

Assessment of water quality of Tingdil Lake in Aizawl District, Mizoram, North-East India using Canadian Council of Ministers of the Environment (CCME) Water Quality Index

N.K. Dangoria^{1*}, Baby Lalremruati¹, Lalhlimpaia¹, B.P. Mishra²

¹Research Scholar, Department of Environmental Science, Mizoram University, Aizawl 796004, Mizoram, India

²Senior Professor, Department of Environmental Science, Mizoram University, Aizawl 796004, Mizoram, India

Abstract:

Tingdil Lake is an artificial freshwater wetland located in Aizawl District, Mizoram, northeast India (24°19'04" N, 92°59'18" E). This study assessed the seasonal water quality of the lake using the Canadian Council of Ministers of the Environment (CCME) Water Quality Index. Water samples were collected from five stations across three seasons - pre-monsoon, monsoon, and post-monsoon seasons of 2024 and thirteen physicochemical parameters were analysed following standard APHA protocols. Ten of these parameters carry numerical objectives and were used in index computation. Pearson correlation analysis revealed strong positive associations among electrical conductivity, total dissolved solids, and turbidity ($r = 0.90-0.93$), indicating monsoon-driven runoff as a dominant influence on water quality. CCME WQI scores ranged from 71.3 to 77.5, placing all five stations in "Fair" category, with the inlet highest (77.5) and the settlement-adjacent station the lowest (71.3). Turbidity exceeded its objective at every station in every season, reaching 58 NTU adjacent to settlement during the monsoon, and accounted for 85% of the total excursion; biochemical oxygen demand failed at every station, contributing a further 15%, and pH at two. These findings highlight considerable spatial and temporal variability in Tingdil Lake water quality and underscore the need for regular monitoring and targeted management interventions.

Keywords: CCME Water Quality Index, Tingdil Lake, Physicochemical parameters, Mizoram, Freshwater wetland, Water quality assessment

1. Introduction:

Lakes are enclosed water bodies with unique physical, chemical, and biological traits, thereby serving as critical systems for investigating ecosystem interactions between land, water, and air (Bhateria & Jain, 2016). Lakes in Mizoram are locally referred to as "Dil," and only a small number of these exist across the region, most of which are small waterbodies or marshy depressions (Lalmuansangi & Lalramnghinglova, 2014). Although Mizoram hosts only a small number of lakes, the only existing scientific document related to water quality are the investigations on Tamdil and Palak Dil, apart from these the Mizoram Pollution Control Board (MPCB) also monitors the water quality of several wetlands, including Rungdil, Rengdil, Tamdil, and Palak Dil, under the National Water Monitoring Programme (NWMP) (MPCB, 2025). Such MPCB data are, however, is often raw and too technical to be used by non-specialists, stakeholders and policy planners to interpret or to translate into meaningful insights. The Water Quality Index (WQI) methodology provides a useful way to simplify and interpret

Published: 26 June 2026

DOI: <https://doi.org/10.70558/IJST.2026.v3.i2.241289>

Copyright © 2026 The Author(s). This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

complex water quality data, and a way to fill gaps in current literature given a lack of water quality research in the lakes.

Degradation of surface water quality is a large risk to aquatic ecosystems, deteriorates groundwater quality and therefore poses a threat to human health (Wats et al., 2019). Water quality indices (WQIs) are important tools used to provide a synthesis of the many, technical, water quality data in a comprehensible format. These science-based tools enable the reduction of multi-parameter water quality data sets to a single dimensionless number as an overall water quality status (Banda & Kumarasamy, 2020). Different WQI models like the NSF-WQI, CCME-WQI, WAWQI etc., provide flexibility regarding the implementation of water quality assessment models that enable the application of proper methodology based on regional standards, monitoring purposes and parameters available, improving the applicability of water quality assessment models around the world (Chidiac et al., 2023). The application and value of WQIs for evaluating lake water quality has been extensively documented in scientific literature across global contexts (Bati et al., 2022; Ball & Church, 1980; Goher et al., 2014; Kürker & Mutlu, 2019; Trikoilidou et al., 2017; Wang et al., 2019; Wu et al., 2017). Therefore, this study assessed the seasonal water quality of Tingdil Lake using the CCME Water Quality Index to identify spatial and temporal variations in physicochemical conditions.

2. Materials and Methods

2.1 Study Area and Sampling sites:

The study site, Tingdil, comprises an artificial freshwater wetland in Mizoram's Aizawl District. Spatial coordinates identify the location as 24°19'04" N latitude and 92°59'18" E longitude, at an elevation of 787 meters above sea level. Covering about 2.52 hectares, Tingdil functions as a relatively small freshwater wetland of notable ecological significance.

Fig 1: Map depicting the study site location

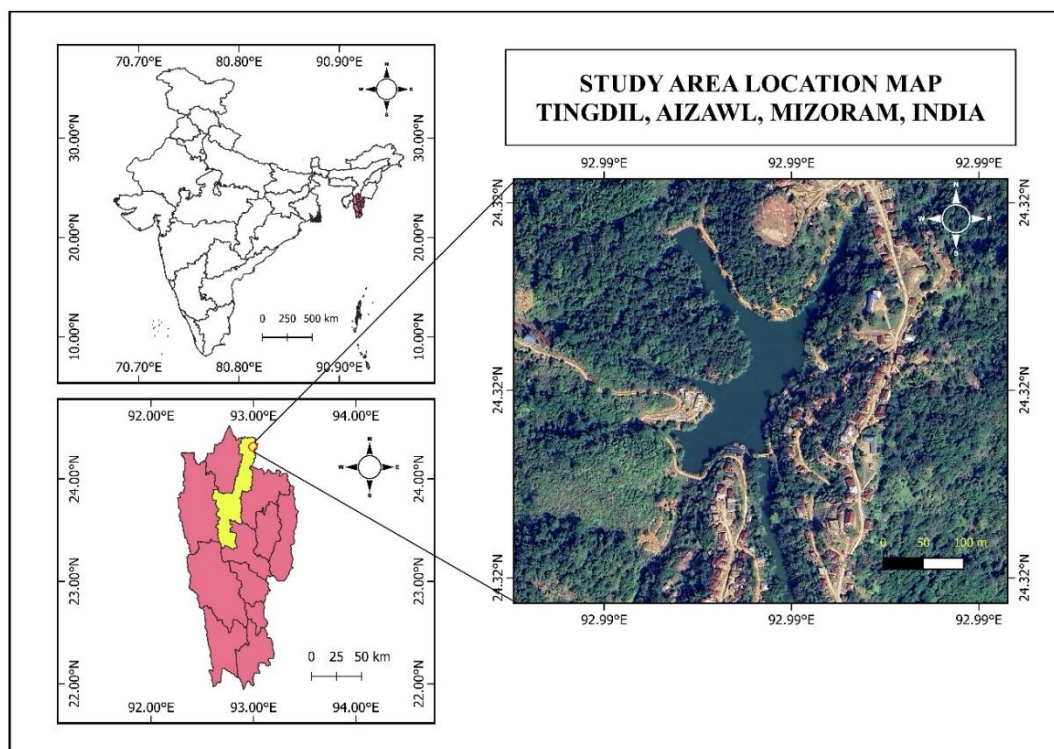


Table 1: Name of sampling sites

Location	Denotation number	Latitude	Longitude
Inlet	S1	24°19'5.71"N	92°59'13.78"E
Outlet	S2	24°19'0.85"N	92°59'16.32"E
Middle	S3	24°19'4.21"N	92°59'18.54"E
Undisturbed	S4	24°19'9.63"N	92°59'16.71"E
Settlement	S5	24°19'1.71"N	92°59'19.15"E

2.2 Methods:

Seasonal monitoring of water quality was undertaken throughout 2024, with samples obtained from five designated locations (as shown in Table 1) during three distinct periods: pre-monsoon, monsoon, and post-monsoon seasons. The study examined 13 physicochemical variables to characterize water quality (Table 2). Field instruments were employed to measure pH, temperature, turbidity at each sampling site. Additional parameters like electrical conductivity (EC), dissolved oxygen (DO), biochemical oxygen demand (BOD), total dissolved solids (TDS), total hardness (TH), total alkalinity (TAK), total acidity (TA), chloride (Cl^-), total nitrogen (TN) and nitrate (NO_3^-) were quantified through laboratory analysis using established protocols (APHA, 2005; Maiti, 2001, Trivedy & Goel, 1984).

Table 2: Methods for physicochemical analysis of water samples

Parameters	Abbreviation	Units	Methods	Standards
pH	-	-	In-situ measurement	6.5-8.5
Temperature	T	°C	In-situ measurement	-
Electrical Conductivity	EC	$\mu\text{S}/\text{cm}$	EC Meter	1000
Turbidity	-	NTU	In-situ measurement	5
Total Dissolved Solids	TDS	mg/L	Gravimetric Method	1500
Dissolved Oxygen	DO	mg/L	Winkler Method	4
Biological Oxygen Demand	BOD	mg/L	5-Day BOD Method	2
Chloride	Cl	mg/L	Argentometric method	600
Total Acidity	TA	mg/L	Titrimetric Method	-
Total Alkalinity	TAK	mg/L	Titrimetric Method	200
Total Hardness	TH	mg/L	EDTA Titrimetric Method	200
Total Nitrogen	TN	mg/L	Kjeldahl Method	-
Nitrate	NO_3^-	mg/L	UV Spectrophotometric Method	50

2.3 CCME Water Quality Index:

The CCME Water Quality Index was developed to simplify complex water quality data and present it in an easy-to-understand format for the public. It evaluates the frequency and magnitude of guideline exceedances to provide a clear indicator of overall water quality (Canadian Council of Ministers of the Environment, 2017).

The index combines three factors: scope, frequency, and amplitude, to produce a single number that represents overall water quality at a glance. The following factors are defined as follows:

Factor 1 (F₁ - Scope): It represents the extent to which measured variables exceed or fall short of their target values, expressed as a percentage. Figure 3 illustrates this graphically, and the mathematical formulation is expressed as:

$$F_1 = \frac{\text{Number of failed variables}}{\text{Total number of variables}} \times 100$$

Factor 2 (F₂ - Frequency): It denotes the proportion of individual tests exceeding guideline values, expressed as a percentage. Figure 4 provides a graphical representation of this component, while the mathematical formulation is expressed as:

$$F_2 = \frac{\text{Number of failed tests}}{\text{Total number of tests}} \times 100$$

Factor 3 (F₃ - Amplitude): It measures the extent to which water quality parameters that exceeded guidelines deviate from their target values. The calculation procedure consists of three steps:

Step 1: Excursion calculation forms the first computational step. This metric measures how much each parameter value differs from its respective objective, either exceeding or falling below it. For situations where test values should not exceed objectives, the following formula applies:

$$\text{Excursion} = \frac{\text{Failed test value}}{\text{Objective}} - 1$$

For the cases in which the test value must not fall below the objective

$$\text{Excursion} = \frac{\text{Objective}}{\text{Failed test value}} - 1$$

Step 2: To quantify the overall extent of deviation from objectives, all individual excursion values are summed and divided by the total number of tests performed, regardless of whether they met their objectives. This value, designated as the normalized sum of excursions (nse), is computed as:

$$NSE = \frac{\sum_{i=1}^n \text{excursion}}{\text{Total number of tests}}$$

Step 3: The third factor (F₃) is calculated using an asymptotic function that scales nse values to generate a dimensionless value within the 0 to 100 range.

$$F_3 = \frac{nse}{0.01nse + 0.01}$$

After determining the three factors, the final index value is computed by treating them as vectors. The sum of the squared values of each factor equals the square of the index. This method represents the index in three-dimensional space, with each factor positioned along a separate axis. Under this framework, any change in the three factors results in a proportional change in the index value.

The CCME WQI is finally calculated as:

$$CCME\ WQI = 100 - \left[\frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732} \right]$$

The normalization factor of 1.732 ensures that the final index values fall between 0 and 100, where lower values (approaching 0) correspond to degraded water quality and higher values (approaching 100) correspond to superior water quality. Index values were interpreted using the categories in Table 3.

Of the thirteen parameters measured, ten carry numerical objectives and were used to compute the index (Table 2). Temperature, total acidity, and total nitrogen have no prescribed objective and were excluded from F_1 and F_2 , since a variable without an objective cannot fail; they are nonetheless reported in the full as supporting information. Index computation was therefore based on ten variables, giving thirty tests per station.

Table 3: CCME WQI based water quality characterization

CCME WQI	Ranking	Water quality Characteristics
95-100	Excellent	Water quality is safeguarded with negligible threats or impairment; conditions close to natural or undisturbed levels.
80-94	Good	Water quality protection is maintained with limited degree of stress or compromise; environmental conditions rarely stray from natural or optimal states.
65-79	Fair	Water quality is generally safeguarded but periodically threatened or impaired; conditions occasionally deviate from natural or desirable levels.
45-64	Marginal	Water quality is regularly threatened or impaired; conditions frequently deviate from natural or desirable levels.
0-44	Poor	Water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

3. Results:

3.1 Seasonal Descriptive Statistics of Physicochemical Parameters

The physicochemical parameters of Tingdil Lake exhibited distinct seasonal and spatial variations across the three sampling seasons (Table 5). Descriptive statistics including mean, standard deviation, minimum, and maximum values for all 13 parameters across five stations are summarised in Table 5, with seasonal distributions illustrated in Fig. 5.

The descriptive statistics indicated that seasonal differences were most evident in turbidity, biochemical oxygen demand and total hardness. Turbidity was highest during the monsoon period, reflecting enhanced surface runoff and sediment input, whereas DO remain above the

recommended minimum throughout the study period. BOD was lowest in the monsoon and higher in the pre-monsoon season, suggesting increased organic stress during the dry months.

Table 5. Seasonal descriptive statistics (mean, SD, minimum, and maximum) of 13 physicochemical parameters in Tingdil Lake water.

Parameters	Unit	Monsoon				Post monsoon				Pre-monsoon			
		Mean	Min	Max	Std. deviation	Mean	Min	Max	Std. deviation	Mean	Min	Max	Std. deviation
Temp	°C	26.4	26	27	0.548	23	21	25	1.581	34.2	33	37	1.643
Turbidity	NTU	47.4	33	58	9.915	12.6	8	18	4.615	16.4	15	18	1.342
TDS	mg/L	43.8	36	49	5.541	18.2	16	20	1.643	24	22	26	1.581
EC	µS/cm	47	41	52	4.528	27.6	21	36	5.505	34	31	37	2.828
pH		6.52	6.3	6.7	0.179	6.67	6.51	6.87	0.142	6.702	6.64	6.77	0.058
Nitrate	mg/L	5.398	3.9	7	1.145	3.94	3.2	3.5	0.91	3.2	2.8	3.8	0.406
Total nitrogen	mg/L	2.276	1.12	3.36	0.716	3.404	2.8	4.6	0.716	2.66	1.8	3.4	0.623
Total Hardness	mg/L	38.4	24	60	13.37	14	10	18	3.162	18.8	4	28	9.757
Total alkalinity	mg/L	26.8	24	30	2.28	33.6	32	38	2.608	30.4	24	44	7.925
Total acidity	mg/L	19.6	10	32	8.414	20.8	12	36	9.654	20	14	30	6.325
Chloride	mg/L	5	3	7	1.581	14.8	14	17	1.304	14.6	12	17	1.817
BOD	mg/L	1.32	1	2	0.415	3.04	0.8	7.4	2.531	5	4.6	5.4	0.4
DO	mg/L	8.56	7.2	9.8	1.014	11.4	8.8	15.4	2.429	8.84	8.6	9	0.219
Min= Minimum; Max= Maximum; Std. deviation= Standard Deviation													

3.2 Boxplot Analysis of Seasonal Variation

The seasonal variation in the key parameters is further illustrated in the boxplots shown in Fig. 2.

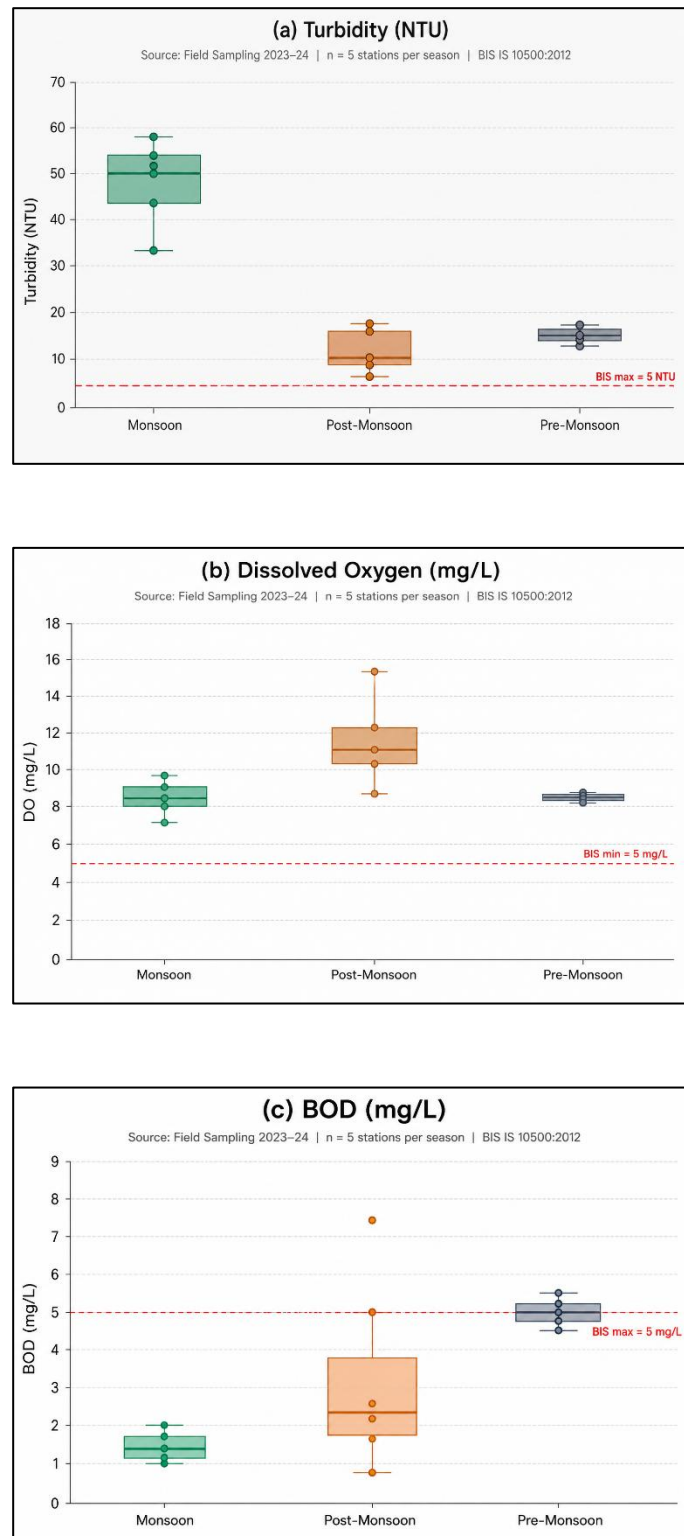


Fig. 2. Seasonal variation of (a) Turbidity, (b) Dissolved Oxygen, and (c) Biochemical Oxygen Demand across five sampling stations in Tingdil Lake (2023-24). Boxes represent the interquartile range, horizontal line indicates the median, whiskers extend to the full range, and

individual points denote station values. Red dashed line indicates the BIS IS 10500:2012 permissible limit.

Significant differences in turbidity, dissolved oxygen and biochemical oxygen demand were found between seasons in boxplots. The turbidity was found to be maximum during monsoon season and was found to be more than BIS limit during monsoon as well as during other seasons of the study period, dose of oxygen is found to be more than the BIS limit throughout the study period. BOD exhibited low monsoon values and showed an increasing trend towards pre-monsoon while one high value was observed over the post monsoon season, suggesting station level variation. In general, the box plots show that the water quality of Tingdil Lake was significantly affected by the seasonal variations.

3.3 Pearson Correlation Analysis

To further examine the interrelationships among the physicochemical parameters of Tingdil Lake, Pearson correlation analysis was performed at a significance level of 0.05, and the results are presented in Fig 3.

Pearson correlation analysis was performed on the pooled dataset of fifteen station-season observations, for which the critical coefficient at $p = 0.05$ is 0.514; twenty-nine of the seventy-eight parameter pairs were significant. The strongest associations formed a single cluster, turbidity with total dissolved solids ($r = 0.935$), electrical conductivity with total dissolved solids ($r = 0.927$) and electrical conductivity with turbidity ($r = 0.900$), indicating a common effect of runoff-induced dissolved and suspended materials, with total hardness ($r = 0.769$ – 0.854) and nitrate ($r = 0.675$ – 0.706) following the same pattern. Chloride behaved in the opposite sense, correlating negatively with turbidity ($r = -0.907$), total dissolved solids ($r = -0.887$) and electrical conductivity ($r = -0.791$), being diluted by monsoon rainfall while suspended load rose. Dissolved oxygen correlated weakly with most parameters, only its association with electrical conductivity ($r = -0.546$) reaching significance. Because the analysis pools three seasons across five stations, this structure reflects a common seasonal driver rather than spatial linkage.

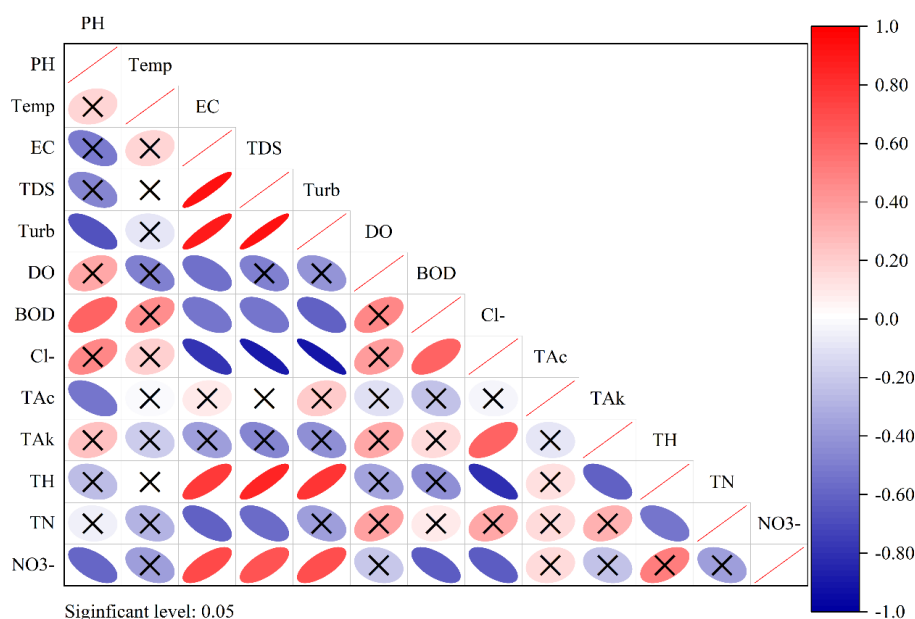


Fig 3: Pearson correlation matrix of physicochemical parameters of Tingdil Lake water samples. Values represent Pearson's correlation coefficients (r); red indicates positive

correlations and blue indicates negative correlations. X denotes non-significant correlations ($p > 0.05$). Significance level: 0.05.

3.4 Parameter-wise Result of Water Quality

pH: All the pH measured five stations were spatially and temporally varied in the range of 6.30 to 6.87. The pH was higher in all the seasons of Station 1 (Inlet) ranging from 6.70 to 6.87, which suggests near neutral condition, while in Station 2 (Outlet), the pH was comparatively higher (6.4-6.77) during the post-monsoon and monsoon seasons respectively. The pH values at Station 3 (Middle) and Station 5 (Settlement) were found to be in the near neutral range of 6.5-6.7. The recorded pH levels were within the acceptable range of 6.5-8.5, however Station 2 (Outlet) and Station 4 (Undisturbed) fell marginally below the lower bound during the monsoon, at 6.40 and 6.30 respectively. The spatial variation in pH may be a reflection of the various local inputs and catchment influences at the sampling stations.

Temperature: The temperature of water at the five stations of Tingdil lake were 21°C to 37°C. The lowest temperature (21-25°C) was observed in post-monsoon season and the highest temperature (33-37°C) was observed in pre-monsoon season. Highest temperature was recorded at Station-5 (Settlement) during pre-monsoon, which may be attributed to less depth of water and higher exposure to solar radiation. During the monsoon season the temperature was moderate at 26-27°C at all the stations. Within each season, the difference in temperature between stations was small (4°C or less) suggesting uniform thermal conditions in the lake.

Electrical Conductivity: The electrical conductivity values for all the sampling points and seasons ranged from 21 to 52 $\mu\text{S}/\text{cm}$, well below the IS 2296:1992 limit of 2250 $\mu\text{S}/\text{cm}$ with Station 4 (Undisturbed) and Station 5 (Settlement) showing significantly higher EC (52 and 51 respectively) in the monsoon season with possible runoff and anthropogenic influence producing ions. The lowest EC values were recorded at the station (Inlet) in post-monsoon (21 $\mu\text{S}/\text{cm}$) indicating dilution effect from the inflow of freshwater streams. Higher EC values were observed during monsoon season at most stations as compared to other seasons. Low EC values are representative of low mineralization and is indicative of the lake water quality being acceptable with respect to ionic load.

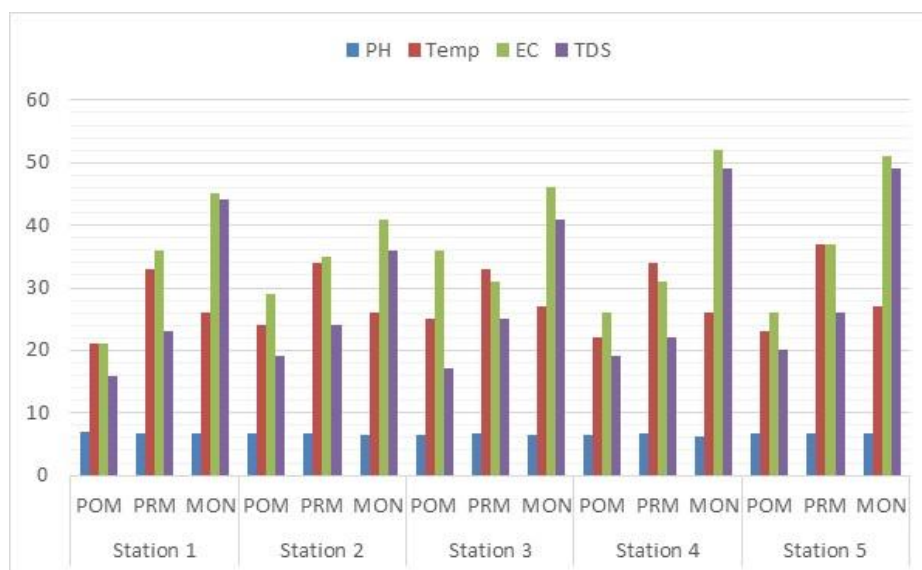


Fig 4: Distribution of physicochemical parameters in water samples [values expressed in mg/L except pH and turbidity (NTU)]

Total Dissolved Solids: TDS values in Tingdil Lake were very low, ranging from 16 to 49 mg/L at all five stations, which is far below the IS 2296:1992 limit of 1500 mg/L. At Station 4 (Undisturbed) and Station 5 (Settlement), the TDS was highest during monsoon with values of approximately 49 mg/L each and may be attributed to the effect of pollutants. Station 1 (Inlet) and Station 3 (Middle) generally showed lower TDS values, indicating relatively dilute water. Low TDS values are overall, suggesting that the water is very dilute with low dissolved mineral content.

Turbidity: At all sites in Tingdil Lake, the turbidity was highly variable ranging from 8–58 NTU with all stations above the standard of 5 NTU in every season. The turbidity was maximum at Station 4 (Undisturbed) at 58 NTU followed by Station 3 (Middle) at 53 NTU for the monsoon season, which suggests high concentrations of suspended matter due to rainfall and runoff. The post monsoon season recorded low turbidity (8-18 NTU) at all the stations due to sedimentation of suspended materials. Moderate turbidity levels (8 – 42 NTU) were observed at Station 1 (Inlet) and Station 2 (Outlet). The large increase in turbidity in the monsoon period is probably attributable to sediment input and resuspension by run-off particles.

Dissolved Oxygen: Dissolved oxygen levels were consistently high across all stations, ranging from 7.2 to 15.4 mg/L, well above the minimum of 4 mg/L. At Station 1 (Inlet) the highest DO of 15.4 mg/L was recorded during post-monsoon, whereas lowest DO was recorded at Station 1 (Inlet) during the monsoon with the value of 7.2 mg/L. High DO is indicative of well-oxygenated waters and good conditions for aquatic life in the entire lake.

Biological Oxygen Demand: The highest BOD value was recorded at Station 1 (Inlet) with 7.4 mg/L during post-monsoon, followed by station 3 (middle) and station 5 (settlement) with 5.4 mg/L each in pre-monsoon period, which indicates that there is high concentration of organic matter and microbial activity during this period. The lowest BOD concentration recorded was at Station 4 (Undisturbed) with 0.8mg/l indicating low organic load and good water quality at this station in post-monsoon. BOD exceeded the limit of 2 mg/L at all five stations, indicating that organic loading is present throughout the lake.

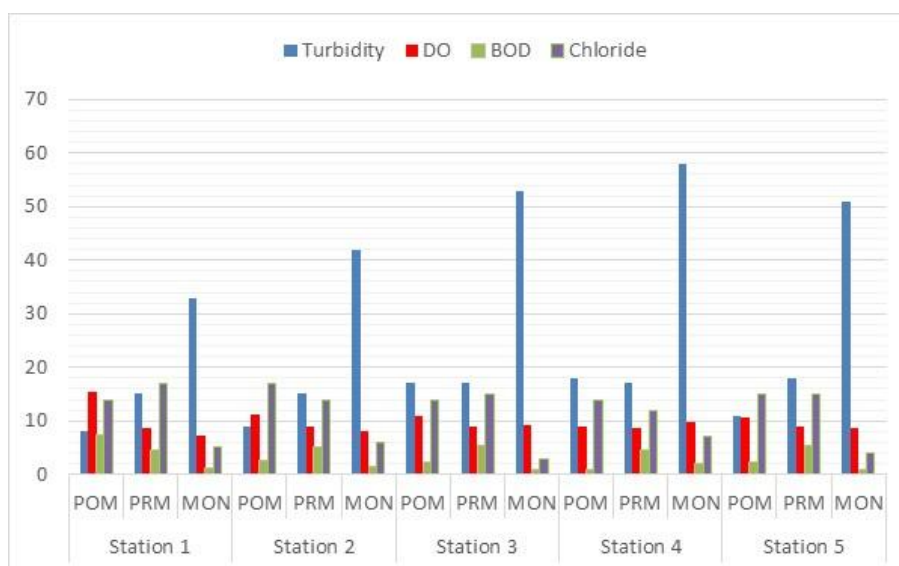


Fig 5: Distribution of physicochemical parameters in water samples expressed in mg/L

Chloride: The chloride concentration at the stations ranged from 3 to 17 mg/L in all seasons, significantly lower than the IS 2296:1992 guideline (600 mg/L), while the Station 1 (Inlet) and

Station 2 (Outlet) had relatively high concentrations ranging between 14 to 17 mg/L with maximum concentration recorded during post-monsoon and pre-monsoon seasons. Monsoon season station 3 (Middle) had the lowest chloride concentration of 3mg/l, thus having the least contamination from anthropogenic activities at this site. The spatial variability was moderate, with moderate chloride concentration (4-15 mg/L) recorded through the different seasons at Station 4 (Undisturbed) and Station 5 (Settlement). The low chloride levels experienced overall indicate little impact of domestic wastewater or agricultural input with little salinization.

Total Acidity: All stations had total acidity between 10 and 36 mg/L. The maximum acidity at Station 4 (Undisturbed) was 36 mg/L during post monsoons, whereas lower acidity values (18-22 mg/L) were observed at Station 5 (Settlement). Post-monsoon months can be correlated with the increased acidity, which could be due to the decomposition of organic matter. The moderate acidity is consistent with the weakly buffered, near neutral pH values recorded.

Total Alkalinity: Total alkalinity values ranged from 24 to 44 mg/L, well within the BIS limit of 200 mg/L. Station 1 (Inlet) showed the highest alkalinity of 44 mg/L during pre-monsoon, while the lowest value of 24 mg/L was recorded at station 1 (Inlet) during monsoon and at Station 4 (Undisturbed) during pre-monsoon. The moderate alkalinity levels indicate the lake has some capacity to resist pH changes, though values are relatively low compared to many freshwater systems.

Total Hardness: Total hardness ranged from 4 to 60 mg/L, far below the limit of 200 mg/L, indicating soft water. Station 5 (settlement) had the highest hardness of 60 mg/L during monsoon, while station 1 (Inlet) recorded the lowest value of 4mg/L during pre-monsoon. Other stations showed values between 10-40 mg/L, with hardness peaking during the monsoon at four of the five stations, following the same pattern as conductivity and turbidity.

Total Nitrogen: Total nitrogen concentrations varied from 1.12 to 4.6 mg/L across all stations. Station 5 (Settlement) recorded the highest value of 4.6 mg/L during post-monsoon, suggesting nutrient inputs from nearby human activities. Other stations maintained moderate levels (1.12-3.4 mg/L). The elevated nitrogen at the settlement area indicates localized nutrient enrichment that should be monitored.

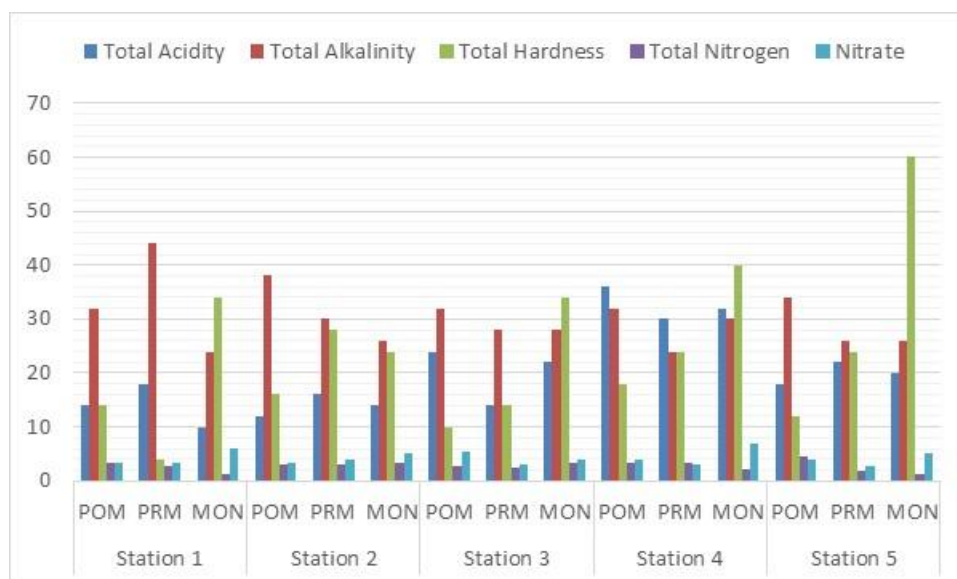


Fig 6: Distribution of physicochemical parameters in water samples expressed in mg/L

Nitrate: Nitrate levels ranged from 2.8 to 7 mg/L, well below the IS 2296:1992 limit of 50 mg/L. Station 4 (Undisturbed) and Station 1 (Inlet) showed the highest values (7.0 and 5.9 mg/L) during monsoon, likely from leaching of nitrogen from surrounding soils. Station 3 (Middle) recorded the lowest monsoon nitrate (3.9 mg/L), while the overall minimum of 2.8 mg/L occurred at station 5 (Settlement) during pre-monsoon. The moderate nitrate levels suggest controlled nutrient loading in the lake.

3.5 CCME WQI Assessment: Index computation was based on the ten parameters carrying numerical objectives, each measured on three occasions, giving thirty tests per station (Table 4). Turbidity failed at all five stations on all three sampling occasions and was the only variable to fail consistently. Biochemical oxygen demand exceeded the 2 mg/L criterion at every station, twice at S1 (Inlet), S2 (Outlet), S3 (Middle), and S5 (Settlement) and once at S4 (Undisturbed), and pH fell below its lower bound during the monsoon at S2 and S4. Two variables therefore failed at S1, S3 and S5, and three at S2 and S4, giving five or six failed tests per station. The resulting indexing values were 77.54 at S1 (Inlet), 75.72 at S5 (Settlement), 74.78 at S3 (Middle), 73.43 at S2 (Outlet) and 71.25 at S4 (Undisturbed), placing all five stations in the “Fair” category.

Table 4: Computed CCME Water Quality Index for water samples from Tingdil Lake, Mizoram

CCME WQI Elements	Station 1	Station 2	Station 3	Station 4	Station 5
Number of failed variables	2	3	2	3	2
Total number of variables studied	10	10	10	10	10
Total number of tests	30	30	30	30	30
Total number of failed tests	5	6	5	5	5
Excursion	12.20	12.02	16.20	16.93	14.80
Nse	0.4067	0.4005	0.5400	0.5644	0.4933
F1	20.00	30.00	20.00	30.00	20.00
F2	16.67	20.00	16.67	16.67	16.67
F3	28.91	28.60	35.06	36.08	33.04
CCME WQI	77.54	73.43	74.78	71.25	75.72
Category	Fair	Fair	Fair	Fair	Fair

4. Conclusion:

The CCME Water Quality Index placed all five stations of Tingdil Lake in the “Fair” category: 77.5 at the inlet, 75.7 at the settlement margin, 74.8 in the open water, 73.4 at the outlet and 71.3 at the undisturbed region. Water quality is generally protected but is threatened from time to time. Turbidity was the main cause. It exceeded its objective at every station in every season, reached 58 NTU during the monsoon and accounted for 85% of the total excursion. Biochemical oxygen demand exceeded 2 mg/L at all five stations, and pH fell below 6.5 at two of them. Every other parameter stayed well within its limit, and dissolved oxygen never fell below its minimum. The lake is therefore under pressure from monsoon sediment washed from

its catchment rather than from local pollution, and the most impaired station was the undisturbed region rather than the settlement. Management should therefore be directed at catchment-scale erosion control and investigation of the inflow stream rather than the settlement region alone.

References:

- APHA (2005). *Standard Methods for the Examination of Water and Wastewater* (21st ed.). Washington, D.C.: American Public Health Association.
- Ball, R. O., & Church, R. L. (1980). Water quality indexing and scoring. *Journal of the environmental engineering division*, 106(4), 757-771.
- Banda, T. D., & Kumarasamy, M. V. (2020). Development of Water Quality Indices (WQIs): A Review. *Polish Journal of Environmental Studies*, 29(3).
- Bati, S. N. A. M., Kamarudin, M. K. A., Toriman, M. E., Samah, M. A. A., Loh, H., Hamzah, F. M., ... & Mustaffa, N. I. H. (2022). Assessment of water quality index in lake ecosystem. *Desalination and Water Treatment*, 269, 123-131.
- Bhateria, R., & Jain, D. (2016). Water quality assessment of lake water: a review. *Sustainable water resources management*, 2(2), 161-173.
- Canadian Council of Ministers of the Environment. (2017). *Synthesis of research and application of the CCME water quality index*. Canadian Council of Ministers of the Environment.
- Chidiac, S., El Najjar, P., Ouaini, N., El Rayess, Y., & El Azzi, D. (2023). A comprehensive review of water quality indices (WQIs): history, models, attempts and perspectives. *Reviews in Environmental Science and Bio/Technology*, 22(2), 349-395.
- Goher, M. E., Hassan, A. M., Abdel-Moniem, I. A., Fahmy, A. H., & El-Sayed, S. M. (2014). Evaluation of surface water quality and heavy metal indices of Ismailia Canal, Nile River, Egypt. *Egyptian Journal of Aquatic Research*, 40(3), 225-233.
- Kükrer, S., & Mutlu, E. (2019). Assessment of surface water quality using water quality index and multivariate statistical analyses in Saraydüzü Dam Lake, Turkey. *Environmental monitoring and assessment*, 191(2), 71.
- Lalmuansangi, & Lalramnghinglova, H. (2014). Preliminary assessment on water quality and biodiversity in and around Palak Dil in southern Mizoram, India. *Science Vision*, 14(1), 39-43.
- Maiti, S. K. (2001). *Handbook of Methods in Environmental Studies, Vol. 1: Water and Wastewater Analysis*. Jaipur, Rajasthan: ABD Publishers.
- Mizoram Pollution Control Board. (2025). *Water quality report 2025*. <https://mpcb.mizoram.gov.in/>
- Trikoilidou, E., Samiotis, G., Tsikritzis, L., Kevrekidis, T., & Amanatidou, E. (2017). Evaluation of water quality indices adequacy in characterizing the physico-chemical water quality of lakes. *Environmental Processes*, 4(Suppl 1), 35-46.
- Trivedy, R. K., & Goel, P. K. (1984). *Chemical and Biological Methods for Water Pollution Studies*. Karad, India: Environmental Publications.

-
- Wang, J., Fu, Z., Qiao, H., & Liu, F. (2019). Assessment of eutrophication and water quality in the estuarine area of Lake Wuli, Lake Taihu, China. *Science of the Total Environment*, 650, 1392-1402.
- Wats, R. K., Grover, A. S., Kumar, R., & Wats, M. (2019). Status of Surface Water Quality in River Markanda and its Correlation With Ground Water Quality and Health of the Residents of Shahabad, Kurukshetra, Haryana, India-A Case Study. *International Journal of Health & Economic Development*, 5(1).
- Wu, Z., Zhang, D., Cai, Y., Wang, X., Zhang, L., & Chen, Y. (2017). Water quality assessment based on the water quality index method in Lake Poyang: The largest freshwater lake in China. *Scientific reports*, 7(1), 17999.