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Comparative Water Quality of Bhosga and Khaji-Kotnoor Reservoirs, Kalaburagi, Karnataka

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Abstract:

Reservoirs in semi-arid regions like northern Karnataka characterize vital freshwater resources supporting drinking water supply, irrigation, fisheries, and local biodiversity. This study comparatively appraises the water quality of Bhosga Reservoir and Khaja Kotnoor Reservoir in Kalaburagi district based on key physico-chemical parameters. Sampling was carried out for a period of one year form April 2024 to March 2025. Parameters such as pH, Total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), total hardness (TH), phosphate, sulphate, and nitrate were analyzed. A Water Quality Index (WQI) was calculated to assess overall suitability. Results show that Bhosga Reservoir maintains relatively better water quality, with higher DO and lower nutrient and organic load, whereas Khaja Kotnoor Reservoir exhibits signs of stress due to elevated nutrients levels, particularly during Nitrate and sulphate. WQI classification indicated "Good to Poor" water quality for Bhosga and Khaja Kotnoor. The study recommends regular monitoring, eco-restoration measures, and reduction of anthropogenic inputs to maintain reservoir health.

Keyword: Water quality, Reservoirs, Bhosga, Khaja Kotnoor, Physico-chemical parameters, Water quality Index.

Introduction:

Freshwater, the most precious natural resource on the planet, is essential to all life (Koehler 2008). For effective water management, it's critical to understand the physical and chemical concentrations of reservoir water (Sanchez-Montoya et al., 2012). In both urban and rural areas, reservoirs are the main source of drinking water, and they are essential to maintaining public health and environmental standards (Falah and Haghizadeh, 2017).

The water quality index is typically used to assess water quality. It is a statistic that distinguishes between particularly clean and contaminated water. Water Quality Indices are a crucial tool right now because they give water managers a clear, complete picture of the water quality in the form of a single number (Tripati and singal, 2019).

The fact that almost every family uses bore wells, frequently without previously getting approval from the planning authority and ground water board, demonstrates how insufficient the water supply was. The city frequently has water shortages. The Khaji-kotnoor and Bosga reservoirs, which are 10–25 kilometers from the treatment facility, now provide the city with piped drinkable water.

Before being used for household, agricultural, or drinking purposes, water must be analyzed. Numerous physicochemical factors must be used to test it. In order to evaluate water quality and compare the results of different physicochemical attribute values to their reference

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standards, parameters must be evaluated (Chinamalli and Vijaykumar, 2023). So, the primary goal of this study is to assess the current physical and chemical characteristics of the waters of Bhosga and Khaji-Kotnoor. This examination will likely uncover the natural and man-made elements impacting the reservoir water's chemistry. In such severely water-scarce areas, it will also help maintain high-quality rivers for the region's long-term development and prosperity.

Materials and methods

Study area

Bhosga and Khajikotnur reservoirs are important perennial and rural water bodies located in the Kalaburagi district of Karnataka. The Bhosga reservoir lies nearly 10 km from Kalaburagi city and is situated within the district's geographical range of 16°12" to 17°46" N latitude and 76°46" to 77°42" E longitude, at an elevation of 454 meters above mean sea level. It encompasses a total catchment area of 756 km², with its eastern boundary defined by a 10.66-meter-high bund equipped with an overflow outlet, while the remaining periphery is surrounded by agricultural fields. In comparison, the Khajikotnur reservoir, located near Khajikotnur village about 18 km east of Kalaburagi, lies at 17.3609° N and 76.9781° E and covers a catchment area of approximately 265.70 km². Together, these reservoirs play a vital role in supporting local hydrology, agriculture, and rural water needs, while reflecting the diverse geomorphological and land-use characteristics of the Kalaburagi region (Parvathi et al., 2017; Sarikar and Vijaykumar, 2022).

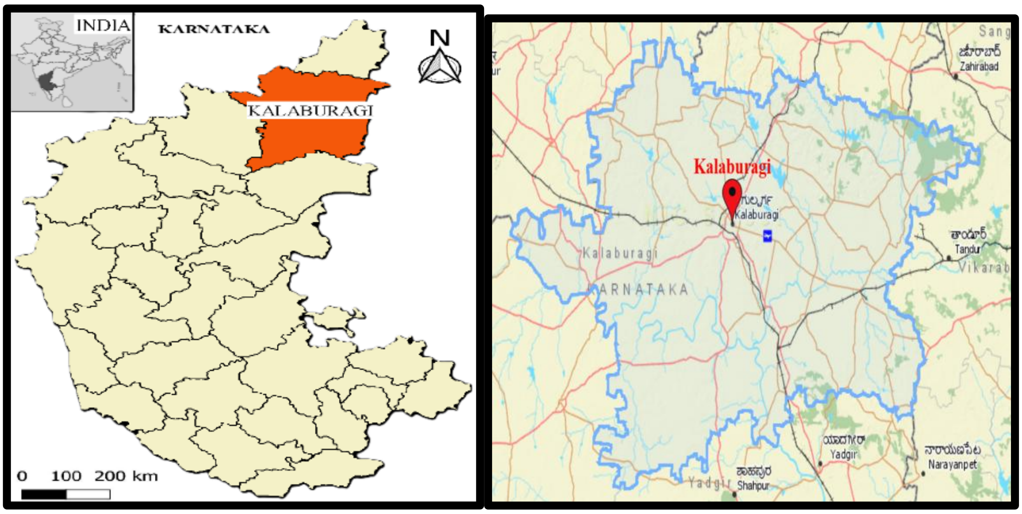

Fig. 1 Study area

Sample collection

The water samples were collected in 1 litre polyethene bottles after being rinsed with water samples that would be obtained from various places. They were then brought to the lab in an ice box and kept there at a temperature of 4°C until analysis. The parameters that we assessed in this study included total dissolved solids (mg/l), pH, conductivity (siemens/cm), alkalinity (mg/l), total hardness (mg/l), dissolved oxygen (mg/l), chloride (mg/l), phosphate (mg/l), nitrate (mg/l), and sulphate (mg/l). The parameters pH, EC, TDS, and fixation of dissolved oxygen were all measured on the spot. Analyses in the lab were performed on the remaining

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parameters. The physico-chemical parameters were determined according to procedures outlined in Trivedi and Goel (1986) and APHA (2005).

Water quality index

Ten significant water quality parameters are used to generate the water quality index (WQI). The weighted arithmetic index approach was employed to determine the WQI for drinking water samples that were collected from four points and two from each reservoir. Utilizing the drinking water standards recommended by the Bureau of Indian Standards, the wqi has been established (BIS). The quality of two reservoirs has been assessed using the weighed arithmetic index approach (Brown et al., 1972).

Calculation of water quality index

Step 1 Unit weight factor for each parameter is calculated by the following equation

$Wn = K/Sn$

Where, Wn is the unit weight of each parameter, n represents number of parameters, Sn indicates the standard permissible limit of nth parameter, and K is the proportionality constant.

Step 2 Sub index (Qn) is calculated using the equation mentioned below

$Qn=[(Vn\text{-}Vi) / (Vs - Vi)]$ X 100; Here,

Vn is the obtained concentration of the i^{th} determinant,
Vi is the ideal value of the i^{th} determinant in fresh water, and
Vs is the standard value of the i^{th} determinant. Except for pH and DO, where Vi = 7 and 14.6 respectively, zero is the optimal value for all determinants.

Step 3 Comprising Step 1 and Step 2, WQI is presented as follows.

$WQI = Wn$ X Qn

Table 1. WQI ranges, status, and possible use of the water sample

WQI range	Water quality status (WQS)	Probable usage
0-25	Excellent water quality	Drinking, irrigation, and industrial purpose
26-50	Good water quality	Drinking, irrigation, and industrial purpose
51-75	Poor water quality	Irrigation and industrial
76-100	Very poor water quality	Irrigation
Above 100	Unsuitable for drinking purpose	Proper treatment required before use

Results and Discussion

The pH values across all four sites ranged between 7.8 and 8.3, indicating slightly alkaline conditions. All values fall within the BIS permissible limit (≤8.5), reflecting a stable buffering capacity of the reservoir water (Table No. 2). Site 4 recorded the highest pH (8.3), suggesting higher bicarbonate influence or photosynthetic activity. EC values varied from 247 to 284 µS/cm, remaining well below the BIS limit of 300 µS/cm. EC was highest at Site 4 (284 µS/cm), implying a slightly elevated ionic concentration, possibly due to local runoff or sediment dissolution. Overall, EC values indicate low to moderate mineralization of the water.

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TDS ranged between 146 and 170 mg/L, which is significantly lower than the BIS limit of 500 mg/L. Such low TDS values indicate good water quality with minimal dissolved salts, making the reservoir suitable for aquatic life and domestic usage after basic treatment. DO levels were notably high, ranging from 8.24 to 10.35 mg/L, exceeding the BIS minimum requirement of 5 mg/L. Site 3 exhibited the highest DO (10.35 mg/L), indicating vigorous aeration and a healthy ecological balance. Such high DO values favour the survival and productivity of aquatic organisms. Total alkalinity values ranged from 114.23 to 125.33 mg/L, aligning with the BIS guideline of 120 mg/L at most sites. Site 4 slightly exceeded the limit (125.33 mg/L), which may be attributed to carbonate-rich runoff or higher organic decomposition. Moderate alkalinity reflects good buffering capacity. TH varied between 154.78 and 186.53 mg/L, well below the BIS limit of 300 mg/L, classifying the water as moderately hard. Hardness increased progressively from Site 1 to Site 4, possibly due to increased dissolution of calcium and magnesium salts. Such values are acceptable for domestic use. Chloride levels ranged from 68.52 to 77.73 mg/L, much lower than the BIS permissible limit of 250 mg/L. These moderate chloride concentrations indicate absence of significant anthropogenic contamination, such as sewage or agricultural runoff. Phosphate concentrations remained low (1.63–2.31 mg/L), well within the BIS limit of 5 mg/L. The slightly elevated value at Site 4 (2.31 mg/L) may be linked to agricultural runoff or organic waste, but still does not indicate eutrophication risk. Sulphate ranged from 6.5 to 8.3 mg/L, extremely lower than the BIS standard of 150 mg/L, indicating minimal industrial or geological sulphate input. All sites exhibit excellent sulphate quality. Nitrate values (1.3–2.02 mg/L) were significantly below the BIS limit of 45 mg/L, reflecting low nutrient pollution and reduced risk of eutrophication or health hazards. Site 4 had the highest nitrate (2.02 mg/L), possibly influenced by agricultural activity.

Table 2. Measured mean values of water quality parameters of two reservoirs

Site	**Site 1(B)**	**Site 2(B)**	**Site 3(K)**	**Site 4(K)**	**BIS (2012)**
Ph	7.9	7.8	7.8	8.3	8.5
EC	251	276	247	284	300
TDS	170	146	167	155	500
DO	8.24	9.24	10.35	8.99	5
TA	114.23	122.1	120.2	125.33	120
TH	154.78	181.26	179.96	186.53	300
CL2	77.73	68.52	69.02	75.8	250
PO4	2.24	1.63	1.86	2.31	5
SO2	6.5	7	6.63	8.3	150
NO3	1.6	1.44	1.3	2.02	45

Water quality index

WQI enables a broad investigation of water quality on many levels that impacts a reservoirs capacity to support life and determines if the general condition of water bodies offers a possible risk to different water usages (Shah and Joshi 2017). According to Table 4, out of the four locations, the water quality was good at S2 and S3, poor at S1 and S4. The geographic location of the study region, which were characterised by anthropogenic activities, and agricultural runoff may be the cause of water quality degradation.

Table 3. The weights (Wi) of the parameters used for WQI calculation.

Sl. No	Parameters	BIS Standards	Relative weight (Wi)
1	pH	8.5	0.207294
2	EC	300	0.005873
3	TDS	500	0.003524
4	DO	5	0.352401
5	TA	120	0.014683
6	TH	300	0.005873
7	Cl	250	0.007048
8	PO_4^{-3}	5	0.352401
9	SO_4^{-2}	150	0.011747
10	NO_3	45	0.039156
			ΣWi= 1.00

Table 4. WQI values of samples

Sites	WQI	Water quality status
S1	54.3	Poor
S2	44.4	Good
S3	42.5	Good
S4	57.7	Poor

Conclusion

The current study was conducted to evaluate the quality of the Bhosga and Khaji Kotnoor reservoir using a variety of physicochemical markers. The water samples were determined to be safe to drink, and the pollution levels were confirmed to be within the allowed limit set by BIS standards. The recent study demonstrated that pH and DO have a substantial influence on the reservoirs' WQI. It doesn't now represent a significant risk to a range of household uses. In order to lessen the load of nutrients and provide residents with a high-quality water supply, it is advised that a regular physical treatment be performed, such as filtering reservoir water.

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