International Journal of Rural Development, Environment and Health Research (IJREH)
ISSN: 2456-8678
[Vol-6, Issue-4, Jul-Aug, 2022]
Issue DOI: https://dx.doi.org/10.22161/ijreh.6.4
Article DOI: https://dx.doi.org/10.22161/ijreh.6.4.2

An assessment of seasonal fluctuations in physicochemical variables in Lake Zuzuwadi and Lake Ballur of Hosur Dt., Tamil Nadu, India

Vidya Padmakumar [1], Murugan S[2]

Department of Zoology, Bangalore University, Bangalore, India
Email: vidyapkumar3@gmail.com

Received: 28 Jul 2022; Received in revised form: 20 Aug 2022; Accepted: 25 Aug 2022; Available online: 30 Aug 2022

Abstract— *Seasonal changes in physicochemical characteristics were investigated in Zuzuwadi Lake and Ballur Lake in the Hosur District of Tamil Nadu, India. Throughout the year, mean air and water temperatures ranged from 27.0 to 32.0ºC. The dissolved oxygen concentrations at each station throughout the summer and winter seasons were in the range of 6.0 ± 0.113 (±1.89%) to 9.0 ± 1.118 (±1.57%) ppm and 12.0 ± 0.127 (±1.05%) to 13.5 ± 0.445 (±3.51%) ppm, correspondingly. The conductivity was between 300.0 ± 1.652 (±4.15%) to 329.0 ± 2.422 (±4.15%) µS/cm. The nitrate content of Lake Zuzuwadi ranges from 8.0 ± 0.113 (±1.62%) to 10.0 ± 1.132 (±12.57%) ppm, indicating that the water is oligotrophic and could destroy aquatic ecosystems. In Lake Zuzuwadi, the Biological Oxygen Demand and Chemical Oxygen Demand remained at 5.0 ± 0.113 (±1.62%) and 200.0 ± 12.652 (±4.15%) ppm, respectively, but in Lake Ballur, they were 9.0 ± 1.386 (±19.80%) and 200.0 ± 12.652 (±4.15%) ppm. Both stations had salinities of less than 200.0 ± 1.497 (±0.50%) ppm. Lake Zuzuwadi has been found to have algal blooms. According to the comparative Physico-chemical parameter interpretations, Lake Zuzuwadi is oligotrophic in nature, while Lake Ballur is slightly contaminated, containing a diverse array of aquatic creatures that rely on the lakes to exist. Zuzuwadi Lake had a WQI of 60.6 ± 0.999 (±1.65%), whereas Ballur Lake had a WQI of 70.4 ± 0.784 (±1.11%) indicating that the water quality is bad.*

Keywords— ***Physicochemical parameters, Water Quality Index, Seasonal changes, Temperature and pH.***

I. INTRODUCTION

Freshwater physicochemical and biological properties are studied in limnological investigations. These metrics are used to assess the water's quality (Boyd and Tucker, 1998; Goldman and Horne, 1983). The physical and chemical characteristics of water bodies influence species variety, distribution, production efficiency, and biological factors of aquatic biota (Bagenal, 1978). Water quality can easily be established using its microbiological and physicochemical aspects. Surveillance of a wide number of quality indicators is needed for efficient water quality maintenance through appropriate control techniques. As a result, in recent years, a statistical correlation-based technique has been employed to construct the mathematical relation for correlating physicochemical data (Mayur *et al*., 2007). The physicochemical properties of water change seasonally, and anthropogenic activities in the catchment area, such as agriculture, urbanization, domestic sewage, and so on, degrade water quality (Vidya and Tharavathy, 2019). Temperature, turbidity, micronutrients, hardness, alkalinity, and dissolved oxygen are only a few of the critical elements that influence the growth of aquatic life (Manjare *et al*., 2010; Murugan and Anandhi Usha, 2016).

Limnology plays a significant part in pollution control and biodiversity preservation decision-making. The importance of limnologic research in the development of freshwater quality cannot be overstated. As a result, water quality is critical to ecosystem productivity. Drinking water, irrigation, fishing, and energy generation all come from lakes, rivers, and streams. Because of factors like industrialization, intensive farming methods, and massive wastewater discharges, among others, almost all water systems are becoming contaminated, leading to poor hydrology (Sinha, 1986; Kashyap *et al*., 2015). In aquatic habitats, there is a complex interplay between external and internal elements. External influences that alter physicochemical properties like temperatures, pH, and dissolved oxygen (DO) of water include weather events and pollution (Rajanna and Belagali, 2011). These variables have a big impact on the biological reactions that happen in the water. Sudden variations in these values could indicate shifting water conditions. Interactions inside a body of water's bacterial and plankton ecosystems are examples of internal factors (Kar *et al*., 2010). This study aims to analyze seasonal fluctuations in the characteristics and characterize the biochemical characteristics of two lakes, Lake Zuzuwadi and Lake Ballur, which are both situated in the center of a substantial industrial sector.

Lake Zuzuwadi is a natural lake in the Hosur region, with its southern part located at coordinates on the Karnataka-Tamil Nadu boundary. It is a huge lake with a 14.323 km perimeter and a generally rectangular form. The lake is encircled on all sides by thick greenery. Fishing is done regularly here. Algal blooms can be seen in some areas of the lake. It also includes three sewage inlets in the northern half, which allow sludge from factories in the Sipcot industrial district to enter.

Lake Ballur is nestled in the Hosur region's Ballur hamlet. The lake is located within Phase 2 of the Sipcot Industrial Area, which has a radius of 4.828 km. It is surrounded by a few industries, but there is a lot of sludge entering the lake, which has caused the water to change color in some areas. It has two sewage inlets on the northern side and three inlets on the southern side. The lake contains one little island in the middle and a surface area of about 25 hectares.

Over the course of two years, water samples were taken from the two stations, Lake Zuzuwadi and Lake Ballur, at six specified places on the perimeter of each site. The samples were gathered in two-liter sterile polythene bottles. Seasonal monitoring was carried out (pre-monsoon, post-monsoon, winter, and summer). Temperature, electrical conductivity (EC), pH, and dissolved oxygen (DO) were measured using the Aristocrat deluxe water and soil analysis kit model-191 E at the sampling site. Other physicochemical parameters such as sodium, total alkalinity, total hardness, calcium, magnesium, chlorides, sulfate, nitrate, phosphate, and biochemical oxygen demand were measured in the laboratory. The gravimetric method was used to calculate the total dissolved solids (US EPA Standard Protocol). Salinity was estimated after measuring the chlorinity of the acquired samples using Mohr's titrimetric method. The turbidity of the samples was measured using the nephelo-turbidimetric method (APHA, 1998). The Open reflux method (APHA, 1998) and Winkler's method (APHA, 1998) were used to determine the Chemical Oxygen Demand and Biological Oxygen Demand of the samples, respectively. The volumetric method (APHA, 1998) was used to determine the amount of ammonia present, while the PDA method (APHA, 1998) and the stannous chloride method (APHA, 1998) were employed to determine nitrates and chlorides, respectively. The physicochemical properties of the collected water samples were expressed as Mean ± SD. The water quality index (WQI) of the water body was calculated using the weighted arithmetic index approach (Brown *et al*., 1972).

III. RESULTS AND DISCUSSION

PARAMETERS	Lake Zuzuwadi	Lake Ballur
pH	6.9 ± 0.113 (±1.89%)	5.8 ± 0.127 (±1.05%)
Conductivity (µS/cm)	300.0 ± 1.652 (±4.15%)	329.0 ± 2.422 (±4.15%)
Air temperature (ºC)	32.0 ± 2	31.0 ± 2
Water temperature (ºC)	29.0 ± 2	28.0 ± 2
DO (ppm)	9.0 ± 1.118 (±1.57%)	13.5 ± 0.445 (±3.51%)
Salinity (ppm)	168.49 ±1.497 (±0.50%)	196.32 ± 1.118 (±1.57%)
Turbidity (NTU)	8.16 ± 1.118 (±1.57%)	9.4 ± 0.113 (±1.62%)
BOD (ppm)	5.0 ± 0.113 (±1.62%)	9.0 ± 1.386 (±19.80%)
COD (ppm)	200.0 ± 12.652 (±4.15%)	200.0 ± 12.652 (±4.15%)
Ammonia (ppm)	0.28 ± 0.127 (±1.05%)	0.28 ± 0.127 (±1.05%)
Chloride (ppm)	93.270 ±1.497 (±0.50%)	279.81 ± 0.633(±8.73%)
Nitrate (ppm)	10.0 ± 1.132 (±12.57%)	7.71 ± 0.113 (±1.62%)

Phosphate (ppm)	0.04 ± 0.0	0.12 ± 0.0
TDS (ppm)	342.113 ± 0.633 (±8.73%)	457.89 ± 1.132 (±1.57%)

Fig. 1: shows the values of physicochemical parameters in the lakes

The inflow of rainwater during the monsoon period has caused seasonal fluctuations in the parameters. Due to the enormous input of rainwater, both of the lakes under study have shown a considerable rise in conductivity, as well as a significant increase in dissolved oxygen levels and turbidity levels. On average, dissolved oxygen levels in both lakes ranged from 6.0 ± 0.113 (±1.89%) to 9.0 ± 1.118 (±1.57%) ppm during the summer and winter seasons, and from 12.0 ± 0.127 (±1.05%) to 13.5 ± 0.445 (±3.51%) ppm during the winter season. Aquatic life, particularly freshwater fish, thrives in the dissolved oxygen range of 7.0 ± 0.113 (±1.62%) to 11.0 ± 1.386 (±15.40%) ppm. Turbidity levels were seen to have risen over the summer season, and turbidity and temperature are known to be correlated. Increased turbidity was seen in both the summer and winter seasons at both sites, with average values of 8.16 ± 1.118 (±1.57%) and 9.4 ± 0.113 (±1.62%) NTU in the summer and winter seasons, respectively. All of the stations had lower dissolved oxygen levels. The ability of aquatic plants to photosynthesize must have been harmed as a result of the lack of light, causing the organisms to be disturbed. The conductivity ranged from 300.0 ± 1.652 (±4.15%) to 329.0 ± 2.422 (±4.15%) µS/cm, indicating that both lakes hosted a rich aquatic life. Increased ion content of nitrates, phosphates, and sodium could have caused the higher conductivity. Due to the mixing of mud that washed in during heavy rains, the total dissolved solid rate has dropped drastically. During the summers, total dissolved solids levels rose, particularly at Ballur Lake, where they reached 457.89 ± 1.132 (±1.57%) ppm. The TDS level in Lake Zuzuwadi stayed unchanged at 342.113 ± 0.633 (±8.73%) ppm. The levels of ammonia, phosphate, and nitrate held steady in both April and June samples, according to chemical analysis, and amounts below 0.4 ppm are suitable for aquatic life. In both lakes, the ammonia concentration was 0.28 ± 0.127 (1.05 %) ppm. The chloride content in the samples collected remained at 93.270 ± 1.497 (±0.50%) and 279.81 ± 0.633 (±8.73%) ppm respectively. Very few quantities of Phosphate content were identified i.e. 0.04 ± 0.0 and 0.12 ± 0.0 ppm. The nitrate content of Lake Zuzuwadi ranges from 8.0 ± 0.113 (±1.62%) to 10.0 ± 1.132 (±12.57%) ppm, indicating that the lake is oligotrophic in nature and has the potential to harm aquatic life. The Biological Oxygen Demand and Chemical Oxygen Demand remained within the limits of 5.0 ± 0.113 (±1.62%) and 200.0 ± 12.652 (±4.15%) ppm in Lake Zuzuwadi and 9.0 ± 1.386 (±19.80%) and 200.0 ± 12.652 (±4.15%) ppm in Lake Ballur, respectively, indicating that the water bodies are polluted. The lakes' pH stayed in the range of 5.0 ± 0.113 (±1.62%) to 7.0 ± 0.633 (±8.73%), indicating that the water was slightly acidic to neutral in nature. All aquatic organisms prefer pH ranges of 6.5 ± 0.0 to 8.0 ± 0.0. The stations had a salinity of less than 200.0 ± 1.497 (±0.50%) ppm, indicating that they were exclusively freshwater lakes. Phosphate-induced algal blooms were discovered in some portions of Lake Zuzuwadi, and photosynthesis must have been the source of rising dissolved oxygen during the summers and winters. During the monsoons, however, there was no apparent blooming, which could be due to the death of the blooms, as well as increased oxygen used by bacteria, which aids in their breakdown. This could have an effect on the aquatic photosynthetic organisms in the body of water. Zuzuwadi Lake had a WQI of 60.6 ± 0.999 (±1.65%), while Ballur Lake had a WQI of 70.4 ± 0.784 (±1.11%). WQI values above 50, implies that the water has exceeded the maximum standard permissible limits to the parameters, and the water is polluted (Brown *et al*., 1972 and Murugan, 2018). Water quality is deteriorating mostly as a result of sewage effluent discharge, as well as localized human activities and waste contaminating the aquatic ecosystem.

Hassan (1974) studied Awba Reservoir, Adebisi (1981) studied Upper Ogun River, Egborge (1981) studied Asejire Reservoir, Ikom *et al*. (2003) studied River Adofi, Idowu and Ugwumba (2005) studied Eleyele Reservoir, Ayoade *et al*. (2006) studied Asejire and Oyan lakes, and Oso and Fagbuaro (2008) studied Ero Reservoir. Because many biological activities can only occur within a small range, the pH of the water body is an important characteristic. As a result, deviations outside of permissible ranges may be lethal to many bigger and smaller organisms. Tyakumbur *et al*., 2002 and Okogwu and Ugwumba, 2006, both analyzed and determined the significance of pH values in water quality analysis. During dry seasons, high pH could have been caused by an increase in photosynthetic activity, resulting in higher primary productivity (Hammer, 1971).

In the aquatic environment, dissolved oxygen is produced by air and photosynthesis and is dependent on its solubility, whereas oxygen is lost through respiration, aerobic bacteria degradation, and breakdown of decaying sediments (Gupta and Gupta, 2006). The low organic richness of the reservoir is supported by BOD measurements (Manson, 1991; Idowu, 2007). Increasing dissolved oxygen levels in aquatic systems is frequently linked to eutrophic and prolific water sources (Egborge, 1994). The temperature has a positive association with dissolved oxygen, according to Egborge (1994). Although temperature and dissolved oxygen normally have an inverse relationship, there are outliers (Oben, 2000). Lewis (2000) stated that oxygen sustainability is a critical management concept for many tropical lakes, citing factors such as water's poor capacity to retain oxygen at a temperature higher than a lower temperature, as well as higher rates of microbial metabolism at a higher temperature as factors that perform against oxygen retention in tropical waters.

IV. CONCLUSION

Several parameter values obtained from most of the samples are beyond the allowed limits. According to the WQI, the quality of water is low. The quality of the water of Zuzuwadi and Ballur Lakes poses an existential threat to aquatic species, according to this investigation. To prevent the lake from dying, appropriate steps must be taken to improve the water quality entering the lakes, and the physical and chemical characteristics, as well as the richness of aquatic organisms, must be continually assessed.

REFERENCES

[1] Adebisi, A.A., 1981. The physicochemical hydrology of a tropical seasonal river-upper Ogun river. *Hydrobiologia*, 79(2), pp.157-165.

[2] Federation, W.E. and Aph Association, 2005. Standard methods for the examination of water and wastewater. American Public Health Association (APHA): Washington, DC, USA, 21.

[3] Ayoade, A.A., Fagade, S.O. and Adebisi, A.A., 2006. Dynamics of limnological features of two man-made lakes in relation to fish production. *African Journal of Biotechnology*, 5(10).

[4] Bagenal, T.B., 1978. Fecundity in Eggs and Early Life History (Bagenal TB, Braum E Part 1) in Methods for Assessment of Fish Production in Freshwaters.

[5] Bezuidenhout, C.C., Mthembu, N., Puckree, T. and Lin, J., 2002. Microbiological evaluation of the Mhlathuze river, KwaZulu-natal (RSA). *Water SA*, 28(3), pp.281-286.

[6] Boyd, C.E. and Tucker, C.S., 2012. Pond aquaculture water quality management. Springer Science & Business Media.

[7] Egborge, B.M., and BM, E., 1981. The composition, seasonal variation, and distribution of zooplankton in Lake Asejire, Nigeria.

[8] Egborge, A.B.M., 1994. Water pollution in Nigeria: Biodiversity and chemistry of Warri River. Ben-Miller Books Nigeria Ltd, pp.27-59.

[9] Filik Iscen, C., Emiroglu, Ö., Ilhan, S., Arslan, N., Yilmaz, V. and Ahiska, S., 2008. Application of multivariate statistical techniques in the assessment of surface water quality in Uluabat Lake, Turkey. *Environmental monitoring and assessment*, 144(1), pp.269-276.

[10] Goldman, C.R. and Horne, A.J., 1983. Limnology. McGraw-Hill.

[11] Gupta, S.K. and Gupta, P.C., 2006. General and applied ichthyology:(fish and fisheries). S. Chand.

[12] Hammer, U.T., 1971. Limnological studies of the lakes and streams of the upper Qu'Appelle river system, Saskatchewan, Canada. *Hydrobiologia*, 37(3), pp.473-507.

[13] Idowu, E.O. and Ugwumba, A.A.A., 2005. Physical, chemical, and benthic faunal characteristics of a Southern Nigeria Reservoir. *The Zoologist*, 3, pp.15-25.

[14] Idowu, E.O., 2007. Aspects of the Biology of African Pike Hepsetus odoe (Osteichthyes: Hepsetidae) in Ado-Ekiti Reservoir (Doctoral dissertation, Ph. D. Thesis, University of Ibadan, Ibadan, Nigeria).

[15] Ikomi, R.B., Iloba, K.I. and Ekure, M.A., 2003. The physical and chemical hydrology of River Adofi at utagba-uno, delta state. Nigeria. *Zool*, 2(2), pp.84-95.

[16] Kar, P.K., Pani, K.R., Pattanayak, S.K. and Sahu, S.K., 2010. Seasonal variation in Physico-chemical and microbiological parameters of Mahanadi river water in and around Hirakud, Orissa (India). *The Ecoscan*, 4(4), pp.263-271.

[17] Kashyap, R., Verma, K.S. and Chand, H., 2015. Heavy metal contamination and their seasonal variations in Rewalsar Lake of Himachal Pradesh, India. *Ecoscan*, 9(1&2), pp.31-36.

[18] Lewis Jr, W.M., 2000. Basis for the protection and management of tropical lakes. *Lakes & Reservoirs: Research & Management*, 5(1), pp.35-48.

[19] Manjare, S.A., Vhanalakar, S.A. and Muley, D.V., 2010. Analysis of water quality using physicochemical parameters Tamdalge tank in Kolhapur district, Maharashtra. *International journal of advanced biotechnology and research*, 1(2), pp.115-119.

[20] Mason, C.F., 2002. Biology of freshwater pollution. Pearson Education.

[21] Murugan, S. and Usha, D.A., 2016. Physico-chemical parameters and phytoplankton diversity of Netravathi-Gurupura estuary, Mangalore, southwest coast of India. *Int. J. of Life Sci.*, 4(4), pp.563-574.

[22] Murugan S, 2018. Effect of Pollutants on Macro Fauna of Mangrove Forests in South Canara, Karnataka (Doctoral thesis, Bangalore University, Bangalore, India).

[23] Oben, B.O., 2000. Limnological assessment of the impact of agricultural and domestic effluent on three man-made lakes in Ibadan, Nigeria. Ph.D. degree. University of Ibadan, p.334.

[24] Okogwu, O.I. and Ugwumba, O.A., 2006. The zooplankton and environmental characteristics of Ologe lagoon, Southwest, Nigeria. *Zoologist (The)*, 4.

[25] Oso, J.A. and Fagbuaro, O., 2008. An Assessment of the Physico-Chemical Properties of a Tropical Reservoir, Southwestern, Nigeria. *Journal of Fisheries International*, 3(2), pp.42-45.

[26] Rajanna, A.H. and Belagali, S.L., 2011. Assessment of seasonal variations of the Physico-chemical profile of Kabini River, Nanjangud, Mysore, Karnataka. *The Ecoscan*, 5(3), p.147.
[27] Shah, M.C., Shilpkar, P. and Sharma, S., 2007. Correlation, Regression Study on Physico-chemical parameters and water quality assessment of groundwater of Mansa Taluka in Gujarat. *Asian Journal of Chemistry*, 19(5), p.34-49.
[28] Sinha, U.K., 1986. Ganga pollution and health hazards.
[29] Tyokumbur, E.T., Okorie, T.G. and Ugwumba, O.A., 2002. Limnological assessment of the effects of effluents on macroinvertebrate fauna in Awba stream and Reservoir, Ibadan, Nigeria. *The Zoologist*, 1(2), pp.59-69.
[30] Vidya Padmakumar and Tharavathy N.C., 2019. A checklist of microalgae in the freshwater lakes of southern Bangalore (Kar.) and Hosur (T.N.) border, India, *The Bioscan*, 14(4), pp. 261-263.