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Qualitative Evaluation of Pookote Lake, Wayanad, Kerala

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ABSTRACT: Pookote lake of Wayanad district has been subjected to various studies for many years, but so far indexing of water quality has never been attempted. To assess the status of the water body, field visits were done at regular intervals and water samples were collected pre monsoon and post monsoon. Indexing of water quality variables was carried out using water quality index method developed by Canadian Council of Ministers of the Environment (CCME). Calculations of the index are based on scope (F1) - The percentage of variables above the guideline; frequency (F2) - The frequency by which the objectives are not met; amplitude (F3) - The range to which the failed tests are above the guideline. The squares of these values followed by the square root of the final value divided by 1.732 produces a value from 0 to 100. The various physico-chemical parameters were analysed for the water samples from the lake, almost all parameters were within the permissible limits except a few exceptions. It was inferred that Pookote lake has a CCME WQI value which can be categorized under the Excellent status.

KEYWORDS: Pookote lake, Wayanad, Fresh Water lake, CCME Water Quality Index

I. INTRODUCTION

Water is a necessity for all living beings, without it; there would be no life. Most of the biological phenomena take place in water medium. Moreover, wherever water exists in nature it always holds life. So the study of a water body is the study of life as well. Water is essential at all levels of life, cellular to ecosystem. Fresh water is essential in many spheres of human life and in general it is seen as an essential input to human production and an effective tool of economic development. It plays a significant role in social prosperity and the well-being of all people.

Water quality is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose. Changes in the physico-chemical characteristics of water quality are influenced not only by anthropogenic factors, but also by the combined interactive natural processes such as hydrological conditions, topography and lithology, climate, precipitation inputs, catchment area, tectonic and edaphic factors, erosion, weathering of crustal materials and bedrock geology, in combination with environmental influence.

Traditional approaches to assessing lake water quality are based on comparison of experimentally determined parameter values with the existing local normative. Usual method of analysis does not give a global vision on spatial and temporal trends in the overall water quality. Water Quality Index is an effective tool in conveying information regarding the status of the lake.

II. OBJECTIVES

- (i) To assess the water quality of the lake.
- (ii) Determination of CCME water quality index of the lake.

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III. MATERIALS AND METHODS

A. Study area

The state of Kerala (India) has a large number of man-made lakes situated in its mid-land and high-land regions. But there are very few natural lakes in Kerala's high-altitude lands. Pookotelake is one such lake situated in the midst of the Western Ghats. Pookote Lake is a rain fed, perennial, natural, fresh water lake surrounded by a chain of hills, rising to the order of 800 m above the mean sea level. The lake has the shape of India's map. The lake has an area of about 6.1 ha and has a maximum depth of 6.01 m. The lake is surrounded by a broadleaved mixed temperate forest, and has a catchment area of 40 ha.

B. Sampling and data collection

The samples were taken from 8 stations during the pre-monsoon and post monsoon season. The collections were made during day time. Maximum care was taken for the collection of samples, their preservation and storage as per the APHA standards. Latitude and Longitude of the sampling stations are also marked by using GPS.

C. Measurement and analysis of water quality parameters

Water quality was analyzed for physical, chemical and bacteriological parameters for more accurate value of Water Quality Index. These parameters were measured as per standard method APHA.

D. Water Quality Index

Indexing of water quality variables was carried out using water quality index method developed by Canadian Council of Ministers of the Environment (CCME). Calculations of the index are based on scope (F1) - The percentage of variables above the guideline; frequency (F2) - The frequency by which the objectives are not met; amplitude (F3) - The range to which the failed tests are above the guideline. The squares of these values followed by the square root of the final value divided by 1.732 produces a value from 0 to 100.

IV. RESULTS

A. General

After conducting detailed survey, 8 sampling locations were selected (Figure 1). Latitude and longitude of the stations were also marked (Table 1). The samples were taken from the stations from Pre-monsoon and post monsoon season.

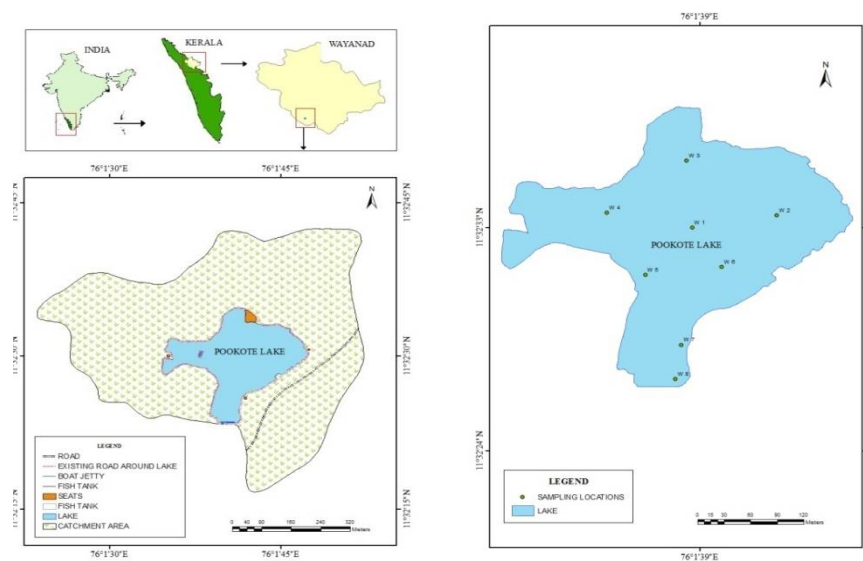


Fig. 1. Location map showing water sampling locations

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Table 1.Sampling locations

Station	Latitude		Longitude	
	Degree Min Sec	Decimal Degree	Degree Min Sec	Decimal Degree
W 1	11° 32' 33'' N	11.5425 N	76° 01' 38.7'' E	76.02742 E
W 2	11° 32' 33.5'' N	11.54264 N	76° 01' 41.8'' E	76.02828 E
W 3	11° 32' 35.7'' N	11.54325 N	76° 01' 38.5'' E	76.02736 E
W 4	11° 32' 33.6'' N	11.54267 N	76° 01' 35.6'' E	76.02656 E
W 5	11° 32' 31.1'' N	11.54197 N	76° 01' 37.0'' E	76.02694 E
W 6	11° 32' 31.4'' N	11.54206 N	76° 01' 39.8'' E	76.02772 E
W 7	11° 32' 28.3'' N	11.54119 N	76° 01' 38.3'' E	76.02731 E
W 8	11° 32' 26.9'' N	11.54081 N	76° 01' 38.1'' E	76.2725

B. Calculation of water quality index (ccmewqi)

The Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI) is a well-accepted and universally applicable model for evaluating the water quality index. The CCME WQI compares observations to a benchmark, where the benchmark can be a water quality standard or a site-specific background concentration. Most applications of the CCME WQI have used the national water quality standard. So, this acts as an advantage of the index, which can be applied in different countries with a few modifications.

The CCME WQI model consists of three measures of variance from selected water quality objectives (scope, frequency, and amplitude). Scope (F1) represents the percentage of variables that do not meet their objectives, frequency (F2) the percentage of individual tests that do not meet objectives, and amplitude (F3) the amount by which failed test values do not meet their objectives. These three factors combine to produce a value between 0 and 100 that represents the overall water quality, where 0 represents the “worst” water quality and 100 represents the “best” water quality.

Water quality index (CCME WQI) was determined by equation:

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

The divisor 1.732 normalizes the resultant values to a range between 0-100.

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

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

F3 (Amplitude) is calculated in three steps

$$\text{Excursion}_i = \left\{ \frac{\text{Failed test value}_i}{\text{Objective}_j} \right\} - 1$$

$$nse = \frac{\sum \text{excursion}_i}{\sum \text{of tests}}$$

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

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The CCME WQI values are then converted into rankings by using the index categorization scheme modified from Khan et al. Once the CCMEWQI has been determined, water quality is ranked by relating it to one of the following categories:

EXCELLENT: 95-100 water quality is protected with virtual absence of threat or impairment; conditions very close to natural or pristine levels ; GOOD: 80-94 water quality is protected with a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels; FAIR: 65-79 water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels; MARGINAL: 45-64 water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels ; POOR: 0-44 water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels

Table 2 Water analysis (post- monsoon)

Sample	Objective	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8
Temperature(°C)	-	31	29.9	29.9	29.6	29.7	29.7	29.9	29.7
Transparency(m)	-	2.1	2.1	1.57	2.0	2.0	2.2	1.9	1.6
EC (µS)	-	29.9	28.7	28.6	28.1	26.9	27.9	27.3	27.9
pH	6.5-8.5	7.18	6.23	6.07	5.98	6.02	5.9	5.9	5.83
TDS(ppm)	500	15.1	15.6	15.4	15.2	14.4	15.1	14.6	14.9
DO (ppm)	5	4.528	3.996	4.129	4.395	3.529	5.194	5.128	5.194
Turbidity (ppm)	5	3.2	1.8	2	1.9	2.4	1.9	2.8	1.8
TH(ppm)	300	12	14	10	8	8	8	10	8
Ca (ppm)	75	4	2.4	3.2	2.4	1.6	2.4	1.6	2.4
Mg (ppm)	30	0.488	1.952	0.488	0.488	0.976	0.488	1.464	0.488
Chloride (ppm)	250	6.99	6.99	6.99	5.99	6.99	5.99	5.99	4.99
Nitrate (ppm)	45	0.097	0.102	0.128	0.12	0.12	0.106	0.159	0.124
Phosphate(ppm)	0.05	0.011	0.04	0.039	0.047	0.059	0.052	0.043	0.044
Iron (ppm)	0.3	0.45	0.28	0.16	0.13	0.23	0.19	0.36	0.2
Fluoride (ppm)	1	0.35	0.49	0.37	0.41	0.38	0.38	0.45	0.44
Sodium(ppm)	200	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.5
Potassium(ppm)	200	0.3	0.4	0.3	0.4	0.3	0.3	0.4	0.3
BOD (ppm)	5	0.666	1.132	0.666	2.331	0.133	1.332	1.132	0.199

Bolded fonts represents the variables that do not meet the objective

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Table 3 Water analysis (pre- monsoon)

Sample	Objective	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8
Temperature(°C)		29.9	29.0	30	29.9	30	30.1	30	29.9
EC (µS)		43.6	36.9	37.2	37.1	36.2	35.6	36	35.1
pH	6.5-8.5	6.72	6.55	6.59	6.62	6.6	6.64	6.68	6.72
TDS(ppm)	500	24.4	19.4	19.9	19.3	19.2	18.6	18.8	18.4
DO (ppm)	5	7.73	7.66	7.86	7.73	7.06	7.26	7.20	6.93
Turbidity (ppm)	5	4.8	4.1	4.6	4.9	4.7	5.4	5.2	4.9
TH(ppm)	300	8	8	6	4	6	10	10	4
Ca (ppm)	75	1.6	1.6	1.6	0.8	1.6	3.2	2.4	0.8
Mg (ppm)	30	0.976	0.976	0.488	0.488	0.488	0.488	0.976	0.488
Chloride (ppm)	250	7.998	5.998	6.998	5.998	5.998	6.998	4.998	5.998
Nitrate (ppm)	45	0.1227	0.1552	0.0934	0.2377	0.2046	0.3212	0.21	0.332
Phosphate(ppm)	0.05	0.032	0.028	0.020	0.044	0.060	0.028	0.032	0.094
Iron (ppm)	0.3	0.505	0.404	0.338	0.623	0.479	0.401	0.301	0.424
Fluoride (ppm)	1	0.393	0.266	0.244	0.198	0.216	0.232	0.334	0.266
Sodium (ppm)	200	4.5	4.9	6.5	4.7	5.2	5.3	5.5	5.5
Potassium(ppm)	200	1.6	1.5	2.1	1.6	1.6	1.8	1.5	1.5
BOD (ppm)	5	3.133	3.333	3.200	3.200	2.467	2.467	2.2	1.867
e-coli (MPN/100 ml)	Absent	absent	absent	absent	absent	absent	absent	absent	absent
Total coliform (MPN/100 ml)	Absent	43	75	75	43	43	93	240	93

Bolded fonts represents the variables that do not meet the objective.

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Sampling of water from ‘Pookote Lake’ for the Physico-chemical analysis was done seasonally for two consecutive seasons. Standard methods were employed for the analytical procedure (APHA). 15 chemical parameters were used for the calculation of CCME-Water Quality Index. Standard or Objective values were as per IS 10500: 2004; for the pre-monsoon period bacteriological analysis was done and it also showed satisfactory results.

F₁, F₂, F₃ were calculated for each water sampling locations and CCME Water quality index were determined for each sampling locations. It is represented in Table 4 and the graphical representation is represented in Fig 2

Table 4 : Calculated values of CCME-WQI in Pookote lake

Station code	CCME WQI	Rank
W 1	97.56451308	Excellent
W 2	98.75794446	Excellent
W 3	99.2028158	Excellent
W 4	97.59653303	Excellent
W 5	97.3331888	Excellent
W 6	98.92438755	Excellent
W 7	99.32840924	Excellent
W 8	97.41154191	Excellent
OverallWQI	98.26491673	Excellent

The overall water quality index was calculated as 98.265 which fell under the ‘Excellent’ water class (index value between 95-100). Site W7 has the highest index value compared to other sampling sites, which is located close to the boat jetty.

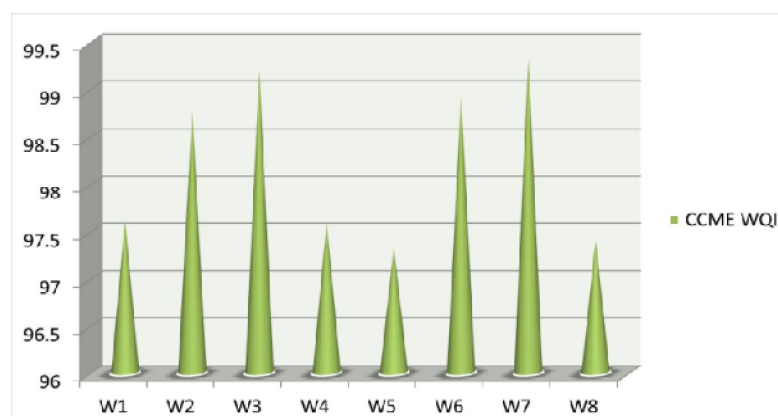


Fig. 2 Graph showing Water Quality Index Variation for sampling points

V. CONCLUSION

The present paper analyzes the water quality data collected from the Pookotelake. CCME Water Quality Index was used for the rating of water quality inPookotelake.From the CCME WQI values obtained during the study, there seems to be no significance change in water quality, which in turn, reveals that lake water is of Excellent quality.The study

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clearly indicates that the lake water can be used for public consumption and recreational activities without any treatment.

REFERENCES

- [1] APHA. Standard Methods for the examination of water and wastes water 19th ed. American Public Health Association Washington DL USA, 1995
- [2] Canadian Council of Ministers of the Environment. Canadian water Quality. Guidelines for the protection of aquatic life. CCME water quality index 1.0, Users' manual in Canadian Environment quality Guidelines,2001
- [3] Munawar,M.. "Limnological studies on fresh water ponds of Hyderabad", India II, The Biotope. Hydrobiologia, 35:127-162 , 1970
- [4] Avnish K. Verma and D. N. Saksena, "Assessment of water quality and pollution status of Kalpi (Morar) river, Gwalior, Madhya Pradesh : With special reference to conservation and management plan", *Asi. J.Exp. Biol. Sci.*,1(2), 419 -429, 2010
- [5] K. B. S. N. Jinadasa, S. K. I. Wijewardena, Dong Qing Zhang, Richard M. Gersberg, C. S. Kalpage, SoonKeat Tan, Jing Yuan Wang and WunJern Ng, "Socio-Environmental impact of water pollution on the mid-canal" , Sri Lanka, *J. Wat. Resou. Prote.*,4(1), 451-459, 2012.
- [6] Sladecsek V, "System of water quality from the biological point of view" *Arch.Hydrobiol. Beih. Ergebn. Limnol.*, 7(1), 1- 218, 1973
- [7] Warhate S. R. and Wankar K. G., "The Evaluation of Water Quality Index around WclKolera-Pimpri coal mines", *Sci. Rev.Chem. Commun.*, 2(3), 197-200, 2012.
- [8] Bhargava D.S., "Use of a water quality index for river classification and zoning of the Ganga River", *Environ. Pollut.*,B(6), 51-67, 1983.
- [9] KavitaParmar and VineetaParmar, "Evaluation of Water Quality Index for drinking purposes of river Subernarekha in Singhbhum District", *Int. J. Environ. Sci.*, 1(1), 77-81,2010.
- [10] Bharti N. and Katyal D., "Water quality indices used for surface water vulnerability assessment", *Int. J. Environ. Sci.*, Vol.2, No. 1, pp154-173, 2011
- [11] Bhattacharya T., Tuck N. and Chakraborty S., "Physicochemical analysis of groundwater quality of Anand district", *ISCA Int. Res. J. Environ. Sci.*, Vol.1, No. 1, pp33-38 , 2012
- [12] Brown R. M., McLelland N.I., Deininger R. A. and O'Connor, M. F., "A water quality index – crashing the psychological barrier", *Indicators of Environmental Quality*, 1972
- [13] Dinius S. H., "Design of an index of water quality", *Water Resour. Bull.* Vol.23, No. 5, pp833– 843, 1987
- [14] Harkins R. D., "An index number system for rating water quality" *J. Water Pollut. Control Fed.*, Vol.46, No. 7, pp588, 1974
- [15] Steinhart C. E., Schierow L. J. and Sonzogni W. C.), "Environmental Quality Index for the Great Lakes", *Water Resour. Bull.*, Vol.18, No. 6, pp1025–1031 , 1982