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Study of influence of environmental variables on water quality parameters of Thippayya Lake of Mysore, India

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Abstract

In order to distribute and utilize the water resources as effectively as possible, it is crucial to evaluate quality of the water. Knowing the water demand for diverse uses, such as irrigation, industry, public health, and domestic uses, both now and in the future, becomes essential. An evaluation of the water quality of the Thippayya lake has been attempted in the current study. Analysis was done on the physico-chemical characteristics of water samples taken from the Thippayya Lake in four different months, including colour, odour, temperature, electrical conductivity, total hardness, total dissolved solids, alkalinity, calcium, magnesium, chloride, fluoride, phosphate, iron, sulphate, and nitrate, as well as their correlation to water quality. The physico-chemical characteristics of the water sample showed a substantial variation over the course of four months. BOD and COD readings fluctuate more than other parameters do. Alkalinity, turbidity, calcium, and magnesium hardness, DO, BOD, and COD levels in the current study are over the acceptable limit. Controlling the lake's physicochemical parameters may lead to balanced phytoplankton growth and a reduction in eutrophication.

Keywords: Correlation Co-efficient Matrix; Correlation; Water quality; BOD; COD; TDS

1. Introduction

One of the most important and plentiful components of the environment is water. Water is a necessary component for the survival and growth of every living thing on Earth. Only Earth has 70% water on the planet yet. However, because of the growth in the human population, industrialization, the use of fertilizers in agriculture, and other human-made activities, the environment is severely contaminated [1]. Total dissolved solids (TDS), total suspended solids (TSS), biological oxygen demand (BOD), and chemical oxygen demand (COD) all rise in river water with high amounts of contaminants, primarily organic waste (TSS). They render water unfit for consumption, irrigating crops, or any other purpose [2].

The concentration of numerous chemical components, which are mostly derived from the geological information of the specific region, as well as their quality, determine the quality of ground water. One of the main contributors to the contamination of surface and ground water is industrial and municipal solid waste. Most rivers in urban regions of emerging nations are the disposal points for industrial effluents. The physical and chemical limnology of a reservoir, which comprises all physical, chemical, and biological aspects of water that affect the water's use for good, determines the water's quality. Water quality is crucial for irrigation, fish production, drinking water supply, recreation, and other uses for which the water must have been impounded [3].

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Lakes are complex ecosystems with many species of animals and plants interacting with each other and their environment. Every lake is a distinctive body of water that exhibits various traits of the watershed and climate it is in as well as the size and form of the lake basin. An complicated web of connections is created when internal forces like as evaporation rates, currents, nutrient release from sediments, nutrient uptake by algae, and plant-animal interactions interact with external forces such as sunlight, wind, air temperature, and water inflows.

The lake is situated in the Indian state of Karnataka's Mysore city. It is approximately 142 kilometres from the state capital Bangalore. With a maximum depth of 12 metres when full, it has a catchment area of almost 2 hectares. It has one inlet and two outlets. Physical-chemical analyses were examined in the current study, as well as their relationship to water quality.

2. Material and methods

2.1. Collection of water samples

Samples forthe estimation of physico-chemical parameters was collected from surface water and deep water at various places of the lakes respectively. Sample was collected at an interval of 30 days as described by [4]. The amount thus sedimented was further reduced to 20ml by centrifugation and on certain occasions when the plankton population was thin it was adjusted to 10 ml or less. These samples were preserved and stored for further analysis. Plastic cans of two-liter capacitieshave been used for collection of lake water sample to analyse the physico and chemical parameters.

2.2. Physico-chemical parameters and their analysis

Table 1 Methods used for physico chemical analysis of water sample

SI. No.	Parameters	Methodology
1)	pH	Electrometrical Method
2)	EC	Conductivity Meter
3)	Temperature	Thermometer
4)	Turbidity	Nephelometric Turbidity unit Method
5)	Dissolved Oxygen	Winkler's Iodometric Method
6)	BOD	Winkler's Method
7)	COD	Dichromate Reflux Method
8)	Total Hardness	EDTA Titrimetric Method
9)	Calcium Hardness	EDTA Titrimetric Method
10)	Magnesium Hardness	Calculation Method
11)	Sulphate	Turbidometric Method
12)	Nitrate	Sulphanilamide spectrophotometric Method
13)	Alkalinity	Titrimetric Method
14)	Chloride	Argentometric Method
15)	Phosphate	Vanadomolybdophosphoric Acid Colorimetric Method
16)	Fluoride	Ion selective Electrode Method
17)	Iron	Spectrophotometric Method
18)	TDS	EDTA Titrimetric Method
19)	Colour	Visual Comparison
20)	Odour	Qualitative Human Receptor

The different parameters measured are Temperature, pH [5], Electrical conductivity (EC) [6], TDS, COD, BOD, Chloride, Alkalinity, Hardness, Turbidity, Odour, Colour, Sulphate, Nitrate, Calcium,Magnesium, Sodium, Phosphate, Fluoride, Iron. The methods used for determination of physico-chemical parameters are presented in the table 1.

3. Results

3.1. Physico-chemical Analysis

Tables 2, 3, 4, and 5 show the physicochemical analyses for the months of February, March, April, and May, respectively. The lake's water had a pH of 7.51 and 7.82. May had the highest pH recorded, with the other three months showing minimal change. The temperature ranged from 23 °C to 34 °C. The two months with the greatest and lowest temperatures were May and February, respectively, with only a little fluctuation in the other two. Between 5.1 NTU and 7.8 NTU, there was variance in the turbidity. The months of February and April had the highest turbidity levels, while March and May had the lowest levels.

Table 2 Physico-chemical characteristics of Thippayya lake in the month of February 2022

Parameters	Sample 1	Sample 2	Sample 3
pH	7.51	7.56	7.58
Odour	objectionable	objectionable	Objectionable
Color	10	10	5
Temperature	24	23	26
Turbidity	7.8	6.7	5.1
Electrical Conductivity	364	329	343
Total Hardness	180	172	168
Total Dissolved Solid	203	198	190
Alkalinity	154	174	164
Calcium Hardness	103	90	110
Magnesium Hardness	77	82	58
Chloride	63	54.98	58
Fluoride	0.56	0.6	0.55
Phosphate	0.36	0.28	0.27
Iron	0.36	0.34	0.32
Sulphate	36	36	28
Nitrate	2.86	2.384	2.640
DO	4.6	4.5	5.1
BOD	26.0	14.4	12.8
COD	36.0	26.8	30.0

All the values are expressed as mg/L, except pH, Temperature 0C, Conductivity as µs/cm and Turbidity (NTU)

The EC fluctuated between 256 µs/cm and 416 µs/cm. The months of February and May had the greatest electric conductivity readings, while March and April had the lowest and medium readings. Between 148 mg/L and 246 mg/L, the overall hardness ranged. The months of March and May had the lowest total hardness readings, while February and April had the highest readings.

The TDS fluctuated from 150 mg/L to 230 mg/L. The highest and lowest TDS values were noted in the months of March, May, and April, respectively, while the median value was noted in February. Alkalinity levels ranged from 120 mg/L to

215 mg/L. The months of March and April saw the highest and lowest levels of alkalinity, respectively, while February and May saw a medium level.

The range of calcium hardness was 72 mg/L to 120 mg/L. The months of March and April saw the highest calcium hardness levels, while February and May saw the lowest levels. The hardness of the magnesium ranged from 55 mg/L to 131 mg/L. The month of March saw the highest magnesium hardness readings, with only a little variance in the other three. Chloride concentrations ranged from 32 mg/L to 81.6 mg/L. The months of March and May saw the highest levels of chloride, while April and February saw the lowest levels. Fluoride levels ranged from 0.50 mg/L to 0.6 mg/L. The months of March and February saw the greatest fluoride levels, while April and May saw medium levels.

The range of the phosphate was from 0.21 mg/L to 0.36 mg/L. The largest concentration of phosphate was found in the month of March, the lowest in the month of April, and a medium concentration of phosphate was found in the other two months.

Iron levels varied from 0.27 mg/L to 0.36 mg/L. The levels of iron were highest and lowest in the months of February and April, respectively, and medium in the months of March and May. Sulfate concentrations ranged from 18 mg/L to 46 mg/L. Sulfate levels were highest and lowest in the months of March and April, respectively, and medium in the months of February and May. The range for nitrite was 2.18 mg/L to 4.58 mg/L.

Table 3 Physico-chemical characteristics of Thippayya lake in the month of March 2022

Parameters	Sample 1	Sample 2	Sample 3
pH	7.62	7.62	7.61
Odour	objectionable	objectionable	Objectionable
Color	10	15	5
Temperature	25	26	28
Turbidity	7.3	6.9	7.1
Electrical Conductivity	308	262	256
Total Hardness	236	220	246
Total Dissolved Solid	216	220	230
Alkalinity	185	215	206
Calcium Hardness	120	79	116
Magnesium Hardness	110	139	130
Chloride	76	81.6	80
Fluoride	0.54	0.56	0.5
Phosphate	0.286	0.308	0.314
Iron	0.296	0.338	0.314
Sulphate	42	46	40
Nitrate	2.18	4.58	3.964
DO	4.8	4.2	5.3
BOD	32.0	14.8	26.0
COD	42.0	32.0	30.0

All the values are expressed as mg/L, except pH, Temperature ^{0}C, Conductivity as µs/cm and Turbidity (NTU)

The nitrite levels were highest in March, lowest in February, and medium in April and May. The DO fluctuated from 4.2 mg/L to 5.6 mg/L. The month of May had the highest DO readings, while March had the lowest and February and April had the middle readings. The BOD fluctuated from 12.8 mg/L to 42 mg/L. April saw the highest BOD readings, while

February saw the lowest and March and May saw the middle BOD readings. The COD fluctuated from 26 mg/L to 66.2 mg/L. The month of April saw the highest COD levels, while February saw the lowest and March and May saw the middle levels.

Table 4 Physico-chemical characteristics of Thippayya lake in the month of April 2022

Parameters	Sample 1	Sample 2	Sample 3
pH	7.61	7.58	7.60
Odour	objectionable	objectionable	Objectionable
Color	15	10	10
Temperature	32	31.2	33
Turbidity	7.8	7.6	6.8
Electrical Conductivity	324	314	286
Total Hardness	174	188	194
Total Dissolved Solid	164	150	160
Alkalinity	123	120	144
Calcium Hardness	106	131	120
Magnesium Hardness	68	55	74
Chloride	46	32	38
Fluoride	0.52	0.55	0.50
Phosphate	0.286	0.314	0.21
Iron	0.294	0.306	0.27
Sulphate	22	18	30
Nitrate	2.794	2.864	2.804
DO	4.6	4.4	5.4
BOD	38	42	35
COD	66.2	58	60

All the values are expressed as mg/L, except pH, Temperature 0C, Conductivity as µs/cm and Turbidity (NTU)

Table 5 Physico-chemical characteristics of Thippayya lake in the month of May 2022

Parameters	Sample 1	Sample 2	Sample 3
pH	7.82	7.69	7.69
Odour	objectionable	objectionable	Objectionable
Color	15	10	10
Temperature	33	34	34
Turbidity	6.4	6.6	5.8
Electrical Conductivity	368	416	354
Total Hardness	154	168	148
Total Dissolved Solid	212	230	232
Alkalinity	172	168	194
Calcium Hardness	72	80	76

Magnesium Hardness	78	88	72
Chloride	52	56	48
Fluoride	0.52	0.53	0.54
Phosphate	0.284	0.279	0.308
Iron	0.282	0.284	0.284
Sulphate	32	24	26
Nitrate	2.869	2.870	2.875
DO	4.6	4.8	5.4
BOD	32	30	28
COD	48	50	38

All the values are expressed as mg/L, except pH, Temperature ^{0}C, Conductivity as µs/cm and Turbidity (NTU)

3.2. Correlation Co-efficient Matrix

The Pearson correlation coefficient was used for the quantitative analysis. A statistical measurement of the interdependence of two or more random variables is correlation. The value basically shows how much of a change in one variable can be accounted for by a change in another. Although other correlation coefficients are available to handle different types of data, the measurement scales employed should at least be interval scales. The range of the correlation coefficient is from -1.00 to +1.00. A perfect negative correlation is represented by several -1.00, whereas a perfect positive correlation is represented by a value of +1.00. A correlation is absent when the value is zero (0.00).

3.3. Pearson's Correlation Matrix (PCM) forphysicochemical parameters

Table 6 Pearson's Correlation Matrix for physicochemical parameters of February

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1	1															
2	-0.500	1														
3	0.756	-0.945	1													
4	-0.106	0.914	-0.731	1												
5	0.803	0.115	0.217	0.507	1											
6	0.189	0.756	-0.500	0.956	0.737	1										
7	-0.132	0.924	-0.749	10.000*	0.485	0.948	1									
8	-0.866	0.000	-0.327	-0.405	-0.993	-0.655	-0.381	1								
9	0.939	-0.768	0.935	-0.443	0.548	-0.161	-0.466	-0.640	1							
10	-0.661	0.980	-0.991	0.816	-0.084	0.612	0.831	0.197	-0.879	1						
11	0.787	0.141	0.191	0.530	1.000*	0.755	0.508	-0.990	0.526	-0.057	1					
12	-0.945	0.756	-0.929	0.426	-0.564	0.143	0.449	0.655	-10.000*	0.870	-0.541	1				
13	0.410	0.585	-0.288	0.864	0.873	0.973	0.850	-0.811	0.070	0.414	0.885	-0.088	1			
14	-0.052	0.891	-0.693	0.999*	0.553	0.971	0.997	-0.454	-0.394	0.784	0.575	0.376	0.890	1		
15	-0.500	1.000**	-0.945	0.914	0.115	0.756	0.924	0.000	-0.768	0.980	0.141	0.756	0.585	0.891	1	
16	0.887	-0.044	0.368	0.365	0.987	0.621	0.341	-0.999*	0.673	-0.240	0.983	-0.687	0.785	0.415	-0.044	1
17	0.629	-0.988	0.984	-0.840	0.041	-0.645	-0.854	-0.156	0.858	-0.999*	0.015	-0.849	-0.452	-0.810	-0.988	0.198
18	0.474	0.525	-0.218	0.825	0.906	0.954	0.810	-0.851	0.142	0.347	0.917	-0.160	0.997*	0.854	0.525	0.827
19	0.693	0.277	0.052	0.643	0.986	0.839	0.623	-0.961	0.402	0.082	0.990	-0.419	0.941	0.683	0.277	0.948

Table 6 displays the PCM for the month of February. Two correlation matrices exist. The remaining characteristics don't correlate with each other, except for the second cluster of factors, colour, which positively correlates with sulphate and sulphate in turn. Table 7 presents the PCM for the month of March. The remaining parameters lack correlation except for the second cluster of parameters, Color, which favorably correlates with fluoride and negatively with DO, and the twelfth cluster of parameters, Fluoride, which negatively correlates with sulphate. Table 8 presents the PCM for the month of April.

There is only one association; sulphate positively correlates with DO in the sixteenth cluster of data, but no link exists for the other parameters. Table 9 presents the PCM for the month of May. Color, temperature, and iron are all correlated with the first cluster of parameter pH. Iron and temperature have a negative correlation with pH, while this colour has a positive correlation with pH. Temperature and colour, which negatively and favorably correlate with iron, respectively, make up the second and third parameter clusters. Alkalinity, a parameter cluster that adversely correlates with COD, is the ninth parameter cluster.

The remaining metrics lack association except for the fluoride cluster, which adversely correlates with BOD, and the phosphate cluster, which negatively correlates with COD. In conclusion, pH is related to iron, temperature, and colour. Iron, sulphate, fluoride, and DO are all correlated with colour. Iron and temperature are correlated. Fluoride and BOD are correlated with alkalinity and COD, respectively. COD and phosphate are correlated. Sulfate and DO are correlated. Fluoride and sulphate are related. Sulfate and colour are related.

Table 7 Pearson's Correlation Matrix for physicochemical parameters of March

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
1	1																
2	0.866	1															
3	-0.945	-0.655	1														
4	0.000	-0.500	-0.327	1													
5	0.561	0.072	-0.801	0.828	1												
6	-0.792	-0.991	0.549	0.610	0.060	1											
7	-0.961	-0.693	0.999*	-0.277	-0.769	0.592	1										
8	-0.029	0.475	0.354	-10.000*	-0.844	-0.587	0.305	1									
9	-0.315	-0.747	-0.013	0.949	0.609	0.828	0.039	-0.940	1								
10	-0.165	0.350	0.479	-0.986	-0.909	-0.471	0.432	0.991	-0.884	1							
11	-0.055	0.452	0.378	-0.999*	-0.857	-0.566	0.329	10.000*	-0.931	0.994	1						
12	0.866	**1.000****	-0.655	-0.500	0.072	-0.991	-0.693	0.475	-0.747	0.350	0.452	1					
13	-0.666	-0.203	0.873	-0.746	-0.991	0.072	0.847	0.765	-0.499	0.846	0.781	-0.203	1				
14	0.082	0.569	0.249	-0.997	-0.779	-0.673	0.197	0.994	-0.972	0.969	0.991	0.569	0.689	1			
15	0.693	0.961	-0.419	-0.721	-0.207	-0.989	-0.466	0.700	-0.902	0.596	0.682	0.961	0.076	0.775	1		
16	-0.238	0.279	0.543	-0.971	-0.938	-0.404	0.498	0.978	-0.847	0.997*	0.983	0.279	0.883	0.948	0.535	1	
17	-0.866	**-1.000****	0.655	0.500	-0.072	0.991	0.693	-0.475	0.747	-0.350	-0.452	**-1.000****	0.203	-0.569	-0.961	-0.279	1
18	-0.172	-0.641	-0.160	0.985	0.719	0.737	-0.108	-0.980	0.989	-0.943	-0.974	-0.641	-0.621	-0.996	-0.829	-0.916	0.641
19	0.629	0.156	-0.849	0.778	0.996	-0.024	-0.820	-0.796	0.540	-0.871	-0.811	0.156	-0.999*	-0.723	-0.125	-0.905	-0.156

Table 8 Pearson's Correlation Matrix for Physicochemical parameters of April

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
1	1																
2	0.756	1															
3	0.605	-0.064	1														
4	0.000	0.655	-0.796	1													
5	0.066	0.703	-0.754	0.998*	1												
6	-0.532	-0.956	0.353	-0.847	-0.880	1											
7	0.929	0.945	0.266	0.371	0.432	-0.808	1										
8	-0.143	-0.756	0.702	-0.990	-0.997*	0.914	-0.500	1									
9	-0.967	-0.899	-0.381	-0.256	-0.320	0.731	-0.993	0.392	1								
10	0.772	0.167	0.973	-0.636	-0.583	0.128	0.481	0.519	-0.583	1							
11	0.866	0.982	0.126	0.500	0.556	-0.884	0.990	-0.619	-0.965	0.351	1						
12	-0.737	-0.115	-0.984	0.676	0.625	-0.181	-0.434	-0.564	0.539	-0.999*	-0.300	1					
13	-0.460	0.234	-0.985	0.888	0.856	-0.508	-0.097	-0.813	0.217	-0.919	0.046	0.939	1				
14	-0.540	0.143	-0.997	0.842	0.804	-0.426	-0.189	-0.756	0.306	-0.952	-0.047	0.967	0.996	1			
15	0.371	-0.327	0.964	-0.929	-0.902	0.589	0.000	0.866	-0.121	0.877	-0.143	-0.901	-0.995	-0.982	1		
16	-0.980	-0.610	-0.752	0.200	0.134	0.352	-0.836	-0.058	0.896	-0.883	-0.749	0.857	0.628	0.697	-0.549	1	
17	0.371	-0.327	0.964	-0.929	-0.902	0.589	0.000	0.866	-0.121	0.877	-0.143	-0.901	-0.995	-0.982	**1.000****	-0.549	1
18	-0.825	-0.254	-0.949	0.565	0.509	-0.040	-0.556	-0.441	0.653	-0.996	-0.432	0.990	0.881	0.921	-0.831	0.921	-0.831
19	0.849	0.988	0.092	0.529	0.584	-0.899	0.984	-0.645	-0.956	0.319	0.999*	-0.268	0.080	-0.013	-0.176	-0.726	-0.176

Table 9 Pearson's Correlation Matrix for Physicochemical parameters of May

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
1	1															
2	**1.000****	1														
3	**-1.000****	-10.000**	1													
4	0.277	0.277	-0.277	1												
5	0.541	0.541	-0.541	-0.658	1											
6	-0.225	-0.225	0.225	0.874	-0.941	1										
7	-0.997	-0.997	0.997	-0.197	-0.608	0.304	1									
8	-0.371	-0.371	0.371	-0.995	0.580	-0.821	0.294	1								
9	-0.500	-0.500	0.500	0.693	-0.999*	0.956	0.569	-0.619	1							
10	-0.143	-0.143	0.143	0.911	-0.910	0.997	0.224	-0.866	0.929	1						
11	0.000	0.000	0.000	0.961	-0.841	0.974	0.082	-0.929	0.866	0.990	1					
12	-0.866	-0.866	0.866	-0.721	-0.048	-0.292	0.822	0.786	0.000	-0.371	-0.500	1				
13	-0.354	-0.354	0.354	-0.997	0.595	-0.832	0.276	10.000*	-0.633	-0.875	-0.935	0.774	1			
14	**-1.000****	**-1.000****	**1.000****	-0.277	-0.541	0.225	0.997	0.371	0.500	0.143	0.000	0.866	0.354	1		
15	0.971	0.971	-0.971	0.038	0.727	-0.452	-0.987	-0.137	-0.693	-0.376	-0.240	-0.721	-0.119	-0.971	1	
16	-0.629	-0.629	0.629	-0.922	0.314	-0.616	0.563	0.955	-0.359	-0.680	-0.778	0.933	0.950	0.629	-0.423	1

17	-0.693	-0.693	0.693	-0.885	0.231	-0.546	0.632	0.926	-0.277	-0.614	-0.721	0.961	0.919	0.693	-0.500	0.996
18	0.866	0.866	-0.866	0.721	0.048	0.292	-0.822	-0.786	0.000	0.371	0.500	-**1.000****	-0.774	-0.866	0.721	-0.933
19	0.359	0.359	-0.359	0.996	-0.591	0.828	-0.281	-**1.000****	0.629	0.872	0.933	-0.778	-**1.000****	-0.359	0.125	-0.952

4. Discussion

Based on monthly variance, the current analysis showed the genuine picture of water quality. For the survival of life, the pH of a perfect freshwater ecosystem should be between 6.5 and 7.0 [7]. Lake water's pH ranged from 7.51 to 7.82, indicating its alkaline character. The greater decomposition beneath shallow water was clearly the cause of the lower pH during other seasons. The addition of hydroxyl, bicarbonate, and carbonate anions is probably what causes the high pH value. The rise in DO produced as a result of photosynthesis may be the reason of the higher pH. The oligotrophic lake has an acidic pH, whereas the mesotrophic and eutrophic lakes exhibit neutral and alkaline pHs, respectively [8].

The pH is inversely related to photosynthetic activity and directly dependent on the amount of CO2 present [9]. Alkaline pH was measured in each of the examined months, with May having the highest value (7.80). Because of the shallowness of the lake and the volume of water in contact with the air as a result, there is a close relationship between atmospheric temperature and air temperature, causing the water to be warmer in the summer and colder in the winter even though the lake's water temperature ranged from 23 °C to 34 °C during the study period. Low water depth and the amount of water that remains in contact with air cause water bodies to be warmer than normal.

The water's properties, which control the presence of the organisms, and its rapidly falling temperature caused a change in the physico-chemical makeup of the water. The most crucial element in aquatic ecology, it has a significant impact [10]. Seasonal variations in water levels result in temperature variations [11], and evidence suggests that temperature affects oxygen levels [12]. Water loses oxygen when the temperature rises.

In addition, bicarbonates fluctuate in direct proportion to calcium and alter the pH of water [13]. The physicochemical parameters such as pH, carbonates, bicarbonates, and calcium are all connected. Based on TDS, EC is employed as a water quality indicator [14].

The study period's average EC value was less than 500 µs/cm, which is comparable to the EC value of Iraq's inland water [15]. On the other side, turbidity levels varied from lower in May to greater in February, with May recording the lowest levels. The proliferation of planktonic algae may be to blame for this [16].

The presence of carbonates and bicarbonates of calcium and magnesium released from kitchen wastewater is what causes alkalinity. The lake's total alkalinity varies between 120 mg/L and 215 mg/L. The fact that cattle bathe and wash their garments may be to blame for the lake's high total alkalinity value [17].

Alkalinity is a measure of all the elements in water that have the capacity to neutralise acids [18]. According to the current study, the type of materials that are discharged into the lake affect the level of alkalinity. Because it combines swiftly with other elements in water, chloride, which dissolves readily in water, is hazardous to most aquatic species [19]. All the months were found to have increased chloride levels. In the current investigation, March, and April, respectively, saw the highest and lowest levels of chloride. Chloride levels are high, which shows that human activity is putting pressure on the lake. The sodium, potassium, and calcium salts are typically to blame for the elevated chlorine.

Phosphorous is thought to play a significant role in the biological productivity of water. The amount of phosphorus in lakes varies widely and is only comparatively little [4]. While Hutchinson (1957) [19] claims that phosphate concentration increases as a result of sewage contamination [13], believes that phosphates are less in water that is not contaminated. Phosphate is always present in significant proportions and is not a limiting factor. Nitrate concentrations remain rather constant, and in lakes with low nitrate levels, there aren't many species that can oxidise free ammonia [21]. One of the key elements and a crucial component for all living things is the oxygen concentration of water [22].

The lake's DO concentration varied from 4.2 to 5.6 mg/L. However, the values of BOD and COD varied from 12.8 to 42.0 mg/L and 26 to 66.2 mg/L, respectively. In general, high BOD and COD values were shown to be correlated with high water temperature and low DO. These results were marginally worse than what was previously reported [23]. Numerous natural processes can contribute to the reduction of oxygen, but pollution and eutrophication, in which plant nutrients infiltrate water sources, are of greatest concern [24].

This is because a large amount of organic material was released, and that material needs oxygen to decompose. Low dissolved oxygen, therefore, is a sign of the biodegradation of organic materials [25]. Similar to this, the biochemical oxygen demand also provides information on the volume of oxygen needed by bacteria to metabolize organic molecules in water under aerobic conditions. More oxygen is needed by bacteria for the breakdown of more organic materials. Physical-chemical characteristics such alkalinity, turbidity, calcium, and magnesium hardness, DO, BOD, and COD have values that are higher than the WHO-2004 acceptable level.

5. Conclusion

The results obtained from the present study shall be useful in future management of the Thippayya lake. The result revealed that there was significant seasonal variation in some physico-chemical parameters and most of the parameters were in the normal range and indicates better quality of lake water. According to the results of the physico-chemical investigation of the water quality in the Thippayya lake, turbidity, total dissolved solids, pH, hardness, alkalinity, COD, BOD,DO and phosphate contents, are slightly over the normal range. The aquatic and terrestrial creature growth in the water repository may be significantly impacted by the current situation, and in the future. Major contaminants that emerge from domestic sections represent an additional threat to the water quality. The civic body must take specific actions and make plans to reduce lake pollution to preserve the ecological and aquatic life in the lake.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

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