



Assessment of Water Quality Index of Various Physiochemical Parameters of Ansupa Lake, Odisha (India)

Prabhashini Behera¹, Kalpita Bhatta²

¹ Department of Botany, Centurion University of Technology and Management, Odisha, India.

² Department of Botany, Centurion University of Technology and Management, Odisha, India.

Corresponding author: Kalpita.bhatta@cutm.ac.in.

ABSTRACT

Water is one of the most abundant compounds and exists in different forms. Lake have always been the most important fresh water resources. Lake supports vast Biodiversity of flora and fauna. one of the most widely known tools for assessing the water quality is Water Quality Index (WQI) and it includes various physiochemical parameters. The present study aims to determine the physiochemical parameters such as DO, pH, EC, nitrate, phosphate and BOD of different seasons i.e monsoon, summer and winter. The collected data of the parameters were used to calculate water quality index (WQI) according to Chatterji and Raziuddin, 2002, to know whether the water is suitable for human consumption or not. The WQI value of both monsoon and summer is good quality i.e. 43.68 and 49.09 respectively but in winter it is poor quality i.e. 51.76. Additionally, studied various water quality parameters i.e. average DO in monsoon, summer and winter is 7.67 mg/l, 8.73 mg/l and 6.63 mg/l resp.; average pH were 6.86, 7.12 and 6.63 in monsoon, summer and winter resp.; In monsoon, summer and winter the average EC were 149.65mhos/cm, 107.13mhos/cm, 89.88mhos/cm resp.; Average nitrate in 3 different seasons like monsoon, summer and winter were 3.067 mg/l, 1.407mg/l and 1.936 mg/l resp.; Average phosphate in monsoon is 0.055mg/l, 0.0304mg/l, 0.254mg/l resp.; In monsoon average BOD is 2.544mg/l, in summer average BOD is 3.933mg/l and in winter average BOD is 2.855mg/l. All water quality parameters measured were within the standard permissible limit by WHO, ICMR and BIS except DO. Hence, the water quality decline from monsoon to winter due to microbial activity.

KEYWORDS :Eutrophication, physiochemical parameters, drinking water standard, water quality index (WQI)

Received 11.06.2021

Revised 22.06.2021

Accepted 05.07.2021

INTRODUCTION

Water is very essential for sustaining all life forms. Also, water is more censorious than energy because there is no alternative to water. The health of the aquatic ecosystem and the water quality of lakes in different region of the world are very sensitive issue [2]. For this we have to take initiatives for the conservation and development of the lake, which are economically precious water bodies. Due to human activities in the catchment area, pollutants from forest and agricultural practices, siltation and wild weeds leads to the eutrophication and degradation of lake [3]. As the quantity and quality of water deteriorates, it not only affect the aquatic life but also have worse impact on availability of clean water for human consumption [4]. So, to recognize the condition of lake water, we need to evaluate the water quality index. Water quality refers to the condition of water (including chemicals, physical, and biological characteristics) with respect to its sustainable use. It is one of the most important factor so that we can know the lake is in oligotrophic condition (good water) or eutrophic condition (poor water). Water quality index is one of the most important tool to express the quality of water and can be used for the proper management and assessment of the water [5]. The water quality index (WQI), which was developed by Horton in united states and then it has been accepted by various other countries like Asian and African countries [1]. This index includes the physiochemical parameters like pH, DO, BOD, conductivity, nitrate, phosphates etc. The water quality of the lake changes continuously according to the physical, chemical and biological parameters [6]. Many researchers worked on the status and conservation of Ansupa Lake and confirmed that lake is decreased to land mass and quality also deteriorates. Therefore, the aim of the present work is to evaluate the water quality index and analysis will be beneficial for the daily consumers.

MATERIAL AND METHODS

A. Lake description :

Ansupa lake is one of the largest sweet water lake in odisha. The lake is horseshoe shaped and situated on the bank of Mahandi river, which is opposite of Banki in Cuttack district of Odisha. It has surface area of 141 ha i.e 350 acres and max. length and width is about 3km and 1.5 km resp. [7]. It lies between 20.459142°N to 85.603709°E. In its southern side it is connected to Mahandi with a channel known as KabulaNala through which flood water enters. In the southeast side there is another channel called Haluhula Nuala. The lake is surrounded by Saranda hills on western side and Bishnupur hills on northern side. Some researcher have done work on water quality parameters of the lake[3]. The economic importance of the lake is fishing, agricultural crops which support livelihood and attracts migratory birds in winter season. And also allure tourists for and bamboo house etc.

B. Description of site and collection of sample:

The lake is basically divided into 3 stations and total 9 samples were collected from different sites i.e 3 replicate samples from each station. Each sampling station of the lake was visited from April to January . The water samples from different sites were collected for the analysis of water quality index. Some parts of water samples were taken in water bottle, often fixed with Winkler’s solution for calculation of dissolved oxygen and other parts were kept normally.

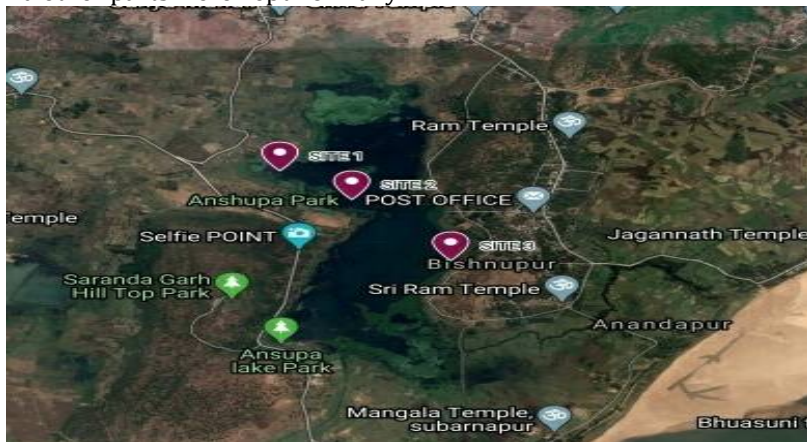


Fig 1. Ansupa lake area showing sampling stations.

C. Analysis of water quality parameters:

Various types of physiochemical parameters were measured. Dissolved oxygen (DO) and biological oxygen demand (BOD) is measured by Winkler’s reagent (APHA,1998). pH, conductivity were measured by microprocessor pH meter and digital conductivity meter (model: LT-16) respectively. Nitrate as No3 is measured by APHA 23rd (4500-No3-E) 2017, and phosphate is measured by APHA 23rd edition (4500-P-O) 2017 respectively.

D. Water quality index(WQI):

Weighted Arithmetic Index

method. In simple terms , the WQI tells the quality of drinking water[8]. It includes various physiochemical parameters and by studying the parameters we conclude whether the water is useful for human or not. Various recommended agencies like ICMR[9], BIS[10],WHO[11] gives the standards for drinking water in table no.1 .

TABLE NO. 1: DRINKING WATER STANDARDS, RECOMMENDING AGENCIES AND UNIT WEIGHT

SL.NO	PARAMETERS	DRINKING WATER STANDARDS	RECOMMENDED AGENCIES	UNIT WEIGHT
1	DO	5	WHO	0.3723
2	pH	8.5	WHO	0.1176
3	EC	250	WHO	0.004
4	NITRATE	50	ICMR/BIS	0.02
5	PHOSPHATE	5	ICMR/BIS	0.2000
6	BOD	5	WHO	0.3723

Water quality index is calculated by

$$WQI = \frac{\sum_i^n Q_n W_n}{\sum_i^n W_n}$$

Where, Qn = Quality weight of nth parameter

Wn= unit weight for nth parameter

Quality Rating(Qn) can be calculated by :

$$Q_n = [(V_n - V_i) / (S_n - V_i)] \times 100$$

V_n = observed value of the parameter

V_i = ideal value for nth parameter (0 for all except pH=7.0 mg/l and DO = 14.6 mg/l)

S_n = standard permissible value of nth parameter

Unit Weight (W_n) can be calculated by :

$$W_n = K / S_n$$

K = constant of proportionality

After calculation of water quality index of Ansupa Lake, then it is compare with the standard WQI values given by Chatterji and Raziuddin, 2002[12].

RESULT AND DISCUSSION

Water quality index of the Ansupa Lake is calculated from various important physiochemical parameters in different seasons. For the calculation of water quality index, the values of various physiochemical parameters were presented in table no.

TABLE NO 2 : Water quality index

WATER QUALITY INDEX	WATER QUALITY STATUS
0 - 25	EXCELLENT WATER QUALITY
26 - 50	GOOD WATER QUALITY
51 - 75	POOR WATER QUALITY
76 - 100	VERY POOR WATER QUALITY
>100	UNFIT FOR DRINKING

TABLE NO. 3: STATISTICAL SUMMARY OF VARIOUS PHYSIOCHEMICAL PARAMETERS IN ANSUPA LAKE

SL NO.	PARAMETERS	MONSOON			SUMMER			WINTER		
		MIN.	MAX.	MEAN	MIN.	MAX.	MEAN	MIN.	MAX.	MEAN
1	DO	6	9.1	7.677	7.8	10.4	8.73	6	7.2	6.633
2	Ph	6.4	7.15	6.865	6.78	7.58	7.121	6.35	6.83	6.637
3	EC	121.5	185.6	149.65	101.5	111.3	107.13	80.9	99.3	89.88
4	NITRATE	2.12	3.9	3.067	0.12	3.2	1.407	0.35	3.12	1.936
5	PHOSPHATE	0.025	0.089	0.055	0.011	0.045	0.0304	0.021	0.64	0.254

Water quality index for three different season like monsoon, summer, winter were calculated and shown in the table no. 4,5 and 6.

TABLE NO. 4: CALCULATION OF WATER QUALITY INDEX OF MONSOON SEASON:

SL NO.	PARAMETERS	OBSERVED VALUE(V_n)	STANDARD VALUE(S_n)	IDEAL VALUE(V_i)	QUALITY WEIGHT(Q_n)	UNIT WEIGHT(W_n)	$Q_n W_n$
1	DO	7.677	5	14.6	72.18	0.3723	26.872
2	Ph	6.865	8.5	7	9	0.1176	1.058
3	EC	149.65	250	0	59.86	0.004	0.239
4	NITRATE	3.067	50	0	6.134	0.02	0.122
5	PHOSPHATE	0.055	5	0	1.1	0.2000	0.22
6	BOD	2.544	5	0	50.88	0.3723	18.942
					$\sum Q_n$ = 199.154	$\sum W_n$ = 1.0862	$\sum Q_n W_n$ = 47.453
WQI = 43.68							

TABLE NO. 5: CALCULATION OF WATER QUALITY INDEX OF SUMMER SEASON

SL NO.	PARAMETERS	OBSERVED VALUE(V_n)	STANDARD VALUE(S_n)	IDEAL VALUE (V_i)	QUALITY WEIGHT (Q_n)	UNIT WEIGHT (W_n)	$Q_n W_n$
1	DO	8.733	5	14.6	61.11	0.3723	22.751
2	Ph	7.121	8.5	7	8.06	0.1176	0.947
3	EC	107.13	250	0	42.852	0.004	0.171
4	NITRATE	1.407	50	0	2.814	0.02	0.056
5	PHOSPHATE	0.030	5	0	0.6	0.2000	0.12
6	BOD	3.933	5	0	78.66	0.3723	29.28
					$\sum Q_n$ = 194.09	$\sum W_n$ = 1.086	$\sum Q_n W_n$ = 53.325
WQI = 49.09							

TABLE NO. 6: CALCULATION OF WATER QUALITY INDEX OF WINTER SEASON

SL NO.	PARAMETERS	OBSERVED VALUE (Vn)	STANDARD VALUE (Sn)	IDEAL VALUE (Vi)	QUALITY WEIGHT (Qn)	UNIT WEIGHT (Wn)	QnWn
1	DO	6.633	5	14.6	82.98	0.3723	30.893
2	Ph	6.637	8.5	7	24.2	0.1176	2.845
3	EC	89.88	250	0	35.952	0.004	0.143
4	NITRATE	1.936	50	0	3.872	0.02	0.077
5	PHOSPHATE	0.254	5	0	5.08	0.2000	1.016
6	BOD	2.855	5	0	57.1	0.3723	21.258
					$\sum Qn$ = 209.814	$\sum Wn$ = 1.086	$\sum QnWn$ = 56.232
WQI = 51.76							

TABLE NO. 7: RESULT OF WATER QUALITY INDEX

MONSOON		SUMMER		WINTER	
WQI	WATER QUALITY RATING	WQI	WATER QUALITY RATING	WQI	WATER QUALITY RATING
43.68	GOOD	49.09	GOOD	51.76	POOR

For more better understanding of the variation, it is also represented graphically in fig 2.

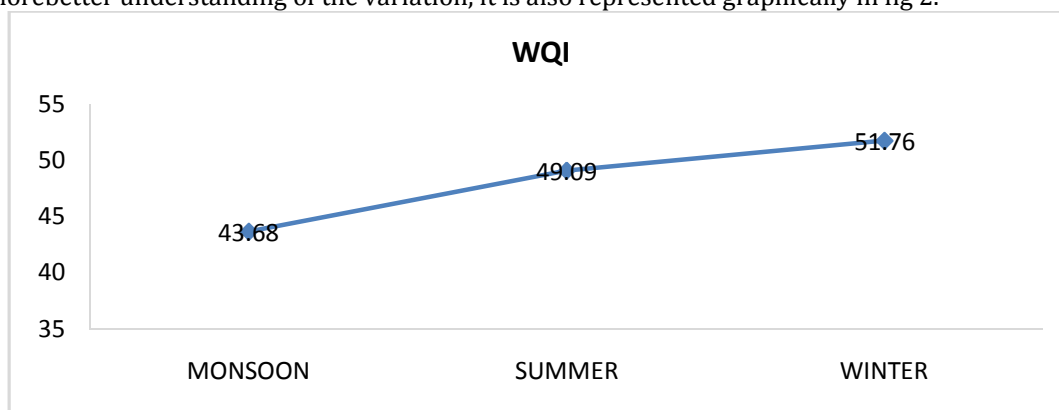


Fig 2. SHOWING WATER QUALITY INDEX OF THREE DIFFERENT SEASON

WQI values for monsoon is 43.68 which is good quality water, summer is 49.09 which is also good but WQI of winter is 51.76 which indicates poor quality according to Chatterji and Raziuddin, [12]. Hence, the water quality of different seasons slightly deteriorates from monsoon to winter.

DO :

Dissolved oxygen(DO) is an important parameter for measuring the pollution of the water. The average of DO in monsoon is 7.6 mg/l, summer is 8.7 mg/l and winter is 6.6 mg/l. And it is not satisfy the drinking water standard by ICMR/BIS[13].

pH :

The average pH of the three seasons i.e monsoon, summer, winter were 6.86, 7.121, 6.63 respectively. And these pH values satisfy the drinking water standard by ICMR/BIS[13].

EC :

The capacity of water to transmit electric current is known as electrical conductivity and it also tells about the purity of water. The average EC of monsoon is 149.65 mhos/cm, summer is 107.13mhos/cm and winter is 89.88mhos/cm. In monsoon EC is high due to water contamination by sewage, domestic wastes etc. EC of these season are under the drinking water standard by WHO[14].

NITRATE:

During the present study, the average nitrate in monsoon is 3.067 mg/l, summer is 1.407 mg/l and winter is 1.936 mg/l. The average value of three different season is within the standard permissible value for drinking water given by WHO[15].

PHOSPHATE :

Phosphates are generally comes from pesticides, insecticides used in agriculture and from detergents during washing of clothes and dishes.

The average value of phosphates during monsoon, summer, winter is 0.055 mg/l, 0.0304 mg/l, and 0.254 mg/l respectively and these values are within the standard permissible limit [15].

BOD :

Biochemical oxygen demand (BOD) is used to determine the contamination of organic matter in water. The three seasons like monsoon, summer, winter has average BOD of 2.5 mg/l, 3.9 mg/l, and 2.8 mg/l respectively . And these values are under the standard value for drinking water given by ICMR/BIS[13].

CONCLUSION

Seasonal water quality parameters of Ansupa Lake was studied and water quality index was calculated. All the parameters studied were within the standard permissible limit but DO was above the standard permissible. The water quality index values of Ansupa Lake of both monsoon and summer season show good quality of water, only winter season show poor water quality. Thus, water quality index is one of the most useful tool and help the people to understand the quality of water. And the result of the index are important so that local authorities will take preventive measures from getting polluted.

ACKNOWLEDGMENT

The author would like to thank, authorities of Centurion University of technology and management for their support in the research facilities.

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CITATION OF THIS ARTICLE

P Behera, K Bhatta. Assessment of Water Quality Index of Various Physiochemical Parameters Of Ansupa Lake, Odisha (India). Bull. Env. Pharmacol. Life Sci., Vol10[8] July 2021 : 197-201