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Hafsa Haleem
Department of Zoology, Sarojini Naidu Govt. Girls P.G. (Auto) College Bhopal, Madhya Pradesh, India

Mukesh Dixit
Professor, Department of Zoology, Sarojini Naidu Govt. Girls P.G. (Auto) College Bhopal, Madhya Pradesh, India

Khair un Nissa
Department of Zoology, Motilal Vigyan Mahavidyalaya College Bhopal, Madhya Pradesh, India

Vartika Yadav
Department of Zoology, Sarojini Naidu Govt. Girls P.G. (Auto) College Bhopal, Madhya Pradesh, India

Corresponding Author:
Hafsa Haleem
Department of Zoology, Sarojini Naidu Govt. Girls P.G. (Auto) College Bhopal, Madhya Pradesh, India

A study on physico-chemical parameters of Ghodha Pachad Dam in Bhopal district (MP) India

Hafsa Haleem, Mukesh Dixit, Khair un Nissa and Vartika Yadav

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Abstract
The current study focuses on the physico-chemical characteristics of Ghodha Pachad reservoir, which is located in Madhya Pradesh's Bhopal District. For a period of one year, seasonal fluctuations in various physical and chemical parameters, including air temperature, water temperature, pH, dissolved oxygen, TDS, total hardness, chlorides, phosphate, nitrate, etc., were examined (Nov 2020-Oct 2021). All physic-chemical parameters were found within the standard limits of WHO and BIS (2012).

Keywords: Ghodha Pachad Dam, Water Quality, WHO, BIS

Introduction
One of the most significant natural resources at our disposal is water. Knowing the significance of water for maintaining life, people all over the world are becoming more aware of the need to conserve water resources, especially freshwater resources. Since water covers 2/3 of the surface of the world, our planet is occasionally referred to as the "water planet." However, only 1% of the world's freshwater resources-surface water, rivers, lakes, streams, and groundwater-are accessible for human consumption and other beneficial uses. It became extremely contaminated as a result of the rise in human population, industrialization, the use of fertilisers in agriculture, and human activity.

In many regions of the world, reservoirs also serve as a reliable source of fresh water; therefore, it is important to monitor and maintain the water quality of these bodies of water in order to ensure human health. Cities, industrial infrastructure, and other complexes have been constructed next to lakes, rivers, dams, and other bodies of water. The water quality of lakes and rivers has declined as a result of human community development. Keeping this in mind, it is essential to analyse and comprehend surface water quality for a variety of objectives.

Any lake's physicochemical water quality parameters are primarily impacted by natural and human-made elements. Relief, precipitation, weathering, geology, inputs from the catchment and atmosphere, mixing of riverine freshwater from rivers and saline water, and climate variability are examples of natural variables. Anthropogenic causes include sewage contamination from homes, agricultural practices, and industrial settings, which disturbs the catchment region. Agricultural runoff is a significant cause of freshwater pollution, and it has a significant impact on drinking water quality, aquatic ecosystems, and human health (Loanidou and Stefanakis, 2020). The first step in determining the water's suitability for uses such as drinking, irrigation, fishery, and industrial ones is to conduct a physicochemical analysis. This analysis also aids in comprehending the intricate processes. The goal of the current study was to evaluate the water's quality using physicochemical factors.

Study Area
Ghodha pachad reservoir is situated in the Huzur tehsil of Bhopal district, Madhya Pradesh, India. Its coordinates are 23º 16' 0" N 77 º 31' 15" E

Methodology
Over the course of a year, the water samples were taken seasonally from the Ghodha Pachad Dam (Nov 2020- oct 2021). To determine the level of pollution, measurement of variables including water temperature, air temperature, pH, and DO were made. In accordance with the established protocols and guidelines, analyses of additional parameters, including TDS, specific Conductivity, total Alkalinity, total Hardness, chlorides, nitrate, and biological oxygen demand, were conducted (APHA, 2012) [37].

Result and Discussion
Physico-chemical analysis of water quality.

Air Temperature (°C)
Surface water's chemical and biological properties are influenced by temperature. It is recognised that temperature affects the pH, alkalinity, and DO content of water (Kumar *et al*. 2010) [17]. Daily and seasonal variations in environmental temperature are a significant physical factor that are directly related to chemical processes in aquatic ecosystems (Goel *et al*. 1986) [30]. The air temperature during the current investigation ranged from 21 °C to 36 °C. 36 °C was the highest air temperature recorded in the summer, and 21 °C was the lowest air temperature recorded in the winter (Table 1). Similar findings were reported by Khan *et al*., (2016) [13] in lower lake and Wanganeo *et al*., (2007) [35] in Sarangpani pond Bhopal.

Water Temperature (°C)
The water temperature throughout the current investigation ranged from 17 to 28 °C. The maximum water temperature (28 °C) was recorded in the Summer season and minimum water temperature (17 °C) was recorded in the winter season (Table 1). Due to the low water level, the clear sky, and the increased solar radiation, may be the reason behind summertime maximum temperature. Khan *et al*. (2015) [14] in the upper lake, Priyatharsini and Dhanalakshmi (2016) [22] in the Vembanoor Wetland, and Surve *et al*. (2005) [28] in the Kandhar Dam all noted similar water temperature patterns.

pH (Hydrogen ions concentrations)
pH is regarded as a crucial chemical factor that decides whether water is suitable for a variety of uses. Water pH is crucial for biotic communities since the majority of aquatic organisms are evolved to a pH range of 0 to 14. 6.8 to 8.2 is the ideal pH range for aquatic life. An important indication of the water quality and level of pollution in the watershed areas is the pH of an aquatic system (Kumar *et al*. 2011; Singh 2014) [18, 25]. The current study at Ghodha pachad Dam found that the minimum pH was 7.2 units in winter season and the maximum pH was 8.5 units in summer season (Table 1). The average pH may be higher in the summer due to low water levels and increased nutrient concentrations in the water, and it may be lower in the winter due to low temperatures and less photosynthesis. Ramakrishna (2003) [23] found that the water's pH reached a maximum in the summer and a minimum in the winter as a result of an increase in bicarbonate ions. In the water of the upper lake of Bhopal, Virha *et al*. (2010) [32] also noted a higher pH during the winter.

TDS (Total Dissolved Solids mg/l)
TDS levels were measured lowest (75 mg/l) in winter and highest (130 mg/l) summer, respectively, (Table 1). According to Tripathy & Pandey (1990) [28], the summer is the time when TDS concentrations are at their highest. It could be caused by high evaporation rates and low water flow into the water bodies. Similar findings were made in Minor Keenjhar lake by Korai *et al*. (2008) [16] and Tighra reservoir by Uchchariya (2012) [31] respectively

Specific Coductvity (µS/cm)
The specific conductivity showed a minimum value of 145 µS/cm in the Winter and maximum value of 230 µS/cm in Summer seasons, respectively (Table 1) The greater conductivity that was noticed during this period may be due to summertime water evaporation. The current research on conductivity is consistent with the findings of Verma *et al*. (2012) [34] and Kaushik & Saksena (1991) [11].

Nitrate (mg/l)
High nitrate concentrations are helpful for irrigation, but when they enter water resources, they encourage the growth of unwelcome macrophytes and algae, which leads to eutrophication and pollution (Trivedy & Goel 1986) [30]. Nitrate levels in the current study were minimal (0.22 mg/l) and maximum (0.4 mg/l) in the winter and summer, respectively (Table 1). Workers on several water bodies also had similar viewpoints (Dagaonkar & Saksena 1992; Garg *et al*. 2006) [3, 5].

Phosphate (mg/l)
Any water body's ability to generate is constrained by the level of Phosphate (Hutchinson 1957) [8]. Lakes can contain phosphorus from a number of sources, such as rock deposits and catchment area runoff. The main sources of phosphate entering the lake environment are residential wastewater and agricultural runoff carrying fertilisers (Gopalkrushna 2011) [6]. During the present study winter saw the lowest level of phosphate (0.0034 mg/l), while the summer saw the greatest level (0.01 mg/l). According to the findings of Durge *et al*. 2018 [4], the highest seasonal values of phosphate were recorded during the summer and the lowest during the winter.

Chloride (mg/l)
The chloride in water comes from the salts of sodium, potassium, and calcium. Chloride levels that are excessive in freshwater are a sign of organic contamination (Venkatasubramani and Meenambal, 2007) [33]. The present investigation period yielded the lowest (15 mg/l) and highest (40 mg/l) chloride readings in the winter and summer

seasons, respectively (Table 1). The outcomes are consistent with the conclusions reached by Tripathy & Pandey (1990) [28] and Khabade *et al* (2002) [12].

Total Alkalinity (mg/l)

The total alkalinity value ranged between 54 mg/l to 134 mg/l. winter and summer seasons saw minimum (54 mg/l) and maximum (134 mg/l) values of total alkalinity, respectively (Table 1). Singh and Saha (1987) [26] found a higher level of alkalinity in the summer in a composite fish culture pond. Gupta *et al*. (2016) [7] discovered a lower level of alkalinity in the winter while working on the Jamwa Ramgarh reservoir in Raipur, Rajasthan; Singh (2014) [25] discovered the same thing on the river Gomti (U.P.) in India. According to BIS (2012), the maximum allowable total alkalinity for drinking purposes is 200 mg/l.

Total Hardness (mg/l)

The cations of calcium and magnesium, which predominately coupled with bicarbonates and carbonates (temporary hardness), as well as with sulphate, chlorides, and other anions of minerals, control the total hardness of water (permanent hardness). The winter and summer seasons, respectively, saw the lowest (49 mg/l) and highest (124 mg/l) total hardness readings during the current study (Table 1). The evaporation of water at greater temperatures throughout the summer, the low water level, and more anthropogenic activities all contributed to higher values of hardness. Karne and Kulkarni (2009) [10] also found the similar trend of total hardness.

Dissolved Oxygen (mg/l)

One of the crucial factors when evaluating the quality of water is the amount of dissolved oxygen. Dissolved oxygen regulates species' metabolic processes, which regulates the overall metabolism of the biological community. It is also used to determine the trophic state of water (Saksena & Kaushik 1994) [24]. In the current experiment, the lowest value of DO was 4.4 mg/l observed in the summer season, while the highest value of DO was 8.8 mg/l found in the winter season (Table 1). As summer progressed, dissolved oxygen levels dropped as a result of rising temperatures and increased microbial activity (Moss, 1972; Morrissette, 1978 and Kataria, 1996) [21, 20, 9].

Biological Oxygen Demand (mg/l)

BOD levels ranged from 1.2 mg/l to 4.1 mg/l, with the winter season recording the lowest level and summer season recording the highest (Table 1). Siraj *et al*. (2010) [27] also gave the same pattern of BOD in Kashmir's Shallabugh Wetland.

Table 1: Showing the present physico-chemical observations in relation to WHO and BIS standard

Parameters	Present Study	WHO Standards 2011	BIS Standards 2016
Air temp. (°C)	21-36 °C	-	
Water temp. (°C)	17-28 °C	-	
PH (Units)	7.2-8.5	7.0-8.5	6-8.5
Conductivity(µS/cm)	145-230 µS/cm	750	750
TDS (ppm)	75-130	500	500-2000
Total Alkalinity (mg/l)	54-134	-	200-500
Total Hardness (mg/l)	49-124	100-500	200-600
Chloride(mg/l)	15-40	250	250-1000
Nitrate(mg/l)	0.22-0.4	0.5	
Phosphate(mg/l)	0.0034-0.01	-	-
DO(mg/l)	4.4-8.8	-	-
BOD (mg/l)	1.2-4.1	-	-

Conclusions

The results of a study on the physico-chemical parameters of the Ghodha Pachad Dam in Madhya Pradesh, revealed that the physicochemical values are within the permissible limits of BIS and WHO, indicating that the dam can be used for irrigation, pisciculture and drinking after treatment.

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