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Assessment on seasonal variation in water quality of Tuirial River Aizawl, Mizoram, India

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ABSTRACT

Water is a valuable resource that all life on Earth requires to survive. The increasing negative effects of pollution on the natural environment, particularly on water resources, has necessitated an assessment of water resources, particularly surface water such as rivers. As a result, the current study was carried out in the Tuirial River, Aizawl Mizoram, which is one of the most important rivers in Aizawl. Evaluating water quality before any use, such as drinking, domestic, or agricultural, is necessary for the betterment of man, society, and economic growth. Water parameters such as pH, temperature, EC, turbidity, TA, DO, BOD, chloride, and phosphate were measured at five different sampling stations over two years (2020-2021). The outcome reveals that pH and DO were lowest during the monsoon season and highest during the winter. The monsoon season saw the highest levels of water temperature, EC, turbidity, BOD, and phosphates, while total alkalinity and chloride reached their peak levels in the summer. Except for phosphate and turbidity, almost all the analyzed parameters were within the permissible limits set by various agencies. According to the study's findings, the Tuirial River has deteriorated due to anthropogenic activities such as the dumping of domestic waste and agricultural fertilizers.

Key word: *Seasonal variation, Temperature, EC, Mizoram, River, Water quality, Agriculture runoff.*

Introduction

Water is the foundation of life. Every living organism on the planet, from tiny bacteria to plants, animals and even humans contain and require some proportionate amount of water inside their bodies fornormal growth and development. Water is an essential component of our environment (Sudarshan *et al.,* 2019). It is used for drinking, domestic, agriculture, industrialization, and many other purposes, it can be stated that surface water meets the majority of human requirement for freshwater for drinking and other purposes (Prasad *et al.,* 2013). However, with the growing human population, urbanization, and industrialization, this vital source of water has become frequently depleted (Pestle, 2000). A good water quality is required for human health to function normally. It is very common for many developing countries to be in water stress and to have several types of water borne diseases because of consuming contaminated water (Juneja and Chauhary, 2013). When the quality of a body of water is altered directly or indirectly on account of waste disposal or other human activities, it is said to be contaminated, and this threatens or harms its suitability for drinking and other purposes (Nayar, 2020).

Rivers are critical waterways that provide freshwater for domestic, industrial, and agricultural purposes (Jain, 2009), but they are highly susceptible to pollution because they serve as a disposal site for both organic and inorganic pollutants (Karunthachalam, 2013). People who live along the river's catchment area frequently discharge their household waste. Untreated discharge of various types of waste from domestic, commercial, industrial, agricultural, and development activities degrades river water quality, affecting both human life and aquatic life (Gupta *et al.*, 2017). Because river ecology can be influenced by a variety of pollutants, it is critical to comprehend the spatial and temporal variations in physicochemical parameters.

Mizoram, located in Northeastern India, is endowed with numerous rivers and streams. Tuirial is one of the most important rivers in Aizawl, running 117 kilometers from the North Chawilung hills in Aizawl district to the Barak River in Cachar district, Assam. Because of its convenience and ease of access, people in the state generally used surface water such as rivers as the primary source of public water supply for drinking and other purposes. These vital water sources, however, face grave threats in meeting the expanding population's rising demand and need. Since the state's people have traditionally relied on agricultural practices for a living, the state's water resources have significantly depleted. Recently, it has been found that some rivers are drying up because of extensive anthropogenic activities such as forest clearing, changes in land use and land cover, and the disposal of certain types of waste in the river system. As a result, the current study was carried out with the goal of analyzing the physicochemical parameters of river water collected from various study sites, and statistical analysis of correlation coefficients was established between the water quality attributes via physiochemical analysis.

Materials and Methods

Description of the study area

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 districts, Assam. For detailed investigation the following five sampling stations have been selected along the river from upstream to downstream.

Site 1: the first sampling station is selected at the upstream with 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 river receives waste from human settlement area.

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

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

Collection of water sample

For assessing the physic-chemical characteristics of water, the water samples were collected from selected study sites at monthly interval (in triplicates) for a period of one year (September 2020 to August 2021). Wide mouth plastic bottles were used for sample collection with taking necessary precautions and the samples were stored in 4°C for further analysis. The findings were computed seasonally i.e., post monsoon (September to November), winter (December to February), Pre monsoon (March to May) and monsoon (June to August).

Analytical methods

Analysis of water quality parameters such as Temperature, pH, Alkalinity TA), Dissolved 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 taking necessary precautions and preservatives.

Results and Discussion

The graphical representation for water quality attributes at five different sites during pre-monsoon, monsoon, post-monsoon and winter are presented in Figure 1 to 5, respectively

pH

pH is a measurement of the hydrogen ion activity in a solution. It usually indicates how acidic or basic the water is. The pH in water during the study ranges from 6.9 to 7.9 at Site 1, 7.04 to 8.2 at Site 2, 7.2 to 8.3 at Site 3, 7.3 to 8.5 at Site 4 and 7.3 to 8.4 at Site 5. The average values were generally lower in monsoon season and higher in winter season. Lower value during monsoon may be due to deposition of

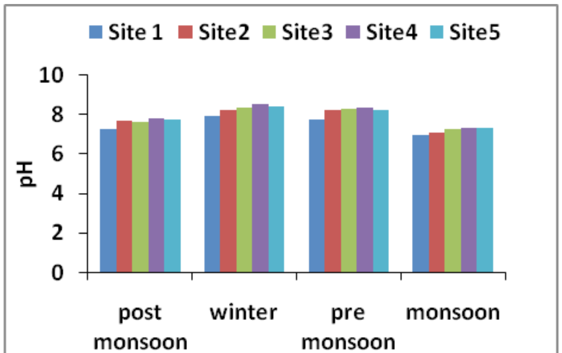


fig1; Seasonal variation in pH of water

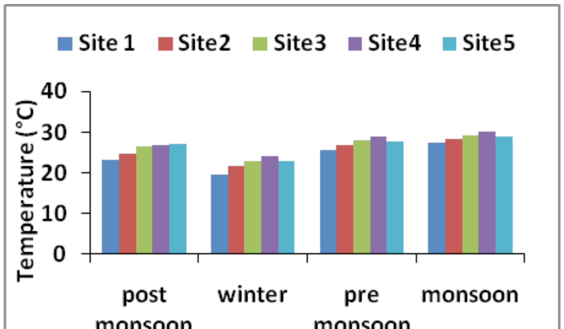


fig2: seasonal variation in temp. of water

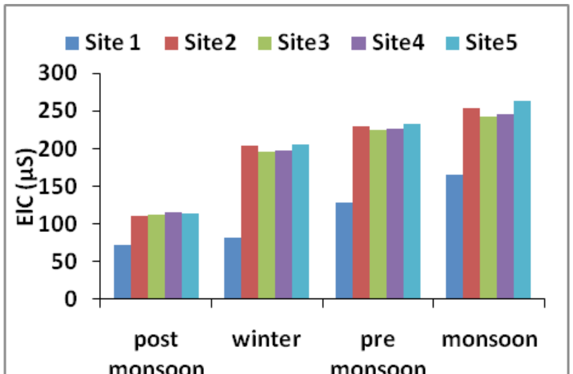


fig3; Seasoanl variation in EC of water

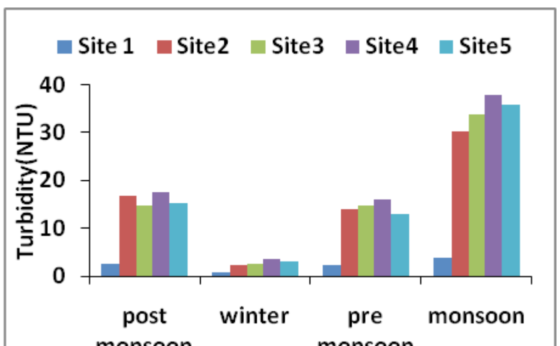


fig4; Seasonal variation in turbidity of water

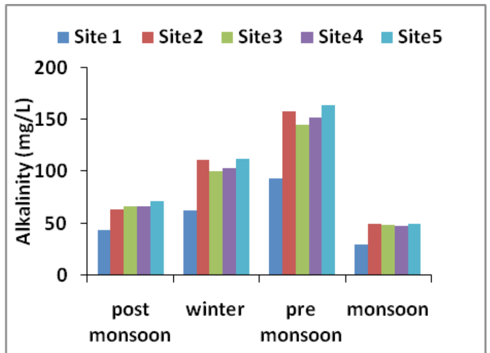


Fig5: Seasaonal variation in TA of water

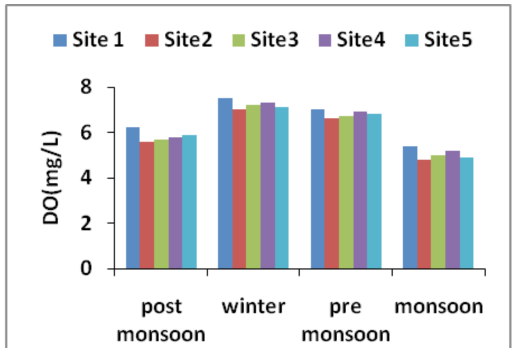


fig6; seasonal variation in DO of water

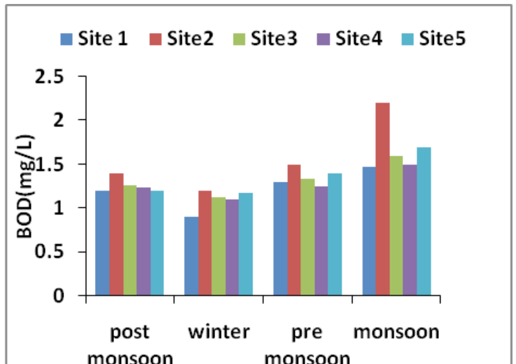


fig7; seasonal variation in BOD of water

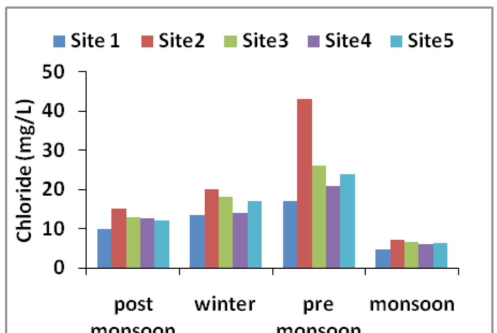
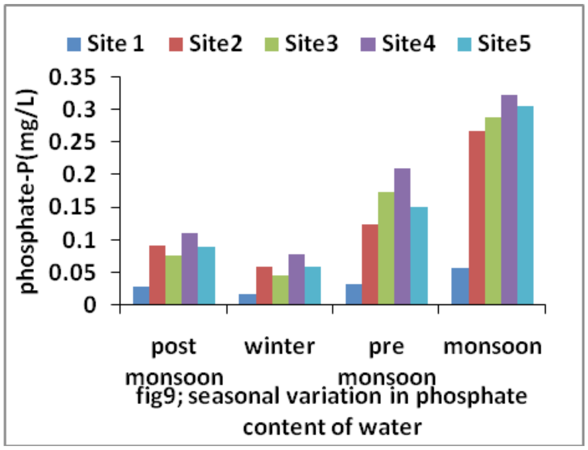


fig 8: seasonal variation in chloride of water



Figs. 1-9. Graphical representation of different water parameter in the study)

acid forming substances as a result of dilution with rain water (Nizami *et al.,* 2021). From the statistical analysis (Table 1), a positive and significant correlation of pH was observed with total alkalinity (TA), dissolved oxygen (DO) and chloride. In contrast, a negative correlation was observed with Biochemial Oxygen Demand (BOD).

Temperature

Temperature of water during the study varied between the value ranges from 19.5 to 27.3°C at Site 1, 21.8 to 28.2°C at Site 2, 23 to 29.3°C at Site 3, 24 to 30.1°C at Site 4 and 22.8 to 29°C at Site 5. In general all the values were lower in winter and higher during monsoon season. Higher values during monsoon can be attributed to chemical reactions and heavy disposal of organic matter through surface runoff (Khapekar *et al.,* 2006). A positive and significant correlation in temperature was observed with EC, turbidity, BOD and phosphate consequently, a negative and significant correlation was observed with Dissolved oxygen (Table 1).

Electrical conductivity

Electrical conductivity ranges from 72 to 165µS at Site1, 110 to 253 µS at Site2, 112 to 242 µS at Site3, 116 to 246 µs at Site 4 and 114 to 263 µS at Site 5. The EC values observed during the study were generally higher in monsoon season as compared to other season. Higher value during monsoon may be due to higher concentration of dissolved solid, decomposition and mineralization of organic matter (Ojok *et al.,* 2017). A positive and significant correlation of EC was observed with temperature, turbidity, BOD and phosphate (Table 1).

Turbidity

Turbidity value during the study ranges from 0.8 to 3.8 NTU at Site 1, 2.4 to 30.2 NTU at Site 2, 2.6 to 34 NTU at Site 3, 3.5 to 38 NTU at Site 4 and 3.04 to 36 NTU at Site 5. The average value obtained was lower during winter and higher in monsoon season. The higher value during monsoon could be due to both organic and inorganic matter, sediments and suspended particles as a result of surface runoff (Subin *et al.,* 2013). The observed value exceeds the limits prescribed by BIS. A positive and significant correlation was observed with temperature, EC, BOD and phosphate (Table 1).

Total Alkalinity (TA)

Total Alkalinity during the study ranged from 30 to 94 mg/l at Site 1, 50 to 158 mg/l at Site 2, 49 to 145 mg/l at Site 3, 48 to 152 mg/l at Site 4 and 50 to 164 mg/l at Site 5. The observed values were generally lower during monsoon and higher during pre-monsoon season. Increased value during pre-monsoon may be due to anthropogenic activities like washing cloth station, domestic waste discharge and wastes water from construction sites (Kumar *et al.,* 2021). A positive and significant correlation was observed with pH, DO and chloride.

Table 1. Correlation coefficient between different physico-chemical parameters

Parameter	pH	Temp	EC	Turbidity	TA	DO	BOD	Chloride	Phosphate
pH	1								
Temp	-.379	1							
EC	.104	.531	1						
Turbidity	-.465	.769	.537	1					
TA	.792	-.023	.345	-.279	1				
DO	.809	-.647	-.191	-.775	.640	1			
BOD	-.557	.639	.560	.703	-.231	-.727	1		
Chloride	.667	-.120	.152	-.314	.860	.552	-.205	1	
Phosphate	-.333	.781	.735	.938	-.102	-.636	.700	-.232	1

Dissolved Oxygen (DO)

The observed value during the study varied between 5.4 to 7.5 mg/l at Site 1, 4.8 to 7.03 mg/l at Site 2, 5 to 7.2 mg/l at Site 3, 5.2 to 7.3 mg/l at Site 4 and 4.9 to 7.1 mg/l at Site 5. The average values were lower during monsoon and higher during winter season. Lower value during monsoon season may be due higher amount of domestic wastes and sewage as a result of surface runoff (Singh *et al.,* 2015). A positive and significant correlation was observed with pH, TA and chloride and a negative correlation was observed with temperature, turbidity, BOD and phosphates.

Biochemical Oxygen Demand (BOD)

The observed value of BOD varied between 0.9 to 1.47mg/l at Site 1, 1.2 to 2.2 mg/l at Site 2, 1.12 to 1.6mg/l at Site 3, 1.1 to 1.5 mg/l at Site 4 and 1.18 to 1.7 mg/l at Site 5. The average values during the study were general lower in winter season and higher during monsoon season. Increased value in monsoon may be due to higher amount of organic matter due to surface run off and construction effluents (Badaii *et al.,* 2013). A positive and significant correlation was observed with temperature, EC, turbidity andphosphate. Consequently, a negative and significant correlation was observed with pH and DO.

Chloride

The value during the study ranges from 4.7 to 17mg/l at Site 1, 7.2 to 43 mg/l at Site 2, 6.5 to 26mg/l at Site 3, 6 to 21 mg/l at Site 4 and 6 to 24mg/l at Site 5. The average values are generally lower in monsoon and higher during pre-monsoon season. Increased value in pre-monsoon may be due to discharge of domestic and municipal wastes as well as agricultural wastes (Singh *et al.,* 2014). A positive and significant correlation was seen with pH, TA and DO.

Phosphate-P

The phosphate value varied from 0.02 to 0.06 mg/l at Site 1, 0.06 to 0.27 mg/l at Site 2, 0.05 to 0.29 mg/l at Site 3, 0.08 to 0.32 mg/l at Site 4 and 0.06 to 0.3 mg/l at Site 5. The value observed was lower in winter and higher in monsoon season. Increased value during monsoon season may be due to higher number of domestic effluents and agriculture runoff (Appavu *et al.,* 2016). A positive and significant correlation was observed with temperature, EC, turbidity and BOD. In contrast, a negative correlation was observed with DO.

Conclusion

According to the current study, the water quality of the Tuirial River has deteriorated. The results show that, apart from site 1, the water parameters at all the selected study sites are above the acceptable limits set by various scientific agencies during both the pre-monsoon and monsoon seasons. Site 1 has better and cleaner water quality than the other three, four, and five study sites. Beginning at Site 2 and moving downstream, the river was subjected to a variety of urban and rural human activities, all of which had a negative impact on water quality due to both natural and anthropogenic factors.

Natural water can never be completely pure because of the dissolved minerals and other impurities that result from hydro-chemical reactions and geological conditions. The normal water quality of the Tuirial River, however, has been altered because of extensive human activities like the discharge of domestic and municipal sewage, effluents from homes and construction sites, clearing of forest land and soil cover from the river's catchment for development activities, and agricultural runoff.

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