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Assessment of Physico-chemical characteristics of water and Water Quality Index of Jambadahalla Dam, Chikmagalur district, Karnataka

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ABSTRACT

The present study deals with the assessment of water quality of Jambadahalla dam situated in Chikmagalur district, Karnataka state to know the status and suitability of water for human usage. Surface water samples were collected for a period of three seasons. The collected water sample subjected to analysis of various physico-chemical parameters viz. air and water temperature, pH, total dissolved solids, total alkalinity, dissolved oxygen, BOD, total hardness, calcium, magnesium, chloride, sulphate, nitrate and phosphate. According to classification of dam on the basis of total alkalinity and total hardness the water body is nutrient rich during all seasons and falls under the category of moderately hard during all the seasons respectively. The water quality index (WQI) shows that the Jambadahalla dam water belongs to good water category. All the physico-chemical parameters were well within the permissible limit of drinking water standards.

1. Introduction

Water quality refers to the chemical, physical, biological, and radiological characteristics of water (Diersing, Nancy, 2009). It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose (Johnson et al., 1997). It is most frequently used by reference to a set of standards against which compliance, generally achieved through treatment of the water, can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact, and drinking water (https://en.wikipedia.org/wiki/Water_quality). Now days, due to population growth in rural areas and irrigation, lakes are facing various problems resulting in deterioration of its water quality. The degradation of lake has occurred due to inflow runoff, domestic sewage, and other activities around the lake. Thus the lake is subjected to enormous anthropogenic stress; the overall impact has resulted in the deterioration of the water quality, accumulation of toxic chemicals and sediments, shrinkage of lake area and loss of the aesthetic value. The pollution of lake majorly shows the effect on physico-chemical quality and then systematically destroys microbial and plankton communities thus it leads ecological imbalance of food chain in aquatic ecosystem (Mohammad et al., 2015; Basavaraja, 2018).

The physico-chemical parameters are the important component of the aquatic system as they indicate the water quality of aquatic ecosystem. Water quality provides current information about the concentration of various solutes at a given place and time. And also, water quality parameters provide the basis for judging the suitability of water for its designated uses and improve existing conditions. Hence periodic monitoring and preventive measures are required to save the dam from eutrophication (Basavaraja, 2018). The study on water quality and status of the dam in Chikmagalur district is very meager. Therefore, the present study is conducted for the benefit of rural people.

2. Materials and Methods

Study Area

Jambadahalla dam is a man made water body situated between 75° 45' 0"E longitude and 13°41' 0"N latitude. The total area of this water body is 2.186 sq. km and the depth is about 11-12 meters. The water storage capacity is 85.5 billion cubic feet and catchment area is 23.9 square kms. Anthropogenic and domestic activities are comparatively less over here. The water is used for irrigation and fishery purposes.

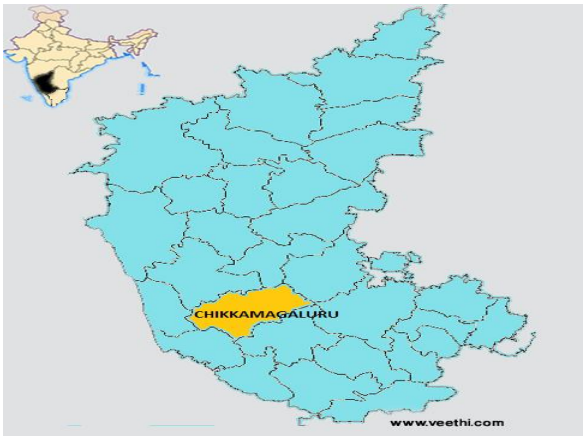

Figure 1: Study area map (Source: www.veethi.com)

Water Sampling

The surface water sample was collected in a 2 litre cleaned polythene bottles and transported to laboratory for analysis of various physico-chemical parameters. The sample was collected for a period three seasons (monsoon, post-monsoon and pre-monsoon) during the year 2016-17. The parameters like air and water temperature, pH, dissolved oxygen etc were measured on the spot itself. The TDS, total alkalinity, total hardness, calcium, magnesium, chloride,

sulphate, nitrate and phosphate were analyzed as per the standard procedures prescribed by the Bureau of Indian Standards (BIS ,1991), APHA (1995) and Trivedy and Goel (1986).

WQI

Water quality index is a technique of rating that provides the composite influence of individual water quality parameters on the overall water quality. It is used for assessment of the quality of water various water resources such as rivers, streams and lakes, etc (Chatterjee and Raziuddin, 2002; Singh et al., 2015). Bureau of Indian Standards for drinking water quality have been used to calculate the water quality index

The WQI is computed following the 3 steps.

First step – Assigning of weight (wi) to the selected water parameters (e.g., pH, TDS, TH, HCO3, Cl, SO4, NO3, Fe, ……) according to their relative importance in the overall quality of water for drinking purposes (weight may be from 1 to 5).

Second step – Computation of a relative weight (Wi) of the chemical parameter using the following equation:

$$Wi = wi / \sum wi \ (i = 1 \text{ to } n)$$

where, Wi is the relative weight, wi is the weight of each parameter and 'n' is the number of parameters

Third step - Assigning of a quality rating scale (qi) for each parameter, as below:

$$qi = (Ci / Si) \times 100$$

where, qi is the quality rating, Ci is the concentration of each chemical parameter in each water sample in mg/l, and Si is the guide line value/desirable limit as given in Indian drinking water standard (BIS 2004).

For computation of WQI, the sub index (SI) is first determined for each chemical parameter, as given below:

$$SIi = Wi \times qi$$
$$WQI = \sum SIi \ 1 – n$$

where, SIi is the subindex of ith parameter; Wi is relative weight of ith parameter; qi is the rating based on concentration of ith parameter and 'n' is the number of chemical parameters.

3. Results and Discussion

Water temperature deviated from 23^{o}C to 29^{o}C throughout the study. The pH was observed in the range of 7.9 to 8.3 which indicates that water was alkaline in nature (Figure 2). Dissolved oxygen (DO) is the most important parameter which can be used as an index of water quality, primary production and pollution. DO values ranged from 4.85 to 7.30 mg/l. The DO level of reservoir water may be favorable for aquatic organisms (Rajashekara et al. 2007).

Biochemical oxygen demand values ranged from 0.25 to 1.25 mg/l. Biochemical oxygen demand values were low; this is because the temperature retards the rate of reproduction of organisms. Similar observations were also made by Mane and Madlapure (2002) from Manar river district Nanded. Chlorides are important in detecting the concentration of ground water by waste water. In the present study, the chloride value ranged between 65.2 and 74.4 mg/l. Similar results were observed by Damodharan and Suresh (2005). Chloride in natural water results from agricultural activities or sometimes, it could be due to dissolution of chloride from chloride containing rocks. The ecological significance of chloride lies in its potential to regulate salinity of water and exert consequent osmotic stress on biotic communities (Shinde et al., 2011). According BIS standards, chloride level was well within the desirable limit.

Sulphate content fluctuated from 109.6 to 157.8 mg/l. Sulphate is present in fertilizers on its application to crop fields through runoff reaches water bodies and contribute to water pollution. And also the supply of sulphate ions in surface water under natural conditions are due to the reactions of water with sulphate containing rock and with the biochemical and partly chemical oxidation of sulphides and other compounds of sulphur (Shinde et al., 2011).

Alkalinity of surface water is primarily a function of carbonate, hydroxide content. The value of alkalinity provides idea of natural salts present in water and also an index of nutrient status in a water body. The alkalinity varied between 140 mg/L to 220 mg/L. The high value of alkalinity was recorded during post monsoon and the low value of alkalinity was recorded during monsoon season. According to classification of lake on the basis of total alkalinity after Spence (1996) lake was nutrient rich during all seasons (Figure 2). Total dissolved solids (TDS) are the solids present in water in the dissolved state. TDS value recorded from 310 to 380 mg/L. TDS level was well within the permissible limit.

Total hardness in water is the sum of the concentrations of alkaline earth metals cations. The hardness present in the dam varied from 120.0 mg/L to 148.5 mg/L. According to Sawyer and McCarthy (1967) classification, Jambadahalla dam falls in the category of moderately hard during all the three seasons. Calcium is one of the important nutrients for organisms and as such has no hazardous effect on human health. In the present study, calcium content ranged from 35.50mg/L to 53.6 mg/L. Its concentration is well within the BIS drinking water standards desirable limit. Magnesium is often associated with calcium in all kinds of waters, but its concentration is generally lower than the calcium.

Phosphate is considered as the most critical single element for biological productivity (Baruah etal.,1984; Sayeswara et al.,2010). Increased concentration of phosphates is taken up by the phytoplankton, which leads to algal blooms. In this study , phosphate content was ranged from 0.002 to 0.06 mg/L. Nitrate is one of the major anions in natural waters, but concentrations can be greatly elevated due to

leaching of nitrogen from farm fertilizer or from feed lots or from septic tanks. The nitrate concentration values ranged from 0.35 mg/L to 2.12 mg/L. Its level was maximum in pre-monsoon season and minimum during monsoon season.

Water quality index is a technique of rating that provides the composite influence of individual water quality parameters on the overall water quality. Table 3 shows the water quality index and status of water quality. In the present investigation, the water quality index varies between 28.1 and 33.5 and hence falls under the 'Good' water quality .

4. Conclusion

The assessment of water quality of the dam shows seasonal variation in different physico-chemical parameters. As per the water quality index, dam falls on 'Good' water quality category. According to the drinking water standards, most of the parameters levels are within the desirable limits. Hence, water can be used for human usage. But, the nutrients like phosphate, nitrate, calcium and magnesium were in low level, indicates the moderately oligotrophic status of the water body.

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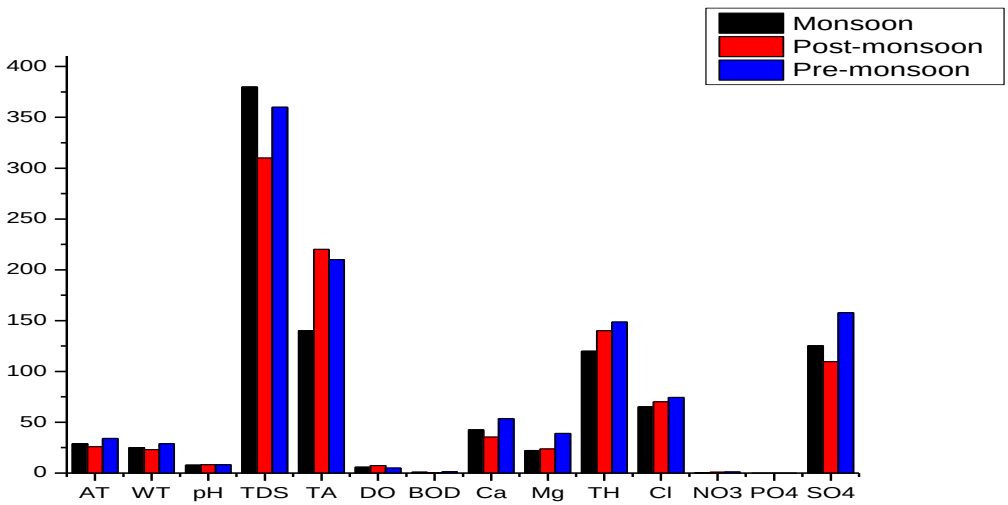

Figure 1: Water quality status of Jambadahalla dam during Monsoon, Post-monsoon and Pre-monsoon seasons

Table 2: Classification of dam on the basis of total alkalinity after Spence (1996) and Total hardness (after Sawyer and Mc Carthy, 1967)

Total alkalinity mg/L	**Classification**	**Monsoon**	**Post-monsoon**	**Pre-monsoon**
1-15	Nutrient poor			
16-60	Moderately nutrient rich			
> 60	Nutrient rich	140	220	210
Hardness range mg/L	**Classification**	**Monsoon**	**Post-monsoon**	**Pre-monsoon**
0-75	Soft			
75-150	Moderately hard	120	140	148.5
150-300	Hard			
> 300	Very hard			

Table 3: Water Quality index (WQI) of the water body during different seasons

WQI value	**Water quality status**	**Monsoon**	**Post-monsoon**	**Pre-monsoon**
< 25	Excellent			
26-50	Good water	28.1	29.4	33.5
51-75	Poor water			
76-100	Very poor			
> 100	Unsuitable for drinking			

