

Water Quality Status and its Suitability for Drinking Purpose in Shettikera Lake, Yadgir District, Karnataka

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Abstract The present study was carried to examine the physico-chemical water quality suitability for drinking and domestic purposes of the Shettikera Lake for a period one year from April to March 2014-15. Surface water sample was collected from the lake on bimonthly basis. The collected water sample and analyzed for physico-chemical parameters by using standard methods. The overall seasonal water quality parameters results have been observed in the range as air temperature (30-35.50°C), water temperature (25.33–27.25°C) pH (7.89–9.08), EC (475–1460 $\mu\text{S}/\text{cm}$)

TDS (223.5–665 mg/L), alkalinity (175–224.5 mg/L), DO (6.58–8.51 mg/L), BOD (1.35–2.84 mg/L), COD (17–28.75 mg/L), Hardness (14–161 mg/L), Ca^{2+} (12.81–26.63 mg/L), Mg^{2+} (17.18–22.25 mg/L), Cl^{-1} (36.88–156.37 mg/L), NO_3^{-} (0.414–3.959 mg/L) and PO_4^{-} (0.002–0.052 mg/L). Water Quality Index and its status of water quality has been calculated and lake water belongs to good water. According to the Bureau of Indian standards the parameters concentrations were within the drinking water range. From the above observation, it is cleared that the Shettikera Lake water is suitable for drinking and domestic purposes.

Keywords Water quality, Drinking water, Water Quality Index, Shettikera Lake.

Introduction

Water is fundamental to human welfare, to all socio-economic development and for maintaining healthy ecosystems. It is an elixir of life on which millions of other species living on the earth [1]. It governs the evolution and functions of universe on the earth hence water is mother of all living world. Water of acceptable quality is essential not only for drinking and domestic purposes but also for agriculture, industrial and commercial uses. In India, rivers and lakes play an important role in providing water for domestic use, industrial and agricultural purposes. And also play an important role in the, ecology and environ-

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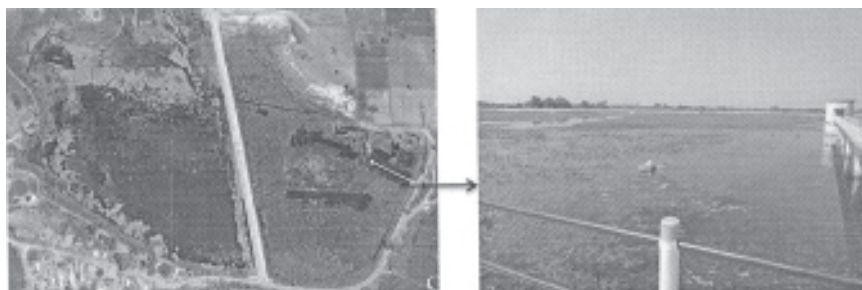


Fig. 1. Showing Satellite view of Shettikera Lake and location of sampling point.

mental aspects of the region, climatic factors are modified by influencing relative humidity and vegetation of the region and it also acts as recharger for aquifers [2]. Because of growing population and human activities on nature, there is scarcity of water and water it being contaminated. Pollution is a serious problem as almost 75% of India's surface water resources have been contaminated by chemical and biological pollutants. Increase in human population creates extreme pressure on the provision of safe drinking water especially in developing countries. River and lake pollution is very severe and critical problem in India due to the natural and human induced factors which affect the quality of water are geology, hydrology, sedimentation/erosion, farm activities, industrial, mining fishing, sewage dumping, deforestation and other activities. These activities aggravate the pollution of water body and greatly influence the quality of water [3, 4]. Thus, water pollution needs serious immediate action and continuous monitoring of pollution level in order to prevent the water because of its importance in maintaining the human health, plants and agriculture. Hence, the present study carried out to assess the water quality status and its suitability for drinking in Shettikera lake of Yadgir district.

Materials and Methods

Shettikera Lake lying between geographical coordinates $16^{\circ}37'40.90''$ - $16^{\circ}37'55.92''$ N latitude and $76^{\circ}44'08.98''$ - $76^{\circ}44'10.32''$ E longitudes with an elevation

of 1478 feet above the sea level in Shahapur taluk, Yadgir district of Northern Karnataka. The total area of the lake is 0.2968 km^2 and water spread area in 0.234 km^2 .

The surface water samples were collected from Shettikera Lake using two liter polythene cans. Separate samples were collected in BOD bottle for analysis of DO and BOD. Air and Water temperature, pH, EC and TDS were recorded on spot using thermometer and water analyzer (Systronics make). The other physico-chemical parameters were analyzed as per the standard methods [5, 6].

Water Quality Index (WQI) is a dimensionless number that combines multiple water quality factors into a single number by normalizing values to subjective rating curves. Conventionally it has been used for evaluating the quality of water for water resources such as rivers, streams and lakes [3, 7].

Calculation of Water Quality Index (WQI)

The three steps of Water Quality Index are :

Step 1

w_i = according to relative importance (overall quality of water for drinking purpose). The maximum weightage of 5 has been assigned to the parameter of nitrate and minimum weightage of 2 has been assigned for calcium (may not be that harmful).

Table 1. Water quality of Shettikera Lake Yadgir district during 2014-15.

Parameters	Monsoon	Post monsoon	Pre monsoon	BIS standards
Air temp. (°C)	31.00 ± 2.83	30.00 ± 1.00	35.50 ± 1.29	–
Water temp. (°C)	26.50 ± 0.71	25.33 ± 0.58	27.25 ± 0.96	–
pH	7.89 ± 0.44	8.90 ± 0.59	9.08 ± 0.67	6.65-9.2
EC (µS/cm)	475 ± 14.14	490.33 ± 46.14	1460 ± 6.35	–
TDS (mg/L)	223.5 ± 16.26	255.67 ± 28.92	665 ± 293	500-2000
Alkalinity (mg/L)	175.00 ± 7.07	212.67 ± 45.49	224.50 ± 52.09	200-600
DO mg/L)	8.01 ± 0.72	8.51 ± 0.41	6.08 ± 0.47	–
BOD (mg/L)	1.42 ± 0.29	1.35 ± 0.23	2.84 ± 0.74	0–3
COD (mg/L)	17.00 ± 4.24	19.00 ± 3.00	28.75 ± 3.77	0–10
T. Hardness (mg/L)	104 ± 8.49	115.33 ± 15.01	161.00 ± 19.77	300–600
Calcium (mg/L)	12.81 ± 1.70	16.82 ± 0.80	26.63 ± 8.20	75–100
Magnesium (mg/L)	17.18 ± 0.79	17.38 ± 3.15	22.25 ± 0.46	30–100
Chloride (mg/L)	36.88 ± 4.01	57.20 ± 20.57	156.37 ± 47.00	200–1000
Nitrate (mg/L)	0.508 ± 0.043	0.414 ± 0.050	3.959 ± 0.434	0–60
Phosphate (mg/L)	0.028 ± 0.034	0.002 ± 0.001	0.052 ± 0.007	–

Step 2

Relative weight (W_i)

$$W_i = w_i / \sum_{i=1}^n w_i$$

$$S_i = W_i * q_i$$

$$q_i = (C_i/S_i) * 100$$

Where q_i=Quality rating, C_i= concentration of each chemical parameter in each year sample in mg/L, S_i=Indian drinking water standard for each chemical parameters in mg/L, Water Quality Index (WQI) = sub index of the Ith parameter.

Step 3

$$WQI = \sum S_i$$

Results and Discussion

The physico-chemical analysis of the water samples carried out for the various water quality parameters. The concentrations of some physico-chemical parameters in water samples in Shettikera Lake Yadgir district Karnataka are presented in Table 1.

Air temperature recorded was fluctuated from 30 – 35.5°C. Water temperature is one of the essential parameter, since it influences the growth and distri-

bution of flora and fauna. Water temperature ranged from 25.33–28.5°C.

pH is an important parameter which determines the suitability of water for various purposes. In the present investigation pH ranged from 7.89 to 9.08 whereas permissible range is 6.5–9.2 and indicates slightly alkaline nature of lake. Similar results were recorded in Renuka Lake in Himachal Pradesh [8].

The electrical conductivity is a numerical expression of its ability to carry on electric current. In the present investigation the values of conductivity recorded is 475 µS/cm to 1,460 µS/cm. Seasonal variations indicates the maximum conductivity was recorded during pre-monsoon season and minimum during the monsoon season. Similarly, the maximum conductivity during the summer season in Basa-

Table 2. Classification of lake on the basis of total Alkalinity after Spence (1996).

T. Alkalinity (mg/L)	Description	Monsoon	Post monsoon	Pre monsoon
1-15	Nutrient poor			
16-60	Moderately nutrient rich			
>60	Nutrient rich	175± 7.07	212.67±. 45.49	224.5± 52.09

Table 3. Classification of water on the basis of total hardness after Sawyer and McCarty (1967).

Hardness (mg/L)	Description	Monsoon	Post monsoon	Pre monsoon
0-75	Soft			
75-150	Moderately hard	104 ± 8.49	115.33 ± 15.01	
150-300	Hard			161.00 ± 19.77
>300	Very hard			

vanbole tank at Sagar taluk of Shimoga district [9]. Electrical conductivity is an estimate of total dissolved salts in water and water with EC values between 2.5 and 10.0 mS/cm is not recommended for human consumption.

Total dissolved solids was recorded from 223.5 mg/L in monsoon to 665 mg/L in pre monsoon season. TDS values found to be with in the drinking water standards range. Similar results reported in Shoolkera Lake, Bangalore [10].

Total alkalinity was observed in the range from 175 mg/L to 224.5 mg/L which is within the permissible limits (600 mg/L). Spence [11] classified the lakes into three categories based on alkalinity; 1-15 mg/L is nutrient poor, 16-60 mg/L is moderately nutrient rich, and >60 mg/L is nutrient rich. On the basis of this classification, Shettikera Lake is nutrient rich shown in Table 2. This may be due to input of nutrients from agricultural fields in the catchment.

Dissolved oxygen (DO) is of considerable importance in water quality as its concentration in water is an indicator of ability of a water body to support a well balanced aquatic life. Oxygen status of any water body is greatly influenced by temperature. As per the classification of Inland surface waters (IS: 2296-1982) minimum value of DO for water is 4.0 mg/L. In the present study, dissolved oxygen was observed a minimum of 6.08 mg/L and maximum of 8.51 mg/L. It shows that it supports fish life in the lake. High DO was recorded in post monsoon season due to circulation, cloud cover and moderate temperature.

BOD is an indication of the organic load and it is

Table 4. Water Quality Index and status of water quality in Shettikera Lake.

WQI value	Water quality status	Monsoon	Post monsoon	Pre monsoon
<25	Excellent			
26-50	Good water	31.25	35.02	37.46
51-75	Poor water			
76-100	Very poor water			
>100	Water unsuitable for drinking			

a pollution index especially for water bodies receiving organic effluent. BOD was observed from 0.81 mg/L post monsoon to 2.84 mg/L pre-monsoon season. Surface water (river, lake) containing BOD values 10 mg/L are consider to be moderately and more than 20 mg/L as to be highly polluted water [12]. In the present study BOD is very less. COD is used to measure the content of oxidizable organic as well as inorganic matter of the given sample of waters. The values of COD ranged between 17 mg/L in monsoon and to 28.75 mg/L in pre monsoon season.

Hard water is not suitable for drinking and domestic purpose as it forms scales on water heater and cooking utensils and consume more soap during washing of clothes. Hardness below 300 mg/L is considered potable but beyond this limits cause gastrointestinal irritation [13]. In the present study, total hardness fluctuated between 104 mg/L in monsoon and 193 mg/L in pre monsoon season and it is well within the limit Kannan [14] has classified water on the basis of hardness values in the following manner; 0-60 mg/L, soft 61-120 mg/L, moderately hard 121-160 mg/L, hard and greater than 180 mg/L very hard. Table 3 shows that lake water belongs to moderately hard during monsoon and post monsoon and hard category in pre monsoon season because of low water volume and high evaporation.

The presence of calcium and magnesium are responsible for the hardness of the water and their desirable limits are 75-200 mg/L and 30-100 mg/L, respectively. The Ca and Mg were observed in the range of 12.81 mg/L to 26.83 mg/L and 15.70 mg/L to 29.95 mg/L respectively. In the present study, both calcium and magnesium were within the drinking water per-

missible limit.

The increased concentration of chloride is considered as an indicator of eutrophication. Chloride was observed in the range of 36.88 mg/L in monsoon season to 164.52 mg/L in pre monsoon season. Chloride was within the permissible level 250 mg/L.

Nitrate fluctuated between 0.414 mg/L in post monsoon season and 5.386 mg/L in pre monsoon season. The high values in pre monsoon season are due to decomposition of organic matter by microorganisms. Microorganisms are active during summer because of high temperature. The nitrate level in freshwater is usually found in the range of 0.1 to 4 mg/L nitrate-nitrogen. Unpolluted waters generally have nitrate levels below 1 mg/L. Nitrate concentration of more than 5 mg/L in water usually indicates pollution made by human and animal wastes or fertilizer runoff [15].

Phosphorus is an essential element for plant life, but when there is too much of it in water, it can accelerate eutrophication. Phosphate content of studied lake water fluctuated between 0.002 mg/L and 0.052 mg/L. Phosphate concentration above 0.5 mg/L is an indicator of pollution [16]. In the present study, phosphate was recorded well below 0.5 mg/L and indicates unpolluted nature of lake.

Table 4 explains water quality classification based on WQI criteria, which in turn, indicates that Water Quality Index (WQI) of all sampling locations. The lake water is found of good quality (WQI – 31.25 to 37.46) during both seasons. Application of Water Quality Index (WQI) in this study has been found useful in assessing the overall quality of water. It is also helpful for public to understand the quality of water as well as being a useful tool in many ways in the field of water quality management.

The results of the assessment of the water quality of the lake indicate that the water quality belong to good category. Most of the water quality parameters concentrations were found to be within the drinking water standards. Hence, lake water can be used

for drinking and domestic purpose by giving simple treatment.

References

1. Chidambaram S, Ramanathan AL, Shivanna K, James RA (2010) Recent trends in water research: Hydrogeological and hydrological perspectives. IK Int Publ House, Bangalore, India.
2. Purushottam J, Puri (2010) Study and interpretation of physico-chemical characteristic of lake water quality in Nagpur city (India). *Rasayan J Chem* 3 : 800–810.
3. Chaterjee C, Raziuddin M (2002) Determination of Water Quality Index (WQI) of a degraded river in Asansol Industrial area, Raniganj. *Burdwan, West Bengal. Nat Environ Poll Technol* 1 : 181–189.
4. A Vyas, DD Mishra, A Bajpai, S Dixit, N Verma (2006) *Asian J Experim Sci* 20 : 289–296.
5. APHA (1998) Standard method for the examination of water and wastewater. 20th edn. Publ by Am Public Health Association, Washington, DC 2005-2605.
6. BIS Indian Standard Specifications for Drinking Water, Bureau of Indian Standards IS: 10500, 1992.
7. Thakor FJ, Bhoi DK, Dabhi HR, Pandya SN, Nikitaraj B, Chauhan (2011) Water Quality Index (WQI) of Pariyej Lake Dist. Kheda – Gujarat. *Curr World Environ* 6 : 225–130.
8. Singh Omkar, Sharma MK (2012) Water quality and eutrophication status of the Renuka Lake, District Sirmaur (HP). *J Ind Water Resour Soc* 32 : 1–7.
9. Narayana J, Purushothama R, Kiran BR, Ravindrakumar KP, Puttah ET (2005) Investigation of drinking water quality of Basavanahole tank with reference to physico-chemical characteristics. *Fundamental of Limnology*, pp 201–206.
10. Gayathri S, Latha N, Ramachandra Mohan M (2013) Impact of climate change on Water Quality of Shoolkere Lake, Bangalore. *J Academia and Industrial Res (JAIR)* 2 : 362–368.
11. Spence DHN (1996) The Zonation of plants in fresh water lakes. *Adv Ecol Res* 12 : 37–125.
12. Paul G (1999) Environment and pollution. Paribes, Dushan O (eds.), pp 323.
13. Indian Council of Medical Research (1975) Manual of standards of quality for drinking water supplies, Indian Council of Medical Research (ICMR), New Delhi.
14. Kannan K (1991) Fundamentals of environmental pollution, S.Chand, Com Ltd, New Delhi.
15. Kumar SM, Ravindranath S (1998) Water Studies - Methods for monitoring waterquality. Published by Center for Environment Education (CEE), Bangalore, Karnataka, India, pp 191.
16. Jain SM, Sharma M, Thakur R (1996) Seasonal variations in physicochemical parameters of Halai reservoir of Vidisha District. *Ind J Ecobiol* 8 : 181–188.