



Seasonal Variations in Water Quality Parameters of Yeldari Dam, Maharashtra

¹SM Yeole, ^{*2}Shubhangi P Kakde and ³Shubhangi S Bharti

^{1, *2, 3}Department of Zoology, M.S.P Mandal's, Shri Shivaji College, Parbhani, Maharashtra, India.

Abstract

Variations of water parameters have a major effect on reservoir ecological health and water quality. This paper presents a study of the physicochemical properties of the Yeldari Dam in Parbhani District, Maharashtra. Monthly changes in physical and chemical parameters include water temperature, air temperature, total solids, pH, dissolved oxygen, free carbon dioxide, total hardness, chloride, alkalinity, phosphorus, and nitrates. They were evaluated for a year, from November 2023 to October 2024. All parameters were within the permissible range. Comparisons to previous studies on Yeldari Dam revealed significant concurrence, while higher sediment and nutrient levels indicate increased anthropogenic pressure. The findings highlight the significance of constantly seasonal monitoring for the long-term management of water quality, fisheries, and downstream irrigation.

Keywords: Yeldari Dam, water quality parameters, seasonal variations, long-term management.

Introduction

Water is widely accepted as the basis of life, providing nutrition to plants, animals, and humans equally. Although water covers about seventy percent of the Earth's surfaces, just a small proportion of it is fresh water suitable for human and ecological use (Malik *et al.*, 2014) ^[25]. Water, as a universal solvent, supports key biological and ecological processes, making its quality and availability essential to life on Earth (Ravikumar *et al.*, 2006) ^[31]. Fresh water resources are essential for agriculture, industry, and domestic consumption; however, they are limited and under increasing pressure from increasing demand (Kumar, 1997) ^[23]. To ensure long-term development, it is essential to preserve both the quantity and quality of these limited resources. Physico-chemical study of water is thus an important tool for determining its quality and suitability for various applications. Anthropogenic activities and natural processes may affect its physical, chemical, and biological properties, causing problems to human health and aquatic life (Agrawal, 2001) ^[1]. Understanding these changes through a detailed investigation serves as the foundation for effectively managing and conserving water resources.

However, the quality of water resources is under the threat from a variety of stresses, including excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution, and unsustainable fishing methods. Water quality is determined by the interaction of physical, chemical, and biological factors and its estimation requirements and

integrate weed analysis of physicochemical, biological, and microbiological parameters that reflect the biotic and abiotic status of aquatic ecosystems (Smitha and Shivashankar, 2013) ^[35].

Freshwater reservoirs are especially significant in mostly dry areas of India, where they provide irrigation, drinking water, hydropower, aquaculture, and ecological balance (Kumar *et al.*, 2019) ^[24]. However, reservoir water quality is not constant; it is affected by seasonal variations in climate, hydrology, and biological activity. Temperature, dissolved oxygen (DO), pH, alkalinity, and nutrients are key limnological characteristics that directly influence the trophic status of aquatic systems and regulate aquatic creature production and survival (Wetzel, 2001) ^[43]. Temperature, organic matter, and photosynthetic activity all have a significant impact on dissolved oxygen, which is essential for aquatic life (Verma & Saksena, 2010) ^[40]. pH, alkalinity, and free carbon dioxide (CO₂) affect water's buffering ability, nutrient solubility, and carbon cycle balance (Stets *et al.* 2017) ^[38]. Nitrates and phosphates are necessary nutrients for biological productivity, but excess levels can cause eutrophication, algal blooms, and oxygen depletion (Boyd, 2020). Similarly, chlorides, total hardness, and total solids are markers of ionic composition, river ecology, and human affects such agricultural runoff and wastewater discharge (Patil & Tijare, 2001) ^[30]. Monsoon inflows dilute salts and nutrients, while pre-monsoon evaporation concentrates them, resulting in deteriorated water quality (Mishra *et al.*, 2020) ^[27].

Review of Literature

Ghaware and Jadhao (2015) ^[11] carried out an assessment of the seasonal variation in physico-chemical and microbial parameters of water from Nal-Damayanti Sagar Dam, located at Morshi in Amravati district, Maharashtra. The study aimed to evaluate the current status of water quality by examining key physico-chemical factors such as temperature, pH, turbidity, dissolved oxygen, sulphates, and nitrates, along with microbial parameters including total viable bacterial and fungal counts. Their results indicated that the values of these parameters varied across seasons, reflecting the influence of agricultural runoff and sewage drains in the catchment area. The authors concluded that untreated domestic and agricultural discharges were primarily responsible for the pollution of the reservoir, and emphasized the need for regular monitoring and management practices to safeguard the water quality of the dam.

Pathan and Shinde (2012) ^[29] investigated the physico-chemical characteristics of Sindphana Dam near Shirur Kasar, Beed district (M.S.) from January to December 2012. The study found seasonal changes in water quality, with air and water temperature correlated positively with transparency and pH but negatively with electrical conductivity and dissolved oxygen. Turbidity, BOD, and COD all were negatively correlated with transparency, but conductivity was positively correlated with all three. Similarly, pH had a negative connection with conductivity, DO, BOD, and COD. They show the significant seasonal influence on water chemistry and the interconnection of parameters. The authors identified that the overall water quality of Sindphana Dam remained within acceptable levels to support aquatic biota, but that constant observation is necessary for ecological balance.

Chhetry and (2011) ^[8] investigated the physico-chemical characteristics of Titrigachhi Daha in Nepal and observed marked seasonal variations. Studied the physico-chemical parameters like air temperature, water temperature pH, transparency, DO, free CO₂, alkalinity, chloride and BOD of the Titrigachhi Daha. Transparency, pH, total hardness, DO and total alkalinity were recorded maximum in winter season. Bhattarai (1996) studied the physico-chemical environment and macro-invertebrates of Lami Lake of Royal Chitwan National Park. Water temperature, pH, conductivity, Total alkalinity, Total hardness, free carbon-dioxide, calcium, Magnesium, Nitrate etc. of water sample of lake were made monthly and these were found normal range necessary for aquatic biota but most important parameter DO was found above the permissible level throughout the study period.

Materials and Methods

Yeldari Dam is an earth-fill construction build on the Purna River near Yeldari village in the Maharashtra state Parbhani district, and it is the second-largest dam in Marathwada region of Maharashtra, India. The dam has been restored and developed into a significant reservoir and tourist destination. The dam is 59.9km distance from research center. The dam is 4,232 m (13,885 ft) in length and 51.2 m (168 ft) in depth at its lowest foundation. The amount of live storage is 0.81 km³ (0.19 cu mi).

The current study was conducted between November 2023 and October 2024. The proposed investigation analyzed physicochemical parameters of Yeldari Dam on a monthly basis at four different study sites. Samples were collected from all study sites during morning hours. Water samples were collected in plastic containers and analyzed for physico-chemical properties. The physicochemical properties of water

were determined using standard methods described in American Public Health Association (2005) provided guidelines for analytical procedures. Air Temperature, Water Temperature, pH, and dissolved oxygen were measured on-site, whereas other were estimated in laboratory on the same day.

Result and Discussion

Various selected water quality parameters were estimated on the monthly basis for the period of one year, i.e. from November 2023 to October 2024. Seasonal variations in all the selected water parameters are depicted in Table 1 and illustrated with Fig.1 and Fig 2.

Water Temperature: Water temperature followed the similar trend to that of air temperature. Water temperature has a significant impact on organisms in water bodies, affecting respiration and metabolism. Studying temperature fluctuations in water bodies is crucial because they affect both density and oxygen content. Temperature indirectly impacts osmoregulation and respiration in animals (Sharma *et al.*, 2010).

The maximum water temperature was recorded as 28.5°C during the summer months, while the minimum was 19.8°C in winter. Elevated temperatures in summer are attributed to increased solar radiation and reduced water levels, leading to higher evaporation rates in summer (Walale & Rathod, 2020) ^[41].

pH: pH is one of the most important variables to consider in evaluation water quality. pH measures the acid-base balance of water and is the most critical factor in determining how acidic water is. The lower the pH number, more acidic the water is. pH has a positive correlation with electrical conductivity and total alkalinity levels (Gupta 2009) ^[14].

The pH measured from 7.2 to 7.6, with higher values in summer.

Dissolved Oxygen: Dissolved oxygen is an essential component indicator of reservoir health, water quality, productivity, and ecological conditions. Oxygen enters a reservoir through two main sources i.e., atmospheric oxygen and photosynthesis by algae and aquatic plants (ICMR, 1975) ^[18]. Its presence in reservoir water regulates the aquatic environment and helps purify the water (Mahamuni and Khobragade, 2020) ^[26]. It is essential to all living species and becomes the primary indicator of the aquatic ecosystem.

Dissolved oxygen (DO) levels were greater in winter months and lower in summer. The reduction in DO during warmer seasons is mainly due to reduced oxygen solubility at higher temperatures, as well as increased microbial and organic decomposition, which consumes oxygen (Khan *et al.*, 2012) ^[22].

Alkalinity: Water's alkalinity is determined by the presence of carbonates (CO₃²⁻), bicarbonates (HCO₃⁻), and hydroxides (OH⁻), which neutralize acids. It is a significant characteristic in measuring water quality because it buffers aquatic systems against pH changes, promotes biological productivity, and regulates the solubility of nutrients and metals (Solanki & Pandit, 2006) ^[36].

The alkalinity fluctuated from 140 mg/L CaCO₃ in winter to 180 mg/L CaCO₃ in summer. Summer alkalinity might be increased due to evaporation concentrating bicarbonates, while monsoon rainfall reduced alkalinity (Howland, *et al.*, 2000) ^[17].

Free Carbon Dioxide: Carbon dioxide, a by-product of organic carbon decomposition in aquatic environments, is a key indicator of ecosystem metabolism (Smith 1997, 1993;

Hopkinson 1985) [34, 16]. Free CO₂ concentrations were highest at 4.5mg/L in summer and lowest at 2.8mg/L in winter. The seasonal fluctuations are influenced by microbial activity and photosynthetic processes (Chhetry *et al.* 2011) [8].

Chloride: Chloride is one of the most common anions in natural streams, and its concentration is used to assess pollution and water quality. Domestic sewage, agricultural runoff, and industrial effluents can all cause excessive chloride levels, however moderate levels occur naturally due to salt dissolved (Trivedi & Goel, 1986). Chloride regulates the osmotic equilibrium of aquatic species in freshwater reservoirs, but high amounts can be hazardous to aquatic life and make water useless for drinking and irrigation (APHA, 2005).

Seasonal changes in chloride concentrations was recorded, including 32 mg/L in winter, 35 mg/L in summer, and 28 mg/L during the monsoon, are caused by climatic and hydrological causes. In summer, increased evaporation might concentrates chloride levels, but monsoon rains dilute surface water, lowering concentration. Groundwater interactions and agricultural activities both contribute to these changes (Gopinath *et al.*, 2018) [13].

Total Hardness: The overall hardness of reservoir water is a complex combination of anions and cations. This is due to the presence of magnesium and calcium ions (WHO 2009). Hardness is an important factor to determine water quality for home, industrial, agricultural, and aquaculture purposes. Moderately hard water improves aquatic productivity by providing required minerals, whereas excessive hardness can cause algae growth, decreased accessibility, and stress on aquatic species (Kumar and Dua, 2009; Hem, 1985; BIS, 2012).

Total hardness varied from 180 mg/L in the monsoon to 210 mg/L in the summer. Summer values are higher due to the evaporation concentrates calcium and magnesium ions, while monsoon rainfall dilutes these ions, lowering hardness (Pathan & Shinde, 2012) [29].

Nitrates: Nitrates are essential nutrients, but excessive levels from agricultural runoff and sewage contribute to eutrophication, algal blooms, and oxygen depletion. High amounts may lead to health problems, such as a lack of hemoglobin in children (Camargo and Alonso, 2006; Spalding & Exner, 1993) [7, 37].

Nitrate levels varied from 1.8 mg/L in summer to 1.2 mg/L in monsoon. The increase in nitrate concentrations during the

summer is attributed to agricultural runoff and leaching (Suárez, 2019) [39].

Phosphate: In freshwater systems, phosphate is an important nutrient that controls primary productivity. It primarily enters reservoirs through sewage, detergents, and agricultural runoff. Excessive phosphate disturbs aquatic balance through increasing eutrophication, algae blooms, and oxygen depletion (Correll, 1998) [9].

Phosphate concentrations were highest in summer ranged from 0.12mg/L and lowest in monsoon at 0.08 mg/L. Evaporation increases nutrient concentration in summer, while dilution during monsoon reduces phosphate levels. Winter levels were 0.10mg/L (Kamble & Jadhav, 2022) [20].

Total Solids: Total solids (TS) are the total amount of dissolved and suspended material in water, which includes minerals, salts, organic matter, and sediments. Increased total solids can restrict light penetration, affect photosynthesis, and alter aquatic productivity (Bilotta and Brazier 2008) [4].

Total solids were varied between 350 mg/L in the summer to 240 mg/L during the monsoon. Higher summer values may be due to evaporation concentrating dissolved and suspended particles whereas lower monsoon values due to dilution from rainfall and inflow. The winter concentrations were moderate (280 mg/L), indicating stable water conditions (Khailwal *et al.*, 2003) [21].

Table 1: Seasonal fluctuations in Water quality parameters of Yaldari Dam during November 2023 to October 2024

Sr. No	Parameter	Winter	Summer	Monsoon
1	pH	7.2±0.2	7.6±0.3	7.4±0.2
2	Air Temperature (°C)	20.8±0.2	29.1±0.3	26.4±0.2
3	Water Temperature (°C)	19.8±0.6	28.5±1.2	25.0±0.8
4	Alkalinity (mg/L)	140±12	180±15	160±10
5	Dissolved Oxygen (mg/L)	8.1±0.2	6.2±0.4	7.8±0.3
6	Chloride (mg/L)	32±2	35±2	28±3
7	Nitrate (mg/L)	1.5±0.1	1.8±0.2	1.2±0.1
8	Free CO ₂ (mg/L)	2.8±0.2	4.5±0.5	3.2±0.3
9	Total Hardness (mg/L) as CaCO ₃	200±11	210±10	180±12
10	Phosphate (mg/L)	0.10±0.01	0.12±0.01	0.08±0.01
11	Total Solids (mg/L)	280±15	350±20	240±12

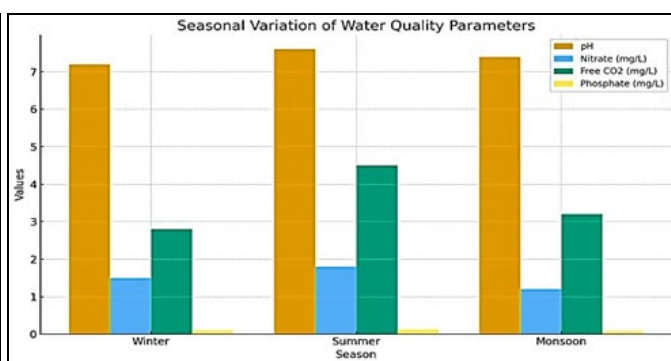
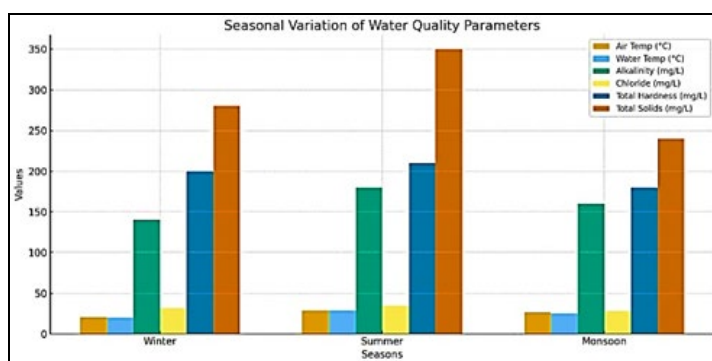


Fig 1 and Fig 2: Seasonal fluctuations in Water quality Parameters of Yeldari Dam during November 2023 to October 2024.

Conclusion

The seasonal variation has significant effects on the physicochemical qualities of Yeldari Dam. Water temperature, pH, alkalinity, and hardness increased in the summer, but dissolved oxygen decreased and nutrient levels (nitrates, phosphates) increased due to runoff during the

monsoon. Seasonal variations in total solids and free CO₂ reflect natural and anthropogenic stresses. Overall, the reservoir water is suitable for agriculture, fishery, and domestic use, but increasing nitrogen and sediment concentrations require constant observation. Regular water quality evaluations will help with long-term management and

eutrophication protection.

References

1. Agrawal KC. Environmental pollution, causes effects and controls, Nidhi Publishers Bikaner, 2001, pp 392.
2. APHA (American Public Health Association). Standard Methods for the Examination of Water Seventeenth edition. American Public Health Association, Washington, DC, 1989.
3. Bhattarai KR. water quality analysis and watershed management at sundarijal, kathmandu. M Sc., Thesis, Tribhuvan University, Kirtipur, 2004.
4. Bilotta GS & Brazier RE. Understanding the influence of suspended solids on water quality and aquatic biota. *Water Research*. 2008; 42(12):2849–2861.
5. BIS (Bureau of Indian Standards), 10500. Indian standard drinking water specification, First revision, 1991, pp 1-8.
6. Boyd EE. Water Quality, an introduction, Kluwer Academic Publishers, London, 2000, 330.
7. Camargo JA & Alonso Á. Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: *A global assessment*. *Environment International*. 2006; 32(6):831–849.
8. Chhetry DT & Pal J. Physico-chemical parameters of Titrigachhi Daha. *Nepalese Journal of Biosciences*. 2011; 1:19–25.
9. Correll DL. The role of phosphorus in the eutrophication of receiving waters: *A review*. *Journal of Environmental Quality*. 1998; 27(2):261–266.
10. Fondriest Environmental, Inc. Water quality parameters: pH and alkalinity, 2021.
11. Ghaware AU & Jadhao RG. Seasonal Variation of Physicochemical and Microbial Parameters of Water of Nal-Damayanti Sagar Dam, Morshi, Dist. Amravati, MS, India. *International Journal of Life Sciences*. 2015; 3(2):157–161.
12. Golterman HL. Methods for Physical and Chemical Analysis of Fresh Waters. *Blackwell Scientific Publications, Oxford*, 1978.
13. Gopinath K, Ramesh S & Kumar S. "*Cs-tungstosilicic Acid/Zr-KIT-6 for Esterification of Oleic Acid: A Sustainable Approach for Biodiesel Production*." *Fuel*. 2018; 231:1–11.
14. Gupta DP, Sunita and Saharan JP. Physiochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India, Researcher. 2009; 1(2):1-5.
15. Hem, John D. Study and Interpretation of the Chemical Characteristics of Natural Water (3rd ed.). *U.S. Geological Survey Water-Supply Paper 2254*.
16. Hopkinson CS. Shallow-water and pelagic metabolism: *Evidence of heterotrophy in the near-shore Georgia Bight*, *Marine Biology*, 1985, 87, 19.
17. Howland RJM *et al.* Distributions and seasonal variability of pH and alkalinity in the Tweed Estuary. *Science of the Total Environment*. 2000; 248(1):1-12.
18. ICMR. Manual of Standards of Quality for Drinking Water Supplies, spl. Res. S. No. 44, ACMR. New Delhi (India), 1975.
19. Jain S, Sharma G & Mathur YP. Effects of temperature variations on fish in lakes. *International Journal of Engineering Research & Technology (IJERT)*. 2013; 2(10):2516–2523.
20. Kamble, Sayali R & Jadhav, Anita S. Seasonal variation of physicochemical parameters and coefficient correlation of Karave Lake (Nerul), Navi Mumbai, Maharashtra, India. *International Journal of Zoological Investigations*. 2022; 8(1):734–743.
21. Khaiwal R, Ameena M, Meenakshi A & Kaushik A. Seasonal variation in alkalinity, total hardness, and TDS in the River Yamuna, Haryana, India. *ResearchGate*, 2003.
22. Khan RM, Jadhav MJ and Ustad IR. Physicochemical analysis of Triveni Lake water of Amravati district in (MS) India. *Bioscience discovery*. 2012; 3(1):64-66.
23. Kumar A. Freshwater resources: Their importance and management. *Water Resources Management*. 1997; 11(2):123–134.
24. Kumar M *et al.* Seasonal dynamics of reservoir water quality in peninsular India. *Journal of Environmental Management*. 2019; 243:1–11.
25. Malik RS, Singh S & Sharma S. Water resources and their management in India. *International Journal of Environmental Science and Technology*. 2014; 11(4), 1091–1100.
26. Mahamuni R & Khobragade K. Assessment of Demand parameters of Nath Sagar Reservoir at Paithan, Maharashtra. *Recent Trends in Environment, Climate Change, Physical and Life Sciences*, 2020, 94-98.
27. Mishra AK, Sahoo PK & Sahu N. Seasonal variations in water quality parameters of Chilika Lake, India: *Implications for eutrophication*. *Environmental Monitoring and Assessment*. 2020; 192(4):1–14.
28. Needham JG & Needham PR: A Guide to the Study of Freshwater Biology. *Holden-Day Inc., San Francisco*, 1969.
29. Pathan TS & Shinde SE. Water quality parameters in Sindphana Dam near Shirur Kasar, Beed district, Maharashtra State, India. *International Journal of Scientific Research*. 2012; 1(8):45–50.
30. Patil SG & Tijare RV: Studies on physico-chemical parameters of freshwater ponds in Nagpur. *Journal of Aquatic Biology*. 2001; 16(2):23–27.
31. Ravikumar MS, Somasundaram P & Subramanian V. Water as a universal solvent: Its role in biological and ecological processes. *Environmental Science and Pollution Research*. 2006; 13(5):290–298.
32. Sharma G, Jain S & Mathur YP. Effects of temperature variations on fish in lakes. *International Journal of Engineering Research & Technology (IJERT)*, 2013, 2(10).
33. Shrestha S. Study on water quality Parameters and benthic macro invertebrates of Taudaha Lake, Kathmandu. M.Sc. Thesis. Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu, Nepal, 2007.
34. Smith SV and Hollibaugh JT. Annual cycle and interannual variability of ecosystem metabolism in a temperate climate embayment, *Ecology/Ecological Monographs*, 1997, 67, 509.
35. Smitha AD & Shivashankar P. Physico-chemical analysis of the freshwater at river Kapila, Nanjangudu Industrial Area, Mysore, India. *International Research Journal of Environment Sciences*. 2013; 2(8):59-65.
36. Solanki HA and Pandit BR. Trophic status of lentic waters of ponds water of Vadodara, Gujrat state, India. *Int. J. of "Bioscience Reporter"*. 2006; 4(1):191-198.
37. Spalding RF & Exner ME. Occurrence of nitrate in groundwater—a review. *Journal of Environmental Quality*. 1993; 22(3):392–402.
38. Stets EG & Striegl RG. Carbonate buffering and

- metabolic controls on carbon dioxide and oxygen concentrations in lakes and reservoirs. *Global Biogeochemical Cycles*. 2017; 31(5):834–849.
39. Suárez SP, Peiffer S & Gebauer G: Origin and fate of nitrate runoff in an agricultural catchment: Haeon, South Korea – comparison of two extremely contrasts years. *Science of the Total Environment*. 2019; 690:1151–1163.
40. Verma SR & Saksena DN. Water quality and pollution status of a temple pond in Gwalior, India. *Journal of Environmental Biology*. 2010; 31(3):283–291.
41. Walale MP & Rathod SD. Study on physico-chemical parameters of Yaldari Dam, Parbhani (M.S.), India. *International Research Journal of Science & Engineering*. 2020; 8(6):255–262.
42. Welch EB. Ecological Effects of Wastewater: *Applied Limnology and Pollutant Effects*. 2nd edn. Cambridge University Press, Cambridge, 1992, 424 pp.
43. Wetzel RG. Limnology: lake and river ecosystems, 3rd ed. *Academic Press, San Diego, CA, 1006 pp*, 2001.