SEASONAL VARIATION IN THE PHYSICAL CHARACTERISTICS OF RIVER TUIPUI, CHAMPHAI DISTRICT – MIZORAM, INDIA

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Abstract: Tuipui River is the main source of potable water in Champhai district of Mizoram. With the growth of population and developmental activities, there is a high risk of pollution especially with regards to the surface water bodies. The present study has been carried out for a period of two successive years i.e. from February 2018 to January 2019 and from February 2019 to January 2020, to assess the quality of river water (untreated) and PHED treated water and to determine the pollutant removal efficiency of the water treatment unit. The water samples were analyzed for selected physical characteristics namely temperature, turbidity, and total dissolved solids on monthly intervals, and results have been presented on a seasonal basis. The findings reveal that the average temperature ranges from 16.95℃ to 24.59℃ for untreated river water and 18℃ to 24.62℃ for PHED treated water. Similarly, turbidity ranges from 2.1 NTU to 34.89 NTU for untreated water and 0.6 NTU to 11.87 NTU for treated water, and total dissolved solids (TDS) ranges from 29.48 mg/L to 45.37 mg/L for untreated water and 28.78 mg/L to 43.45 mg/L for treated water. The findings were also compared with the standards given by scientific agencies. The sharp increase in turbidity during the monsoon season could be attributed due to rain and indicating the inefficiency of the treatment plant to minimize the values at the desired pace.

Keywords: *Tuipui River; Untreated water; Treated water; Temperature; Turbidity; Total Dissolved Solids.*

INTRODUCTION

Water is one of the vital substances which form the basis of life on earth and it participates in almost all processes occurring in nature. Water has different properties in terms of physical, chemical, and biological characteristics (Mishra, 2009). Water is recycled constantly in a system called the hydrological cycle. Of all the water reserves on earth, only 2.8% is freshwater. Of which, a small fraction (about 25%) is available as surface and groundwater (Henry and Heinke, 1996).

With the advancement in development and civilization, the utilization of water grows rapidly. As communities grow, there is ample scope to have a well-organized public water supply scheme, as it is rather difficult to run the present civic life and development without a well-organized water supply scheme (Birdie and Birdie, 2015). Human activities within or near the river cause pollution in the river body and degradation of our river ecosystem need to be monitored and managed properly (Lalchhingpuii et al., 2011; Mishra and Tripathi, 2007).

In the state of Mizoram, the major sources of potable water are river, groundwater, rainwater, and spring water. The water treatment plants are installed at different places across the districts of Mizoram. The river water is processed and managed by the Public Health Engineering Department under the Government of Mizoram, and treated water is supplied especially in towns and cities for drinking and other purposes.

Tuipui river is located in Champhai district of Mizoram and is the main source of public water distribution in the town. Collection and filtration are done and monitored by the PHE Department, Champhai. The present study aims to assess the quality of both the untreated river water and PHED treated water for two successive years (i.e. from February 2018 to January 2019 and from February 2019 to January 2020).

MATERIALS AND METHODS

Water samples were collected from the Tuipui river (untreated source water) and PHED treated water at monthly intervals in triplicates for two successive years (i.e. from February 2018 to January 2019 and from February 2019 to January 2020) for analysis of physical attributes. The monthly observations have been computed on a seasonal basis i.e., pre-monsoon (February – May), monsoon (June – September), and post-monsoon (October – January) seasons. Analysis of water samples was carried out using the methods as outlined in the "Standard Methods for the Examination of Water and Wastewater" as prescribed by APHA (2017). The temperature was measured onsite using a handheld digital thermometer. The turbidity and total dissolved solids were analyzed using Nephalometer and digital TDS meter respectively.

RESULTS AND DISCUSSION

TEMPERATURE

The temperature of surface water corresponds with the surrounding atmosphere, its location, ambient air temperature, seasons, and chemical reactions that took place in the water bodies. Temperature is one of the important factors that influence the physical, chemical, and biological characteristics of water (Mishra and Tripathi, 2007; Chenkual et al., 2016).

The minimum and maximum temperature of untreated water ranged between 16.95℃ (post-monsoon season) and 24.05℃ (monsoon season) during 2018-19, and 18.8℃ (post-monsoon season) and 24.59℃ (monsoon season) during 2019-20 respectively. Similarly, PHED treated water possessed temperature range between 18℃ (post-monsoon season) and 23.83℃ (monsoon season) during 2018-19, and 19.15℃ (post-monsoon season) and 24.62℃ (monsoon season) during 2019-20.

It has been observed that the water temperature increased from pre-monsoon to monsoon season and then decreased from monsoon to post-monsoon season. A similar trend in results has been observed in both years. (Figure 1 & Figure 2) This could be attributed due to favorable conditions for microbial growth leading to a high rate of decomposition of organic matter in water.

Moreover, in the monsoon season, river water receives more organic waste due to surface run-off, resulting in a rise in temperature as influenced by microbial activities. The aforesaid findings conform with the work of Sunar (2016), Mishra (2009), and Chenkual et al. (2016).

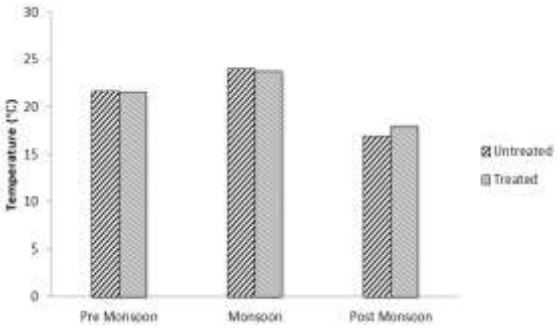

Figure 1
Seasonal variations in temperature of water during 2018-19

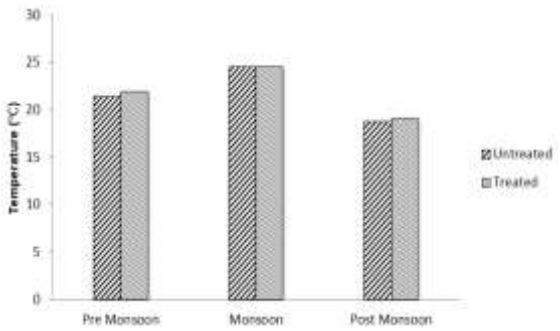

Figure 2
Seasonal variations in temperature of water during 2019-20

TURBIDITY

Turbidity is the expression for the optical property of water which measures the cloudiness of water. It can be caused by clay, mud, algae, silica, rust, bacteria, and other particulates. Polluted water tends to have undesirable cloudiness in it (Henry and Heinke, 1996; Chenkual et al., 2016; Laldintluanga et al., 2016).

The findings reveal that the untreated river water possessed minimum and maximum turbidity values as 2.13 NTU (pre-monsoon season) and 34.89 NTU (monsoon season) during 2018-19, and 2.1 NTU (pre-monsoon season) and 29.57 NTU (monsoon season) during 2019-20. On the other hand, the minimum and maximum values for treated water were 0.8 NTU (pre-monsoon season) and 11.87 NTU (monsoon season) during 2018-19, and 0.6 NTU (pre-monsoon season) and 11.35 NTU (monsoon season) during 2019-20.

A similar trend in results has been observed in both years. The values are within the permissible limit except during the monsoon season (Figure 3 & Figure 4). This was mainly due to the influx of soil and clay particles into the river during the heavy rainfall. The surface run-off may be the most effective reason for a sharp increase in turbidity values during monsoon season, impacting the efficiency of the treatment plant as the treated water also possessed high value during monsoon season. A similar trend in observations has also been reported by Chenkual et al. (2016) for Tamdil Lake, Mizoram.

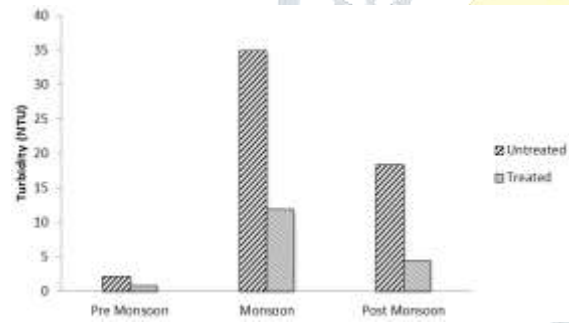

Figure 3
Seasonal variations in turbidity of water during 2018-19

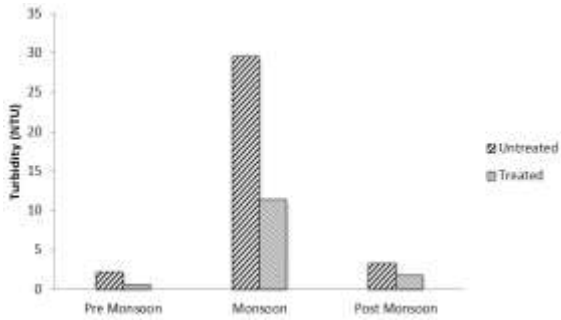

Figure 4
Seasonal variations in turbidity of water during 2019-20

TOTAL DISSOLVED SOLIDS

Total dissolved solids (TDS) is the measurement of dissolved solids present in the water. It can be organic or inorganic substances and mainly salts of calcium, sodium, potassium, iron, magnesium, etc. (Chenkual et al., 2016).

The TDS values for untreated water ranged between 30.03 mg/L (monsoon season) and 42.35 mg/L (pre-monsoon season) during 2018-19, and 29.48 mg/L (post-monsoon season) and 45.37 mg/L (pre-monsoon season) during 2019-20. Similarly, treated water possessed TDS values ranging from 28.78 mg/L (monsoon season) to 39.89 mg/L (pre-monsoon season) during 2018-19, and 31.61 mg/L (monsoon season) to 43.45 mg/L (pre-monsoon season) during 2019-20.

The TDS values for both years followed the same trend and are within the range of permissible limits. The highest TDS value has been observed during the pre-monsoon season which may be due to the low volume of water. Laldintluanga et al. (2016) also reported a similar trend in results. (Figure 5 & Figure 6)

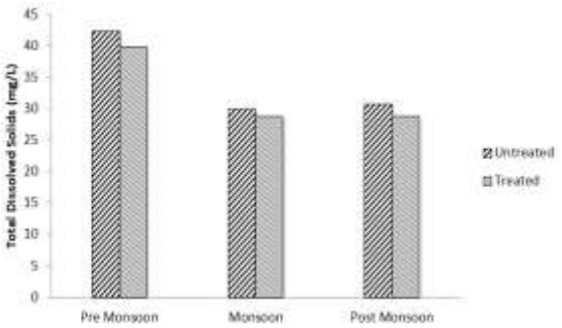

Figure 5
Seasonal variations in TDS of water during 2018-19

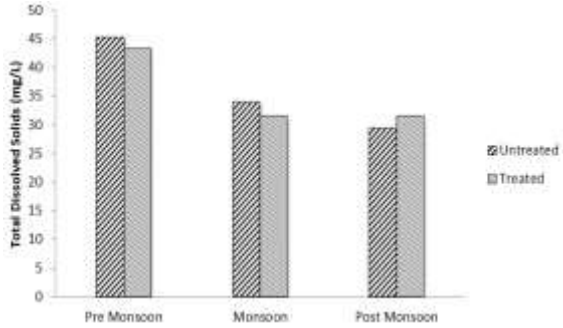

Figure 6
Seasonal variations in TDS of water during 2019-20

Results from the present study were compared with the standards of drinking water given by various scientific agencies such as ICMR (1975), USPH (1962), and BIS (10500:2012). It was observed that the turbidity values of Tuipui River during monsoon season for untreated and treated water were beyond permissible limits. (Table 1)

Table-1: Water quality standards given by scientific agencies and comparison of results.

Parameters	Standards			Range of water quality during the study period		Remarks
	ICMR	USPH	BIS	Untreated	Treated	
Temperature (°C)	-	-	-	16.95°C to 24.59°C	18°C to 24.62°C	-
Turbidity (NTU)	2.5	5	1	2.1 NTU to 34.89 NTU	0.6 NTU to 11.87 NTU	Beyond permissible
TDS (mg/L)	500	500	500	29.48 mg/L to 45.37 mg/L	28.78 mg/L to 43.45mg/L	Permissible

CONCLUSION

The findings of the present investigation suggest that the direct use of water of river Tuipui for drinking purposes should strictly be prohibited due to the intensity of pollutants. The long-term use of such polluted water may lead to adverse effects on human beings. Moreover, the water treatment plant needs to be improved in terms of the removal of pollutants at the desired pace, as pollutants removal efficacy is rather poor.

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