



Seasonal Variations Of Physico–Chemical Parameters Of Khaji Kotnoor Reservoir, Kalaburagi District, Karnataka.

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Abstract: The present study examines the seasonal fluctuations in physico-chemical parameters of the Khaji Kotnoor reservoir, located in Kalaburagi district, Karnataka. In aquatic ecosystems, these parameters are crucial indicators of water quality, significantly influencing both ecological health and human usage. The deterioration of water quality is largely attributed to the extensive application of agricultural chemicals like pesticides and fertilizers, along with the discharge of urban waste into water bodies. Consequently, regular monitoring of water quality is essential. This investigation aimed to assess seasonal variations by collecting water samples from four different sites across the reservoir over a one-year period, from January to December 2023. The parameters analysed included atmospheric and water temperature, pH, dissolved oxygen, free carbon dioxide, total dissolved solids (TDS), chloride, calcium, magnesium, phosphate, and sulphate. The study revealed seasonal changes in the concentrations of these parameters, which were then compared with standards set by the World Health Organization (WHO) and the Bureau of Indian Standards (BIS). Findings indicate that the Water Quality Index (WQI) remains within acceptable limits, making the water suitable for domestic use.

Index Terms - Khaji kotnoor reservoir , physico- chemical parameters, water quality, season-wise analysis.

I. INTRODUCTION

Water is a vital and indispensable natural resource on Earth, essential for the survival of all living organisms, including humans. It exists in various forms such as rain, rivers, and oceans. While about 97% of the Earth's water is saline, only around 3% is fresh and usable. In India, approximately 77% of water usage is dedicated to agriculture. Nearly all aspects of human development depend on water, including drinking, irrigation, sanitation, and industrial applications. Despite its abundance, water remains a highly valuable resource. Variations in the physico-chemical properties of water significantly influence the distribution and diversity of plant and animal life within aquatic environments.

To understand the implications of water quality on human health, a study was conducted focusing on the physico-chemical characteristics of a specific water body. The findings offer essential insights for communities that depend on this water source for daily use. Water quality assessments provide real-time information about the concentrations of various substances in the water at a given location and time. These parameters help determine the water's suitability for various uses and guide efforts to improve water conditions.

The reservoir studied serves primarily for irrigation and fishing activities. Additionally, the water is used for drinking, livestock bathing, and household chores. Local communities, including fishermen and villagers, rely on it for breeding significant quantities of both major and minor carp species. Gaining a clear understanding of the reservoir's ecosystem is crucial for evaluating its environmental health, which requires an analysis of the reservoir's physical and chemical water properties. Hence, the current research is focused on examining these essential characteristics. Water quality assessment through physico-chemical parameters is fundamental to understanding aquatic ecosystems, as documented in numerous studies. Trivedi and Goel (1986) [1] provided foundational methodologies for analyzing water pollution using chemical and biological techniques, forming the basis for subsequent water quality studies.

Research specific to Karnataka has contributed significantly to understanding seasonal variations in local reservoirs. Vijaykumar et al. (2000) [2] and Kumar & Sharma (2001) [3] reported distinct seasonal trends in water chemistry and zooplankton dynamics in reservoirs of the Gulbarga region. Similar seasonal influences were observed by Murthuzasab et al. (2010) [5] in the Hirahalla Reservoir and by Bhadja and Vaghela (2013) [10] in their water quality index-based analysis.

Comparative studies from other countries also underline the role of seasonal dynamics. For instance, Chukwuka et al. (2008) [4] examined how aquatic weeds like water hyacinth alter water quality in Nigeria. Ibrahim et al. (2009) [8], Odewade et al. (2021) [9], and Sadauki et al. (2022) [11] assessed reservoirs across Nigeria, emphasizing the influence of climate and anthropogenic activities on water parameters. Similarly, Teame and Zebib (2016) [6] studied Tekeze Reservoir in Ethiopia, revealing seasonal shifts in pH, TDS, and DO.

In the Indian context, Kumar et al. (2006) [7] highlighted significant seasonal changes in Ranjit Sagar Reservoir's physico-chemical profile, attributing them to regional climate and land-use patterns. Gupta et al. (2017) [20] reinforced this by linking biological and physico-chemical indicators to river water quality in Madhya Pradesh.

Theoretical and methodological perspectives also enrich this field. Boyd (2000) [13] and Bozorg-Haddad et al. (2021) [14] discussed the interdependence of pH, CO₂, and alkalinity in aquatic environments. Chapman & Sullivan (2022) [15] emphasized the importance of long-term water quality monitoring for sustainable use. Loucks and van Beek (2017) [24], as well as Mondal et al. (2016) [26], offered models to predict water quality trends under varying seasonal and anthropogenic pressures.

Other studies have investigated pollutant dispersion and the ecological impact of contaminants. Dietz et al. (2000) [16], French-McCay et al. (2018) [19], and Fu et al. (2012) [18] analysed pollutant behaviors across

ecosystems and their health impacts. Mahad & Baawain (2019) [27] and Null et al. (2017) [28] further connected water quality fluctuations to aquatic organism health and habitat availability.

Overall, these studies collectively emphasize the significance of continuous monitoring and the role of seasonal and anthropogenic influences on water quality. They provide a comprehensive backdrop for the current study on Khaji Kotnoor Reservoir, reinforcing the necessity for localized assessment in the broader context of global water quality challenges.

II. MATERIALS AND METHODS

Study Area

Khajikotnur is a small village situated in the Gulbarga Taluk of Karnataka's Gulbarga District, falling under the jurisdiction of the Khajikotnur Panchayat in the Gulbarga Division. The village is located approximately 18 kilometers east of the district headquarters, Gulbarga. Geographically, it is positioned at 17.3609° North latitude and 76.9781° East longitude. The reservoir associated with this area covers a total catchment area of approximately 265.70 square kilometers.



Fig.1. A view of Khaji kotnoor reservoir.



Fig. 2. Sattelite map showing

Khaji kotnoor Reservoir

Every month water samples were collected from the study area from January 2023 to December 2023. The Atmospheric and water temperature pH and free CO₂ were measured in the field and samples collected for further physico-chemical analysis according to standard methods APHA (1998); Trivedi and Goal (1987).

III. Results and Discussion:

The seasonal variations of physico-chemical parameters data of Khaji Kotnoor Reservoir, Gulbarga District, and Karnataka, India have been presented in Table I, Table II and Table III.

Atmospheric and Water Temperature:

Temperature is a key indicator of water quality and one of the easiest physical parameters to measure. It naturally varies with seasonal changes and plays a crucial role in both chemical reactions within the water and biochemical processes in aquatic organisms. As a physical factor, temperature influences the characteristics

of water and significantly impacts plankton fluctuations and the overall functioning of aquatic ecosystems (Wetzel, 1975; Dwivedi and Pandey, 2002; Singh and Mathur, 2005).

In the current study, seasonal variations in both atmospheric and water temperatures were recorded. The highest temperatures were observed during the summer, reaching 42.0°C in the air and 33.0°C in the water in May. Conversely, the lowest temperatures were recorded in November during winter, with atmospheric and water temperatures dropping to 29.0°C and 20.0°C, respectively. These findings are consistent with the observations of Kannan and Job (1980). The elevated water temperatures during summer can be attributed to lower water levels, high ambient temperatures, and clear skies (Salve and Hiware, 2008). In contrast, lower temperatures in winter are likely due to higher water levels, reduced solar radiation, and cooler atmospheric conditions.

Hydrogen Ion-Concentration:

The recorded pH values across Monsoon (6.81), Winter (8.07), and Summer (8.125) reflect seasonal shifts in the chemical composition of the water. During the monsoon season, the water is close to neutral but slightly acidic, likely influenced by rainwater and surface runoff. In winter, the pH becomes mildly alkaline, which may be attributed to reduced biological activity and an increase in dissolved minerals. In summer, a further rise in pH is observed, primarily due to evaporation and enhanced photosynthetic activity, which lowers CO₂ levels in the water. Despite these fluctuations, the pH remains within the acceptable range of 6.5 to 8.5, indicating typical seasonal variation.

Total Dissolved Solids (TDS): TDS refers to the concentration of dissolved minerals and salts in water and serves as an indicator of its purity. The lowest TDS value was observed in winter (116.78 mg/L), suggesting clean and stable water conditions, likely due to reduced surface runoff. In summer (117.88 mg/L), TDS levels were slightly higher, possibly a result of evaporation increasing the concentration of dissolved substances, yet still reflecting excellent water quality. The highest TDS was recorded during the monsoon (127.85 mg/L), probably due to rainwater runoff introducing additional dissolved materials into the water. All recorded values remain below 150 mg/L, classifying the water as excellent and safe throughout all seasons.

Dissolved Oxygen (DO):

Dissolved oxygen is a key factor in evaluating water quality, essential for sustaining aquatic life and maintaining the water's aesthetic and ecological balance. DO levels vary seasonally, with the lowest concentration in summer (5.58 mg/L), due to elevated temperatures and heightened biological activity, which reduce oxygen solubility. During the monsoon (6.03 mg/L), DO slightly improves, although runoff and decomposing organic matter can still contribute to oxygen depletion. The highest DO levels were recorded in winter (7.68 mg/L), as cooler temperatures enhance oxygen solubility and slow down biological processes. While these seasonal shifts are expected, low DO levels in summer may place stress on aquatic organisms. Nonetheless, all values fall within acceptable limits for water quality.

Free Carbon dioxide (mg/l):

CO₂ concentration in water varies seasonally due to natural processes. In Winter (0.85), levels are lowest due to reduced photosynthesis and cooler temperatures. Monsoon (1.48) shows elevated CO₂ from increased biological activity and freshwater runoff mixing with seawater. The highest level appears in Summer (1.65),

likely due to intense photosynthesis and respiration. These seasonal changes reflect natural cycles, though human activities like fossil fuel emissions can also influence long-term CO₂ patterns in the environment.

Alkalinity

Total alkalinity reflects water's ability to neutralize acids and maintain stable pH, which is vital for water quality and aquatic life. During Winter (115.4 mg/L), alkalinity is lowest due to reduced evaporation and biological activity. In the Monsoon (141.5 mg/L), moderate levels result from runoff mixing with surface water. The highest value is in Summer (159.25 mg/L), likely due to increased evaporation and biological processes. All values fall within the safe range of 80–200 mg/L,

Total hardness

The total hardness of water shows seasonal variation due to environmental factors. It is lowest in Winter (78.4 mg/L) due to reduced evaporation and stable conditions. During the Monsoon (84.53 mg/L), rainwater dilutes minerals, slightly reducing hardness. The highest value is in Summer (95.83 mg/L), caused by increased evaporation and concentration of calcium and magnesium ions. Despite these changes, all values fall within the acceptable range of 60–180 mg/L,

Chloride

The chloride levels are at their lowest in Winter (30.73 mg/L) because of reduced evaporation and consistent conditions. It experiences a minor rise during Monsoon (30.9 mg/L), probably due to surface runoff transporting salts into the water. The peak concentration is observed in Summer (32.68 mg/L), primarily because of evaporation that intensifies dissolved salts. Regardless of the seasonal fluctuations, all measurements remain significantly under the safe drinking water threshold of 250 mg/L, suggesting the water is safe for consumption.

Calcium

The calcium concentration in water is lowest during Monsoon (58.08 mg/L) due to dilution from heavy rainfall. It increases in Winter (63.58 mg/L) as there is less rain and moderate evaporation. The highest concentration is observed in Summer (69.84 mg/L) because high temperatures cause more evaporation, concentrating the minerals.

Magnesium

The magnesium concentration in water shows a slight seasonal variation, increasing from 20.40 mg/L in Monsoon to 21.61 mg/L in Winter, and reaching 22.33 mg/L in Summer. This rise is likely due to dilution by rainfall during the Monsoon and increased evaporation in Summer which concentrates minerals. Winter shows moderate levels due to stable environmental conditions. All values are within safe limits for drinking water.

Phosphate

Phosphate levels are highest in Monsoon (0.54 mg/L) due to runoff carrying fertilizers and waste. Summer (0.50 mg/L) shows moderate levels, possibly from evaporation and biological activity. Winter (0.43 mg/L) has the lowest concentration because of reduced runoff and cooler temperatures.

Sulphate

The sulphate concentration in water varies slightly across seasons. It is lowest in winter (12.93 mg/L), likely due to reduced runoff and evaporation. During the monsoon (13.19 mg/L), the value increases slightly,

possibly from dilution by rainwater but also some leaching from soils. The highest concentration is seen in summer (13.60 mg/L), likely due to evaporation concentrating the salts and increased mineral leaching. These variations are minor and all values are well within the safe limit (200–250 mg/L), indicating good water quality with respect to sulphate.

Biological Oxygen Demand (BOD)

Biological Oxygen Demand (BOD) indicates the amount of oxygen needed by microorganisms to decompose organic matter in water. Higher BOD means more pollution. The BOD values of 12.10 mg/L (Monsoon), 9.24 mg/L (Winter), and 13.84 mg/L (Summer) show that the water is moderately to heavily polluted in all seasons. Pollution is highest in summer due to increased microbial activity and concentrated waste, and high in monsoon due to runoff carrying pollutants. Winter shows lower BOD due to cooler temperatures and less runoff

Table 1: Monthly variations of Physico-chemical parameters of Khaji kotnoor reservoir.

Month	Atmospheric Temp (°C)	Water Temp (°C)	pH	TDS (mg/L)	DO (mg/L)	CO ₂ (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)
January 2023	31	21	8.06	116.50	8.2	0.9	107.50	81.80
February	34	23	8.16	110.00	6.1	0.9	154.00	86.10
March	36	29	8.32	120.80	6.0	1.6	158.50	95.50
April	38	28	8.40	121.50	5.4	2.1	160.00	106.80
May	42	33	7.94	119.20	4.8	2.0	164.50	94.90
June	35	26	7.25	125.50	5.2	2.0	160.20	89.00
July	33	22	7.28	130.00	6.0	1.4	140.50	85.20
August	31	22	7.21	129.10	6.3	1.5	136.80	84.00
September	32	23	6.50	126.80	6.6	1.0	128.50	79.90
October	33	21	7.89	121.00	7.1	1.1	123.90	74.80
November	29	20	8.19	119.50	7.6	0.8	119.00	76.90
December 2023	30	20	8.12	110.10	7.8	0.6	111.20	80.10
Maximum	42 (May)	33 (May)	8.40 (April)	130.00 (July)	8.2 (January)	2.1 (April)	164.50 (May)	106.80 (April)
Minimum	29 (Nov)	20 (Nov)	6.50 (Sept)	110.00 (Feb)	4.8 (May)	0.6 (Dec)	107.50 (Jan)	74.80 (Oct)

Table 2: Monthly variations of Physico-chemical parameters of Khaji kotnoor reservoir.

Month	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Phosphate (mg/L)	Sulphate (mg/L)	BOD (mg/L)
January	28.65	61.10	21.65	0.420	12.88	10.35
February	31.90	64.80	23.40	0.470	13.15	11.80
March	32.00	69.55	22.70	0.460	13.48	13.80
April	33.60	73.10	20.50	0.540	13.70	15.20
May	33.20	69.90	24.70	0.490	14.05	14.55
June	30.60	58.80	23.20	0.505	13.12	13.40
July	29.20	56.50	18.20	0.570	13.08	12.95
August	31.10	53.50	19.70	0.590	12.97	11.10
September	32.70	63.50	20.50	0.515	13.60	10.95
October	31.80	67.90	21.10	0.460	13.22	9.80
November	29.85	63.50	21.20	0.435	13.05	7.45
December	30.60	59.80	22.50	0.410	12.55	9.35
Maximum	33.60 (April)	73.10 (April)	24.70 (May)	0.590 (August)	14.05 (May)	15.20 (April)
Minimum	28.65 (January)	53.50 (August)	18.20 (July)	0.410 (December)	12.55 (December)	7.45 (November)

Table 3: Monthly variations of Physico-chemical parameters of Khaji Kotnoor reservoir

Parameter	Winter (Oct, Nov, Dec, Jan)	Summer (Feb, Mar, Apr, May)	Rainy (Jun, Jul, Aug, Sep)
Atmospheric Temp (°C)	30.75	37.5	32.75
Water Temp (°C)	20.5	28.25	23.25
pH	8.07	8.21	6.81
TDS (mg/L)	116.78	117.88	127.85
DO (mg/L)	7.68	5.58	6.03
CO ₂ (mg/L)	0.85	1.65	1.48
Alkalinity (mg/L)	115.4	159.25	141.5
Hardness (mg/L)	78.4	95.83	84.53
Chloride (mg/L)	30.73	32.68	30.9
Calcium (mg/L)	63.58	69.84	58.08
Magnesium (mg/L)	21.61	22.33	20.4
Phosphate (mg/L)	0.43	0.50	0.54
Sulphate (mg/L)	12.93	13.60	13.19
BOD (mg/L)	9.24	13.84	12.10

Conclusion:

The present study provides a comprehensive assessment of the physico-chemical characteristics of the Khaji Kotnoor reservoir in Gulbarga District, Karnataka. The analysis reveals that the water is nutrient-rich and all measured parameters fall within the permissible limits set by regulatory standards. While the findings indicate that the reservoir water is suitable for drinking, irrigation, and fisheries, regular monitoring is essential to ensure the long-term sustainability and quality of the water resources.

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