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Analysis of Water Quality Index Using Physico-Chemical Parameters of Karave Lake (Nerul) Navi Mumbai, Maharashtra, India

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Abstract: Water is one of the regular and valuable assets available all over the world and it is significant for the endurance of vegetation and maintaining life on the planet earth. Water quality can easily be identified with the natural, physical properties of water. The availability of good quality water is a necessary feature for improving quality of life. In principle, the quality of lake water is evaluated by compiling all physico-chemical and biological parameters data. The water quality index was calculated using the weighted Arithmetic Water quality Index Method (WQI). It is a means by which water quality data is summarized for reporting to the public in a consistent manner. The determination of existing properties helps in determination of future trends of pollutants and thereby the quality of the lake water in future scenarios. The water quality index of Karave lake was found to be 44.63 mg/l, 44.19 mg/l, 43.77 mg/l, during pre monsoon, monsoon, post-monsoon phase respectively, and was classified under B category of lake.

Keywords: Water quality, Physicochemical parameters, Karave Lake, Biological parameters

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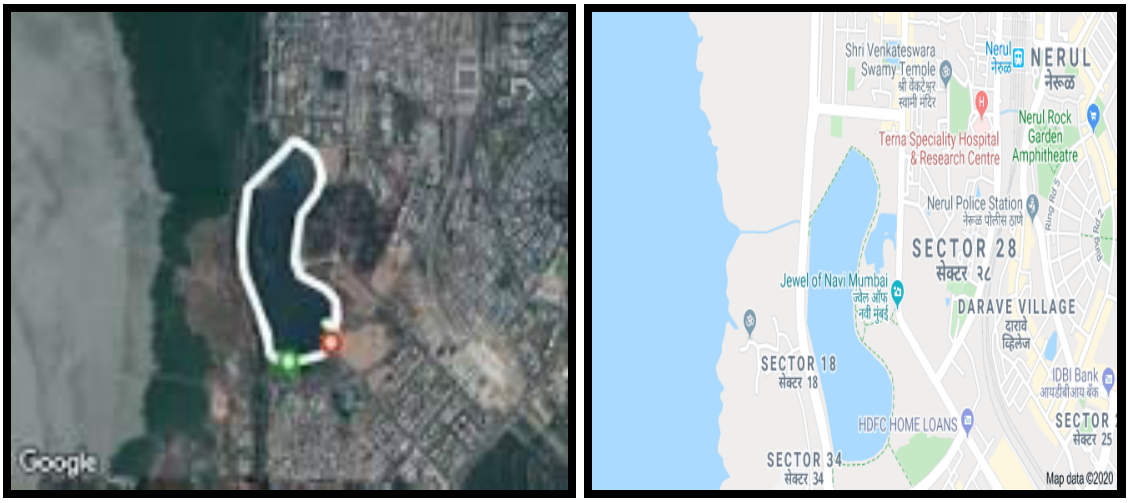
Introduction

The lake plays a vital concern for mankind since it is directly connected to human welfare (Mishra and Gupta, 2015). The supply of quality water remains a major challenge for humanity in the twenty-first century. During the last decade, this is observed that lake water quality is drastically getting deteriorated drastically because of increased human activities mainly sewage and rapid civilization (Puri and Yenkie, 2011). Navi-Mumbai is recently experienced rapid urbanization leading to elevation of the pollution level. However, this lake receives direct pollution load from human settlements around the lake besides the influx of waste from construction activities, siltation load, and waste from other human activities (Dhar and Slathia, 2018). The



(a) **(b)**

Fig. 1a, b: Satellite image of Karave Water body Jewel of Navi Mumbai.

availability of good quality water is a necessary for preventing diseases and improving quality of life.

Water quality Index (WQI) is defined as a rating, reflecting the composite influence of different water quality parameters its suitability of surface water for human consumption. Water quality index is a widely accepted approach to highlight the water quality information to the public domain as well as provide a baseline idea about the suitability of water for different activities (Vasistha and Ganguly, 2020). WQI is calculated mathematically from different test results and gives a single value. Therefore, WQI is applied to represent a complex water quality data in a simpler and understandable form. It is one of the most effective tools to communicate information on the quality of water to the concerned citizens (Aneka and Dongare, 2016). The present study deals with the monitoring of variation of seasonal water quality index of Karave lake Navi Mumbai, India. The index improves the comprehension of general water quality issues, communicates water quality status and illustrates the need for and the effectiveness of protective practices. (Dasa and Tripathy, 2019).

Materials and Methods

Study area:

The present study aimed to analyse water quality and degree of pollution of Karave lake (Jewel of Navi Mumbai) which has latitude of 19.0263° N and longitude of 73.0119° E. (Figs. 1a, b, 2)

Water sample Collection:

Water sample was collected every month from August 2019 to March 2020 from five different sampling stations (Fig. 3) in well rinsed Plastic cans. Temperature was taken *in situ*. Physico-chemical parameters such as temperature, pH, Dissolved Oxygen, Biochemical Oxygen Demand were performed using Winkler's method. Chemical Oxygen Demand (COD), Hardness, Electrical Conductivity, Turbidity, Nitrate-Nitrogen, Nitrite-Nitrogen, and Alkalinity were Analysed using photometrical method given by APHA (2005). Calculated values were considered for the Water Quality Index (WQI).

Water quality index:

The WQI was calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO). Eleven important water parameters were considered for calculation of water quality index and it is also calculated by using the Weighted Arithmetic Index Method. The quality rating scale for each parameter qi was calculated by using the following expression:

$$qn = 100\times (Vn-Vi)/ (Vs- Vi)$$

Where Vn = actual amount of nth parameter; Vi =

Fig. 2: Photograph of Karave Lake.

Fig. 3: Sampling station.

Ideal value of the nth parameter in pure water (i.e., 0 for all parameters except pH and DO which are (7.0 and 14.6 mg/l, respectively); Vs = Standard value of the nth parameter.

The overall WQI was calculated by aggregating the quality rating with the unit weight linearly:

$WQI = \sum qn\ Wn / \sum Wn$

Wn = k/Sn; Wn =unit weight for the nth parameter; Sn = 'n' number of standard values; K = constant for proportionality.

Results and Discussion

Throughout the current study, the results of the water analysis were compiled seasonally (pre-monsoon, monsoon, and post-monsoon), with mean and standard deviation values for various parameters. Different physico-chemical parameters' average values were computed month-wise. Unit weights (Wn), quality rating (Qn), sub-index value (QnWn) and WQI of Karave lake are depicted in Table 1 and compared with various national and international drinking water standards (Table 2).

A key physical factor in determining the electrical conductivity, pH, and dissolved ions present in each water sample is temperature of the water. The alkalinity, chemical and biological interactions, and chemical equilibrium of water are all impacted (Waribam *et al*., 2015; Dhar and Slathia, 2018). In the present investigation, average temperature was observed between 26.6℃-28.6℃. Table1 and Figure 4 show variation of temperature for all three seasons. The pH level, which was recorded to be between 7-8, within the acceptable range (Table 1, Fig. 4). According to Pawar and Sonawane (2012), the fast growth rate of the algal population using CO_2 through photosynthetic activity may be the cause of the elevated pH in the pre-monsoon. The pH values are typically reported to range between 6 and 9 in the vast majority of studies on freshwater ecosystems (Kamran *et al*., 2003).

The health of the water body is reflected by the level of the dissolved oxygen and the capacity of the water body to support and balance the aquatic life (Kangabam *et al*., 2017; Nama and Dhan, 2018; Sharma and Bore, 2020). In the present study the DO level during monsoon was 6.63 mg/l (Table1, Fig. 4). High level of DO during monsoon may be due to rain fall as well as well mixing of run-off water (Vaishnavi, 2018; Gupta, 2018). Low levels of DO in summer are concurrent with the observation made by Jain and Pahade (2023). BOD is the amount of oxygen consumed in biodegradation of organic matter. The low biochemical oxygen demand in pre-monsoon's (Table 1, Fig. 4) ensures that organisms from the water are not the only ones using the dissolved oxygen (Bhateria and Jain, 2016; Vaishnavi and

Table 1: Seasonal variation in Water Quality Index (WQI) of Karave lake- Jewel of Navi Mumbai

S. No.	Para meters	Standard values (Sn)	Unit weight (Wn)	PRE-MONSOON			MONSOON			POST-MONSOON		
				Observed value (Vn)	Quality rating (qn)	Wnqn	Observed value (Vn)	Quality rating (qn)	Wnqn	Observed value (Vn)	Quality rating (qn)	Wnqn
1	WT	15 (WHO)	0.123	27.92	186.13	22.89	26.68	177.8	21.88	28.6	190.66	23.45
2	pH	6.5-8.5 (ICMR/ BIS)	0.219	7.6	115.1	25.21	7.5	115.3	25.27	7.8	120	26.28
3	DO mg/l	5.00 (ICMR/ BIS)	0.372	5.04	100.8	37.5	6.63	132.6	49.33	5.65	113	42.04
4	BOD mg/l	5.00 (ICMR/ BIS)	0.372	1.78	35.6	13.24	2.08	41.6	15.48	2.16	43.2	16.070
5	COD mg/l	10 (WHO)	0.025	38.92	389.2	9.73	40	400	10	36.67	366.7	9.1675
6	Alkalinity mg/l	120 (ICMR)	0.015	82.5	68.75	1.03	92.92	77.4`	1.16	80.42	67.057	1.005
7	Turbidity	5 NTU (BIS)	0.37	20.17	403.4	149.26	25.17	503.4	186.26	24.17	483.4	178.858
8	Hardness mg/l	300 (ICMR/ BIS)	0.006	19.81	6.6	0.04	11.25	3.75	0.02	9.61	3.203	0.0192
9	EC µS/cm	300 (ICMR)	0.006	0.13	0.04	0	0.12	0.04	0	0.15	0.05	0.0003
10	Nitrite µg/l	3 (BIS)	0.616	39.17	1305.6	804.29	36.19	1206.33	743.1	36.33	1211	745.97
11	Nitrate µg/l	45 (ICMR/ BIS)	0.041	13.35	29.67	1.22	15.61	34.689	1.42	12	26.667	1.0933
Total			**∑Wn= 2.1685**			**∑Wnqn =96.76**			**∑Wnqn =96.76**			**∑Wnqn =94.90**
Water Quality Index				**44.63**			**44.19**			**43.77**		

WT-Water temperature ; DO -Dissolved Oxygen , BOD -Biological Oxygen demand, EC-Electrical Conductivity

Table 2: Classification of water quality based on the lakes' WQI

S. No.	Water quality index range	Status	Category
1	0-25	Excellent	A
2	26-50	Good	B
3	51-75	Poor	C
4	76-100	Very Poor	D
5	100 and above	Unsustainable for Drinking	E

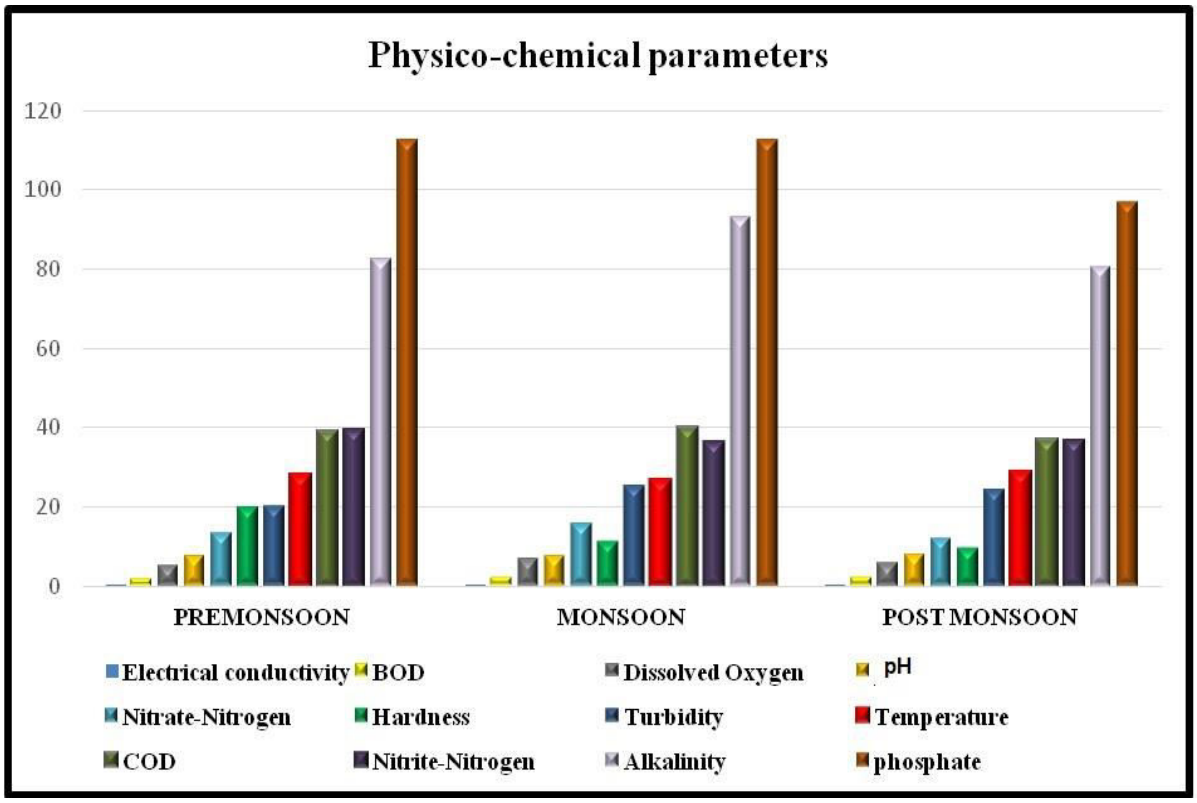


Fig. 4: Seasonal variation in Physico-chemical parameter of Karave lake Jewel of Navi Mumbai.

Gupta, 2018; Jain and Pahade, 2023). COD is one of the indicators to assess the degree of water pollution from organic matter, when COD levels are high, this may cause depletion of oxygen levels in water bodies (Vaishnavi and Gupta, 2018; Smajl *et al*., 2022). During the study it was recorded that the COD level (Table1, Fig. 4) is higher during all season as compared with the range recommended by WHO. Moreover, it attribute to intrusion of high organic load in the water. The observed value in Karave lake (Table1, Fig. 4) were observed to be high during monsoon. Similar finding has also been recorded by earlier investigators (Surve *et al*., 2005; Garg *et al*., 2007; Tiwari and Sharma, 2017). However, the values were within the acceptable limits when compared to the standard. The lower alkalinity values in the present investigation may be attributed to the high flow discharge. Alkalinity in water indicates that water is hard (Harlow, 2003; Amte *et al*., 2019; Bytyqi *et al*., 2020),

The hardness of water is due to the presence of soluble bicarbonates, chlorides and sulphates of calcium and magnesium. During the study it was recorded that in all three seasons the values were much less (Table 1, Fig. 4) when compared to the standard recommended by BIS. Similar observation was made by Pawar and Sonawane (2012) and Bytyqi *et al*. (2020**).** In the current investigation turbidity in all seasons was higher

(Table 1, Fig. 4), which is a sign of suspended particulate matter. It was observed during the investigation that the nitrite level exhibits greater values in all three seasons (Table 1, Fig. 4). These findings accord with those made by Wetzel (20010, Shanti *et al*. (2002), and Sharma *et al*. (2017). Nitrate levels estimated in this study (Table 1, Fig. 4) are within the range recommended by BIS and ICMR standards. It is among the most crucial nutrients for an aquatic ecosystem. Nitrate levels are typically greater in water bodies that are contaminated by organic materials (Shanti *et al*., 2002). However, the type of sediment in the water body has a significant impact on the concentration of nutrients (Pawar and Sonawane, 2012). Electrical Conductivity measure the presence of inorganic dissolved solids such as chloride, nitrate, sulphate, phosphate, sodium, magnesium, calcium etc. During this investigation it was found that in all season the Electrical Conductivity (Table 1, Fig. 4) was below the recommended range by WHO.

In the present study WQI was computed in three seasons utilizing various physiochemical and nutrient factor. WQI values for Karave waterbody for all three seasons were found to be less than 50 in all seasons (Tables 1, 2) indicating that the water body falls in 'B' Category which is good quality (Gajendran and Jesumi, 2013). On the basis of these results the status of the Karave lake fall under the category suitable for human uses and considered to be in the acceptable range as recommended by WHO.

Conclusion

The water quality index is a useful tool for evaluating the overall quality water of our water resources. The Karave Lake Water Quality Index was found to be in Grade B during the investigation, which is considered to be good water quality. A good score on the water quality index means that the water is both safe for human use, ideal for aquatic life and recreational activities. For the sustainability of our natural resources and to maintain our standard of living, it is crucial that we continue monitoring and taking action to maintain acceptable water quality. For the purpose of sustaining the water quality of surface water bodies, this study can provide insight for restoring management practices in routine monitoring.

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