in the work of Saini and Dube (2017), Badusha and Santhosh (2017) and Salam *et al.* (2019).

pH

pH in water is a measure of the concentration of hydrogen ions in water. pH plays an important role in maintaining the entire aquatic ecosystem. The higher value in pH of water indicates the presence of carbonates and bicarbonates in higher concentration. In the present study the pH value varied from 6.23- 8.24 in site1, 6.4-8.4 in site 2, 6.4-8.37 in site 3, 6.7-8.5 in site4 and 6.4-8.4 in site5. The lowest value was recorded from site1 6.23 in August while the highest value 8.5 was recorded from site 4 in February (Table 2). Lower pH value during rainy period could be due to accumulation of organic matter through surface runoff and as a result of decomposition releases the acid forming substances. The pH values recorded

Table 1. Monthly observed value of water temperature from September 2019-August 2020.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	24.80	26.33	28.33	28.33	27.33
October	21.93	22.67	26.73	26.67	25.33
November	20.47	21.50	25.33	26.00	25.33
December	18.70	20.67	22.67	23.33	23.33
January	16.90	19.03	20.67	22.47	21.67
February	19.90	21.80	23.27	25.00	24.00
March	22.73	24.53	27.67	27.33	25.67
April	24.20	26.73	28.67	28.67	27.33
May	26.40	27.33	28.67	29.50	29.20
June	27.33	28.47	30.73	30.93	28.33
July	27.20	27.33	29.13	29.33	28.67
August	25.57	27.00	28.33	28.53	27.67

Table 2. Monthly observed pH value from September 2019- August 2020.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	7.33	7.47	7.50	7.43	7.47
October	7.60	7.58	7.83	8.00	7.93
November	7.57	7.90	8.07	8.27	8.00
December	8.10	8.40	8.17	8.30	8.30
January	8.24	8.23	8.37	8.40	8.40
February	7.87	7.97	8.37	8.50	8.38
March	7.77	7.87	8.13	8.20	8.23
April	8.03	8.20	8.33	8.40	8.30
May	7.80	8.10	8.13	8.21	8.07
June	7.33	7.67	7.73	7.73	7.77
July	6.83	7.23	7.47	7.47	7.43
August	6.23	6.40	6.40	6.70	6.40

Fig. 5. Monthly variation in dissolve oxygen (DO) of water from Sep 19-Aug 2020.

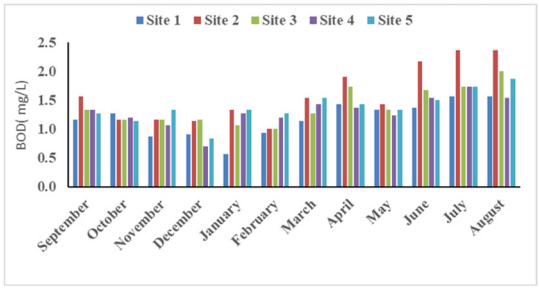

Fig. 6. Monthly variation in BOD of water from Sep 19-Aug 2020.

during the study fall under the prescribed limit given by various scientific agencies. The results obtain were in conformity with the work of Birajdar *et al.* (2017), Sinha and Sinha (2020) and Nama and Raj (2018).

Total alkalinity

Alkalinity of water is a measure of the capability of water to neutralize acids. It occurs in nature due to the presence of carbonates, bicarbonate and hydroxide compounds in water (Wetzel 2001). In the present study the total alkalinity value ranges from 25.3 - 166.7 mg/L. The highest value was recorded from site5 in April while the minimum value was recorded from site1 in August (Table 3). The average total alkalinity values were generally higher in summer in all respective sites. Increased value in total alkalinity of water may be due to human activities like washing of cloth, bathing and discharge of domestic sewage which increases the concentration of dissolved carbonates and bicarbonates. The observed value of the present work is more or less similar to the work of Elayaraj and Selvaraju (2014), Gupta *et al.* (2020), Sasikala *et al.* (2015), Divya Tyagi and Malik (2018).

Table 3. Monthly observed value in total alkalinity of water.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	39.3	54.67	51.3	47.3	54.67
October	40	51.3	47.33	49.3	54.3
November	46.7	56	45.3	53.3	56
December	54	72.7	82.67	66.67	76.7
January	62.67	90.67	82.7	96.7	103.3
February	69.3	100.7	86.67	94.7	102
March	83.3	124.67	115.3	116.7	153.3
April	92.7	139.3	125.3	132.67	166.7
May	100	114	107.33	104.7	106
June	38	65.3	56.7	62.7	58
July	32.67	31.7	26.67	26.7	31.3
August	25.3	38	36.7	36.67	42.67

Total hardness

Hardness of water is the capacity of water to react with detergents. The principal factor that contributes hardness in water are the dissolved minerals like calcium and magnesium salts. Measuring the hardness of water is important in order to determine the suitability of water for domestic, industrial processing, and also for drinking. According to the limits of WHO, hardness in water has been classified in the following range: The range between 0-40 are considered as soft, 40-100 as moderately hard, between 100-300 as hard and between 300-500 as very hard. The total hardness in the present study varied from 20.7 mg/L at site1 in August to 143.3 mg/L at site 5 in March (Table 4). The recorded values from site1 to site 5 were within the standard limit prescribed by BIS. Increased value

Table 4. Table showing the observed value in total hardness, of water during the study.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	38.00	52.33	44.00	41.33	49.33
October	36.67	50.67	54.00	48.00	60.00
November	45.33	80.00	64.00	66.67	70.67
December	53.33	63.33	76.00	93.33	92.00
January	56.00	91.33	85.33	91.33	96.00
February	58.67	94.33	84.67	97.33	100.00
March	66.67	116.67	102.00	105.33	143.33
April	73.33	110.00	97.33	101.33	118.67
May	76.00	97.33	94.67	93.33	98.00
June	32.00	46.67	46.67	51.33	53.33
July	31.33	48.00	42.67	42.67	41.33
August	20.67	31.33	24.67	26.00	31.33

Table 5. Table showing the observed value in DO of water from Sep 19-Aug 20.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	5.63	4.73	5.13	5.53	5.00
October	6.00	5.27	5.67	5.80	5.53
November	6.47	5.60	5.70	5.47	5.67
December	7.10	6.40	6.80	7.13	6.90
January	8.07	7.03	7.67	7.40	7.40
February	7.93	6.97	7.43	7.67	7.00
March	7.23	6.07	6.67	6.67	6.37
April	7.03	6.40	7.00	7.03	6.53
May	6.83	6.43	7.03	6.70	6.60
June	5.67	5.23	5.10	5.33	5.07
July	5.13	4.43	4.93	5.07	4.87
August	4.80	4.13	4.67	4.60	4.47

Table 6. Table showing the observed BOD value during the study.

Month	Site 1	Site 2	Site 3	Site 4	Site 5
September	1.17	1.57	1.33	1.33	1.27
October	1.27	1.17	1.17	1.20	1.13
November	0.87	1.17	1.17	1.07	1.33
December	0.90	1.13	1.17	0.70	0.83
January	0.57	1.33	1.07	1.27	1.33
February	0.93	1.00	1.00	1.20	1.27
March	1.13	1.53	1.27	1.43	1.53
April	1.43	1.90	1.73	1.37	1.43
May	1.33	1.43	1.33	1.23	1.33
June	1.37	2.17	1.67	1.53	1.50
July	1.57	2.37	1.73	1.73	1.73
August	1.57	2.37	2.00	1.53	1.87

at summer can be attributed to evaporation of water, addition of sewage and sediments containing calcium and magnesium salts and soaps and detergents from human activities like washing cloth and bathing in the river. A similar finding of result was reported by Kumar *et al.* (2015) and Nahian *et al.* (2018).

Dissolve oxygen (DO)

Dissolve oxygen is the amount of oxygen present in water. It is one of the most important parameters in water quality because of its greater effects on the organisms living in the water bodies. A dissolved oxygen level that is too high or too low can harm aquatic life and also affects the water quality. In the present study DO values varied from 4.1mg/L in site2 to 8.07mg/L in site1 (Table 5). Lower dissolved oxygen content during monsoon could be due to the utilization of the dissolve oxygen in water by aerobic organisms during decomposition of organic matter as a result of addition of more organic matter and higher value of DO in winter may be due to low temperature. The values were within the range given by scientific agencies. Similar values of observation were made by Udoinyang and Ukpatu (2015), Singh and Shrivastava (2015), Samlafo *et al*. (2022).

Biological oxygen demand (BOD)

Biological oxygen demand is a measurement of the total amount of dissolved oxygen used by microorganisms in the process of breaking down of the organic matter present in water. Higher and lower value of BOD indicates the amount of organic pollution present in an aquatic ecosystem (Vaishali *et al.* 2005). In the present study BOD value varied from 0.6 mg/L in site1 to 2.4 mg/L in site 2 (Table 6). The lowest value was recorded in January while the highest value was recorded both in July and August. Increased value of BOD in site 2 may be due to increase concentration of more organic matter from surface runoff and lower value at site1 can be attributed to low amount of organic material. The overall recorded values were within the standard limit given by scientific agencies. The value observed during the study was in conformity with the work of Gupta *et al.* (2017), and Nahian *et al.* (2018).

CONCLUSION

The assessment of the physical and chemical parameter of the water quality of Tuirial river is very important in providing necessary information with regards to the water quality. For the present study a total of six water parameters were analyzed namely pH, Temperature, Total alkalinity, Total hardness, Dissolve oxygen (DO) and Biological oxygen demand (BOD). From the analysis, it was found that all the analyzed water parameters were within the standards range as prescribed by various agencies (WHO, ICMR, BSI, CPCB).

According to our result, all parameters were generally lower in the upstream with the least anthropogenic activities. However, the findings generally

increase towards the downstream which might be due to human interference to the river water. Human discharge of several types of domestic and municipal wastes, urban run-off as well as agriculture run off and are the main factors that lead to water deterioration in Tuirial river. Therefore, regular monitoring of river water quality is essential for sustainability of the environment as well as in maintaining the normal functions of human health, society and the economic growth of a nation.

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