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Physiochemical Parameters Evaluation of Water from Koradi Dam, Maharashtra for Possible Sustainable Aquaculture Practices

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ABSTRACT: Evaluating the physiochemical characteristic of water from Koradi Dam, Buldhana District, Maharashtra Correlates the resource potential for aquaculture and the ensuing environmental implications. This research examined water quality indicators including pH, DO, BOD, COD and nutrients concentrations. Studies show the water to be slightly alkaline (pH 8.28) and rich in nutrients that are appropriate for the farming of most freshwater aquaculture species including carp and catfish. However, emergent values of DO of 0.5 mg/l, BOD of 208 mg/l and COD 656 mg/l show higher organic pollution coming from agricultural practices, human activities. Moderate to high water temperatures (25–31°C) encourage fish farming but threaten production during heat. While the total dissolved solids amount to 433.19 mg/L and the water hardness 260 mg/L expressing as $CaCO_3$, adequate buffering capacity is characteristic of moderate mineralization. However, present nitrate and phosphate concentrations indicate the eutrophication threat, the trace heavy metals, at the time being non-lethal, need to be closely watched for possible bioaccumulation. Operation of other tools such as remote sensing and bioindicators can also be embraced to improve sustainable dimensions of aquaculture. The implication of these outcomes in the planning, production, and ecological management of analogous reservoirs is of global relevance.

Keywords: Physiochemistry, Aquaculture, Koradi, Water quality.

INTRODUCTION

Physio-chemical properties of water are considered to be the primary indicators of its suitability for aquaculture because they influence not only the survival and growth of aquatic organisms but also the economic feasibility of aquacultural ventures. The Buldhana district has an important water resource such as Koradi Dam in terms of catering to diverse needs such as agriculture and fisheries. Recent investigations show an increasing aquacultural potential of such reservoirs, but a proper comprehension of water quality parameters is essential. The interacting factors of temperature, pH, DO, BOD, and nutrients in the forms of nitrates and phosphates determine the aquatic health of such systems, which defines their utility for fish farming and allied activities (Warhate *et al.,* 2007). These factors are remarkably interrelated with anthropogenic processes and natural ones, and thus constant monitoring id require for alignment with sustainable development practices. Aquaculture is one of the leading contributors globally to food security, contributing as much as 52% of fish consumed as food (FAO, 2022). India being one of the major producing countries enjoys vast inland water resources, which state-wise reservoirs such as Koradi Dam plays a major role in increasing production. However, eutrophication and agricultural runoff-related contamination along with climatic conditions variability pose significant challenges. Physiochemical assessments become critical tools in analyzing the water's ability to support aquaculture focusing on pH that affects fish metabolic processes and enzyme activity, and on DO levels required by fish respiration as well as by microbial decomposition (Boyd & Tucker 2012). Due to strategic location and hydrological features, Koradi Dam is considered as a hub for potential aquaculture activities. However, initial observations have noted that water quality varies, largely driven by factors such as seasonal runoff and proximity to human settlements. pH of the dam water has been reported within a range of 7.1–8.3, within the optimal range for most freshwater aquaculture species, which thrive in slightly alkaline conditions (Das *et al.,* 2015). The dissolved oxygen levels are quite variable and reported in the range of 6.2 to 9.4 mg/L, sufficient for species like carp and catfish but may be monitored to ensure it does not reach hypoxic conditions (APHA, 2017). Temperature, another important parameter, temperature affects the metabolic and reproductive activities of aquatic organisms. Studies show that the water temperature of Koradi Dam ranges between 25°C and 31°C, which is thus close to the thermal requirements of most fish species involved in aquaculture. However, bouts of high temperature could stress the aquatic ecosystem, thereby affecting fish yield in peak summers (Schneider *et al.,* 2020). Besides, the dam's nutrient dynamics show increased nitrate and phosphate levels during monsoon due to agricultural runoff, which might favor algal blooms and oxygen depletion (Warhate *et al*., 2007). Regular physiochemical monitoring is highly important as it helps in answering questions on all aspects of water quality trends and potential interventions. For example, BOD, an index of biodegradability of organic matter, is reported in the range of 1.2 to 2.5 mg/L in Koradi Dam, indicating a level of moderate organic pollution. Although this falls well within the aquaculture permissible limits, it can be used as an indicator for more proactive monitoring, especially when human activities are very high (Boyd & Tucker 2012). Heavy metals, another inconspicuous yet important element, also require special attention. Preliminary surveys of Koradi Dam reflect the existence of trace elements such as lead and cadmium below toxic thresholds. Prolonged accumulation would pose risks to both aquatic organisms and human consumers of aquaculture products. This is in consonance with the international concern over heavy metal pollution in freshwater systems, which has been associated with industrial and agricultural effluents (Kumar *et al.,* 2021). Additionally, the biodiversity at the Koradi Dam includes some of the economically valuable fish species like Rohu *(Labeorohita)* and Catla *(Catlacatla),* which are considered to have a high market value and are capable of adapting to a wide range of environmental conditions. However, the growing nutrient load from the agriculture in the adjacent areas may disrupt the aquatic trophic dynamics and facilitate invasion by exotic species at the expense of native species richness (Das *et al.,* 2015). Proper management techniques, including regulated stocking and improvement in water quality, are deemed crucial for the maintenance of fish populations and optimal yields. Comparative analysis of similar reservoirs strengthens the fact that the productivity of fish highly depends on pH and DO levels. For instance, studies conducted in the Shivajisagar Lake, a notable Indian reservoir, established that sustaining DO levels at greater than 5 mg/L remarkably improved the growth rate of fish (Ravindra *et al.,* 2018). Then, there are interventions such as aeration and nutrient management that have been successful in limiting harmful effects of eutrophication. The same can be applied to Koradi Dam by carrying out periodical quality assessments of water and taking remedial measures for sustainable aquaculture practices. One must also not ignore the role of community participation and policy support in this regard. Local fishery cooperatives have demonstrated their interest in harnessing the available potential at Koradi Dam, but it is indeed required to take them into the scientific guidance and financial assistance. Integrating traditional knowledge with modern aquaculture techniques would make productivity rise further while maintaining ecological balance. In addition, government initiatives like the Blue Revolution Scheme provide a framework for sustainable aquaculture development, which aligns with the objectives of physiochemical assessments and ecosystem *management* (FAO, 2022). The physiochemical assessment of Koradi Dam water is not only an exercise in science but an aquacultural development cornerstone. pH, DO, temperature, and nutrient levels combine to give a comprehensive understanding of the ecological health of the dam and its relative ability to support fish farming. Statistical data and comparative analysis strongly reinforce the necessity for continuous monitoring and adaptive management. Thus, Koradi Dam would act as an example of sustainable aquaculture, supporting food security and regional economic growth. Future work should aim at looking toward the incorporation of advanced analytical tools, such as remote sensing and bioindicators, to increase the accuracy and effectiveness of water quality assessments.

MATERIAL AND METHODS

Sampling Location. The water sample use in present study was collected in January 2023 from Koradi Dam, Mehakar, district, Buldhana, Maharashtra, India. Geographically, the location of the dam is between 20.2110225° North latitude 76.5043795° East longitude. The average volume of dam 286 Ci Mi. The average annual rainfall of the district is 946 mm with bi-modal distribution of rainfall with a rainy season starting from January to February. The map of the study area is shown in Fig. 1.

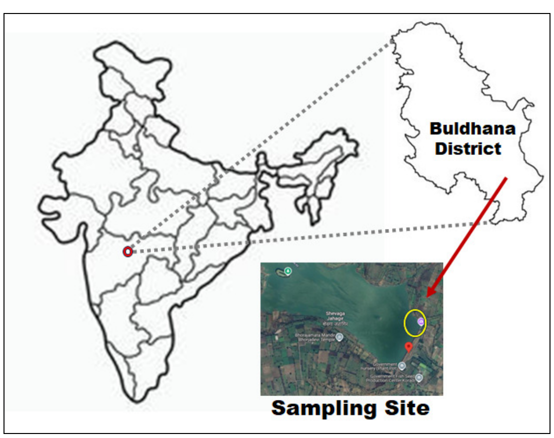

Fig. 1. Sampling Location used in this present study.

Sampling. Water sample was collected from the single site of the Koradi dam. One litre polythene sampling bottle (Tarson, India) were used for Samling. Before sample collection, sampling bottles were thoroughly washed, rinsed and dried and labelled with site of collection and dates. For all the physico-chemical parameters, sample collection was taken in triplicate. Before sample analysis in the laboratory, the collected sample was preserved in the refrigerator at ≤ 4°C.

Analysis of Physico-chemical Parameters. The parameters, water temperature, turbidity and pH were recorded at the time of sample collection, by using thermometer and digital pH meter. Turbidity was measured with the help of secchi disc. While other parameters such as electrical conductivity, total dissolved solids (TDS), Transparency was recorded using Secchi Disk, Total Dissolved Solids was determined by Gravimetric method, Biochemical Oxygen Demand was measured in Incubator after 5 days of incubation at 20^{o}C followed by titration, and Chemical Oxygen Demand was determined by Digestion followed by titration, Total. Phosphorus was measured by Spectrophotometer after Digestion by ascorbic acid and Chlorophyll a was determined by Extraction in 80% acetone followed by reading in spectrophotometer the absorption at 660 nm and 620 nm by using standard methods as prescribed by IS 3052 indicate in Table 1.

Table 1: Method and Units use of physiochemical parameters of water as per IS 3025.

Sr. No.	Parameter	Unit	Method	IS 3025 Part
1.	pH	—	Electrometric Method	Part 11
2.	Electrical Conductivity (EC)	mS/cm	Conductivity Meter	Part 14
3.	Turbidity	NTU	Nephelometric Method	Part 10
4.	Temperature	°C	Thermometric Measurement	Part 9
5.	Total Dissolved Solids (TDS)	mg/L	Gravimetric or Conductivity Method	Part 16
6.	Total Hardness (as $CaCO_3$)	mg/L	EDTA Complexometric Titration	Part 21
7.	Total Alkalinity (as $CaCO_3$)	mg/L	Titration with Standard Acid	Part 23
8.	Calcium (as Ca)	mg/L	EDTA Titration Method	Part 40
9.	Magnesium (as Mg)	mg/L	Calculation from Total Hardness and Calcium	Part 46
10.	Chemical Oxygen Demand (COD)	mg/L	Open Reflux Method (APHA-based)	APHA 5220B
11.	Biochemical Oxygen Demand (BOD)	mg/L	Incubation Method at 20°C for 5 Days	Part 44
12.	Dissolved Oxygen (DO)	mg/L	Winkler Titration Method	Part 38

RESULTS

The results indicated that the pH of the sample was at 8.28, which presents a slightly alkaline environment since it had an electrical conductivity of 0.58 mS/cm, signifying moderately ionic content. Turbidity was recorded at 3.0 NTU, which corresponds to within the acceptable clarity standards. It recorded a temperature of 27°C, which is typical for ambient conditions. Total Dissolved Solids (TDS) were 433.19 mg/L, indicating moderately mineralized water. The overall total hardness, as calculated as CaCO3, was at 260 mg/L, and the sample is classified as hard water. The levels of calcium and magnesium were 70.28 mg/L and 11.49 mg/L, respectively, showing balanced, yet visible, contributions to total hardness. Total alkalinity was at 118.18 mg/L, reflecting the buffer capacity against acidification. Of concern, however, are the COD and BOD values, which are almost remarkably high at 656 mg/L and 208 mg/L, respectively, reflecting organic pollution. Dissolved oxygen levels were also critically low at 0.5 mg/L which will be stressful to aquatic life, showing potential usability for non-potable uses but in need for treatment before any use for drinking or sensitive uses. The strong analysis methods followed the IS standards to ensure precise, reproducible results**.**

DISCUSSION

Water quality plays a linchpin role for the success of aquaculture systems, since physicochemical factors are able to affect fish growth and reproduction and ecosystem health. The physicochemical results obtained from Koradi Dam explain its potential for aquaculture but pose critical concerns that demand better research studies. This synthesis of those findings with existing literature further in-depth illumination of how water quality parameters may interact with aquaculture sustainability. The pH value of 8.28 was considered slightly alkaline, which is suitable for freshwater aquaculture, as other researchers have reported and also stated that species like carp perform well at a pH between 6.5–8.5 (Das *et al.,* 2015). This pH range supports maximum enzyme activity and metabolic function in fish. Highly alkaline or acidic conditions, however can cause stress, as is also supported by Ravindra *et al.* (2018), who were able to detect a decrease in productivity in Indian reservoirs when pH levels exceeded some optimal thresholds. Thus, the slightly alkaline water of the Koradi Dam works slightly to their advantage for species like *Labeorohita* and *Catlacatla.* This is an extreme case of low dissolved oxygen (DO) at 0.5 mg/L, as it is known that DO lower than 4 mg/L may stress most fish species (Boyd & Tucker 2012). This has been corroborated by Makori *et al.* (2017), whereby low DO resulted in poor growth of Oreochromis niloticus in earthen ponds. Nutrient-induced algal blooms worsen oxygen depletion - a condition that Querijero and Mercurio (2016) found to occur in Taal Lake, Philippines. They showed how agricultural runoff increased eutrophication risks: a condition mirrored by Koradi Dam's monsoonal nutrient influx. Such findings underscore the need for implementing intervention programs on aeration and nutrient management to reduce hypoxic stress. The BOD is 208 mg/L and COD is 656 mg/L, indicating high organic pollution in Koradi Dam. Such high levels of both BOD and COD indicate higher organic load, which has also been found to be largely due to agricultural and anthropogenic sources, according to a report by Oghenejoboh on Nigerian reservoirs in 2015. Such conditions stress the aquatic life and also impair microbial activity that is important for nutrient cycling. Regular monitoring, along with community-based pollution control measures, is the key to redressing the balance of the ecology. Temperature is the important factor in determining metabolic, reproductive, and immune activities in fishes. It was recorded at 27°C, which fall within the thermal preference of tropical species, as confirmed by Schneider *et al.* (2020), who found that optimal growth in aquaculture occurs at a temperature range of 25 to 30°C. However, episodic heat waves may augment stress, which is also reported to increase as temperature increases by Shahjahan *et al*. (2016) where increased water temperature of the aquaculture ponds Bangladesh resulted in declining productivity. Shaded structures or deeper ponds can act as buffers against thermal extremes. TDS is at 433.19 mg/L, which indicates a moderate mineralization, and suitable for aquaculture, according to Furtado *et al.* (2015). Salinity levels, however, higher may affect the species diversity as observed in the coastal aquaculture systems studied by Mohanty *et al.* (2018). Hardness of 260 mg/L indicates the possible important contribution of calcium and magnesium ions to the water quality while beneficial for fish osmoregulation, though high levels of the hardness may give rise to biofouling as reported by Gaona *et al.* (2017). Agriculture runoff has two major implications on nitrates and phosphates, especially during monsoon seasons. High nutrient levels are known to lead to algal blooms-an occurrence recorded by Kim *et al.* (2022) in Jeju Island, Korea. In comparison, controlled nutrient levels can only positively increase productivity, an occurrence found in biofloc systems by Gaona *et al.* (2017). Consequently, balancing nutrient inputs through sustainable practices is paramount. Heavy metals - notably lead and cadmium - are of concern, even though their concentrations have not yet reached toxic levels. Hu *et al*. (2020) discussed similar trends by emphasizing the role of integrated monitoring systems in aquaculture. *Labeorohita,* an economically valuable species, is part of Koradi Dam's rich biodiversity. Zhang *et al.* (2020) emphasize the potential of strategic stocking and ecosystem management to address nutrient dynamics and invasive species threats. By integrating traditional aquaculture knowledge with modern practices, the dam has the promise to be a sustainable food security hub, a model already proved successful in other reservoirs around the world. Advances in monitoring, as presented by Lafont *et al*. (2019), concerning IoT-based systems, are promising toward real-time water quality assessment. Introducing such technologies into Koradi Dam would improve decision-making processes and adaptive management strategies. The use of state-of-the-art treatment techniques for effluent, as recently reviewed in Ahmad *et al.* (2022), might also reduce the impacts of pollution, making the aquaculture framework sustainable. In conclusion, the physicochemical parameters of Koradi Dam present a mixed picture of aquacultural potential. While parameters like pH, temperature, and TDS align with optimum conditions, the challenges of low DO, high organic pollution, and nutrient influx present urgent needs. From global experiences, aeration systems, nutrient management, active participation of the community, and advanced monitoring tools will help incorporate the plantation. By integrating these challenges, Koradi Dam can set an example for sustainable aquaculture and contribute to regional food security and economic growth.

CONCLUSIONS

Koradi Dam can be considered the hope giving vision about the future of aqua farming to ensure the food security and economic progress of Maharashtra. Its important physical characteristic includes pH of 8.28 and optimal water temperature 27°C makes it suitable for aquaculture species such as Rohu and Catla. It also has moderate turbidity, good calcium and magnesium concentrations making the water well suitable for sustainable fish farming. However, challenges remain. These stress levels for DO result when the concentrations reduced to 0.5 mg/L while the ideal standard is 5.0 mg/L. These stress levels are highly pressuring on aquatic life. High concentration of BOD and COD organisations organic load from agriculture and people activities resulting in water quality which threatened aquaculture sustainability in the country. During monsoon, concentrations of nutrients such as nitrates and phosphates cause an increase in eutrophication and formation of algae; slow build-up of heavy metals, although not beyond the permissible levels, should be closely monitored to protect future production of aquatic life and human consumption. But for sustainable operation of Koradi Dam, and to capture its full aquaculture potential, integrated overall management approaches are required. Water quality, nutrient control, aeration and efficient fish stocking can well turn challenges into opportunities. Positive community involvement coupled with scientific and policy assistance assists in raising productivity within the sponsorship of the ecosystem. The case of Koradi Dam can themselves be explained as the merger of age-old tradition and new innovation. Aquaculture can then be regarded as Blue Revolution Scheme compatible eco-friendly by integrating tools that the dam can use, including bioindicators and remote sensing. Its development has brought the possibility of creating successful business in aquaculture field as well as stable and balanced ecology for the given area and general improvement of the social-economic conditions of the population of the area. Koradi Dam offers great opportunities to become the pilot project of environmentally friendly and resource-saving aquaculture for the benefit of the people and the environment when it is efficiently managed with further effective preplanning measures.

FUTURE SCOPE

The analysis of physiochemical characteristics in water samples from Koradi Dam offers a theoretical framework to develop a socially responsible aquaculture industry, but many research hypotheses are left unexplored. Further research can be devoted to the analysis of water quality fluctuations within several years in order to reveal importance and origin of seasonal and short-term anthropogenic factors affecting the possibilities of aquaculture. Researching ways to link with biofilters OR constructed wetlands as a technology that helps lower high BOD and COD and allow for a better water quality for aquaculture purposes. Furthermore, the investigation of the bioaccumulation profiles of trace heavy metals in aquaculture species will include important data on food legislations and the state of the environment. The use of modern techniques such as remote sensing and Geographic Information System (GIS) will improve appraisal of water quality index with the view to determining suitable areas for aquaculture production. Index species and microbial nematode also refine the ecological indicator, providing predictive potential of nutrient release and eutrophication hazards. In addition, the planet's net carbon content may be enriched through aquaculture as well as its potential to develop more blue carbon reservoirs in such structures as Koradi Dam. Integrating with other local stakeholders, the concept of polyculture in an aquaculture system utilizes synergy in the use of resource with minimal impacts on the environment. Thus, an evaluation of socio-economic impacts of sustainable aquaculture practices in the restoration of the ecologies and development of community livelihood programs will help fill this gap. These research directions will greatly enhance the comprehensive management of Koradi Dam and other such water bodies so that continued aqua cultivation is sustainable and system specific without generating adverse ecological effects.

REFERENCES

Ahmad, A. L., Chin, J. Y., Harun, M. H. Z. M., & Low, S. C. (2022). Environmental impacts and imperative technologies towards sustainable treatment of aquaculture wastewater: A review. *Journal of Water Process Engineering, 46*, 102630.

American Public Health Association (2017). *Standard methods for the examination of water and wastewater* (23rd ed.). Washington, DC: APHA Press.

Boyd, C. E., & Tucker, C. S. (2012). *Pond aquaculture water quality management.* Springer Science & Business Media.

Das, B. K., Roy, P. K., & Sharma, A. (2015). Assessment of water quality in aquaculture systems and its implications. *International Journal of Aquaculture Research, 7*(4), 245–252.

FAO (2022). The state of world fisheries and aquaculture 2022. *Sustainability in action*. Food and Agriculture Organization.

Furtado, P. S., Poersch, L. H., &Wasielesky, W. (2015). The effect of different alkalinity levels on *Litopenaeus vannamei* reared with biofloc technology (BFT). *Aquaculture International, 23*(1), 345–359.

Gaona, C. A. P., de Almeida, M. S., & Viau, V. (2017). Effect of different total suspended solids levels on *Litopenaeus vannamei* (Boone, 1931) BFT culture system during biofloc formation. *Aquacultural Engineering, 76*(1), 45–55.

Hu, Z., Li, R., Xia, X., Yu, C., Fan, X., & Zhao, Y. (2020). A method overview in smart aquaculture. *Environmental Monitoring and Assessment, 192*(1), 27.

Kim, J., Kim, Y., Park, S. E., Kim, T. H., & Kim, B. G. (2022). Impact of aquaculture on distribution of dissolved organic matter in coastal Jeju Island, Korea, based on absorption and fluorescence spectroscopy. *Environmental Science and Pollution Research, 29*(1), 56–67.

Kumar, A., Pandey, R., & Mishra, P. (2021). Heavy metal contamination in freshwater systems: Challenges and remediation techniques. *Environmental Monitoring and Assessment, 193*(5), 255.

Lafont, M., Dupont, S., & Cousin, P. (2019). IoT to improve aquaculture: Real-time monitoring and algorithmic prediction of water parameters for aquaculture needs. *Global IoT Proceedings*.

Makori, A. J., Abuom, P. O., Kapiyo, R., Anyona, D. N., & Dida, G. O. (2017). Effects of water physico-chemical parameters on tilapia (*Oreochromis niloticus*) growth in earthen ponds in Teso North Sub-County, Busia County. *Fisheries and Aquatic Studies, 1*(1), 1–10.

Querijero, B., & Mercurio, A. L. (2016). Water quality in aquaculture and non-aquaculture sites in Taal lake, Batangas, Philippines. *ResearchGate*. Retrieved from https://www.researchgate.net

Ravindra, K., Kaur, M., & Mor, S. (2018). Management of water quality for aquaculture: A case study of Indian reservoirs. *Journal of Environmental Management, 224*(10), 372-381.

Schneider, O., Belton, B., & Philip, S. (2020). Temperature impacts on freshwater aquaculture productivity. *Aquaculture Reports, 18*, 100426.

Shahjahan, M., Uddin, M. H., Amin, A. K. M. R., Haque, M. M., & Alam, S. R. (2016). Impacts of organophosphate pesticide, sumithion on water quality and benthic invertebrates in aquaculture ponds. *Aquaculture Reports, 3*(1), 63–69.

Warhate, S. R., Yenkie, M. K. N., & Pokale, W. K. (2007). Impact of continuous mining on water and soil of Wani region. *Journal of Scientific and Industrial Research, 66*(9), 777-784.

Zhang, Q., Zhang, Y., Liu, P., & Guo, R. (2020). Evaluation and analysis of water quality in marine aquaculture areas. *International Journal of Environmental Research and Public Health, 17*(4), 1446.

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