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Assertion of water quality index for Pichhola Lake in Udaipur, Rajasthan

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Abstract
The objective of the current study is to evaluate the water quality of Pichhola Lake in Udaipur (Rajasthan). An evaluation of the lake's current physical, chemical, and biological state has been made. In three places over the course of six months, from November 2021 to April 22 and June 22, the physical, chemical, and biological characteristics of the lake were examined. When compared to the drinking water standards, the physical-chemical characteristics of the lake were found to be moderate throughout the study period. The following aspects of the lake's typical water quality were identified during the study period: Unpleasant colour and smell, Temperature 28.15°C pH 9.0, EC 819.5 mS/cm, BOD 4.195 ppm, COD 38.45 ppm, DO 5.54 ppm, Total Nitrogen content 8.0 ppm, Alkalinity 259.5 ppm, Total hardness 32.65 ppm, Calcium hardness 8.65 ppm, Magnesium hardness 24.55 ppm, Chloride content 174.1 ppm, Fluoride content 0.5565 ppm.

Keywords: Pichhola lake, water quality, organic wastes sewage pollution, bone fluorosis, biological status

Introduction
Water is a chemical compound that can exist as a liquid, a solid, or a gaseous state. All three of these types of water are very beneficial to man because they not only meet his fundamental needs but also give him luxuries and comforts. We are all aware of the value and importance of water. We are helpless whenever there is no water coming out of our faucets. Water is a necessity for all life, just as air is. No life can live without it. Two-thirds of the human body is thought to be made up of water. Water is critically necessary for all living things to survive, including humans, animals, plants, and other organisms. Additionally, the water they require for their purposes must be of a high quality and free of undesired pollutants, dangerous chemicals, or pathogens. Planning and constructing appropriate water supply schemes that can deliver potable water to the various sections of the community in accordance with their demands and requirements is therefore practically necessary in a modern society to ensure the availability of a sufficient quantity of high-quality water.
Aquatic life depends on the physical, chemical, and biological properties of water, and industrialization, urbanization, and waste from human activities can cause unfavorable changes in these properties. As Udaipur is blessed with the good number of lakes and it is also known as 'The city of lake'. Every year numbers of tourist come from all around the world to visit Udaipur city and the lakes of Udaipur are the major source of drinking water. Therefore, it is important to asses and monitors the water quality of the lakes and its significant values provided information about the problems related with public health.
Investigating the physical, chemical, and biological characteristics of the water in Pichhola Lake is the goal of the current paper. Scope of this study is to check the compliance of selected parameters with the permissible limit recommended under various standards.

Methodology
1. Study Area
Pichhola Lake is located 2.5 km away from the south- west of Udaipur at 74042' E Longitude and 24034' N latitude. It spans a total of 30.81 hectares of water spread area over a 1.97 kilometer overall length. The lake is rain-fed and receives water from Pichhola Lake via the connecting canal. The catchment area is approximately 2.56 square meters. The capacity at maximum lake level is 9 million cubic meters. The deeper part of the lake is located to the north-east, which has a high slope, while the field and farms are situated to the south-west (Mehta, 2009).
The details of morphometric features of the Pichhola Lake are given in Table-1.

Table 1: Morphometric features of Pichhola Lake

Latitude	24°35'8.5"N
Longitude	73°31'55"E
Altitude	580 m (MSL)
Typical rainfall	663 mm

spread of water	Over 17.67 ha
Marginal area overgrown with weed	Over 12.73 ha
Overall area	30.40 ha.
Catching basin	2.56 sq.km.
Greatest depth (Zm)	7.5 m
Greatest length (L)	1.62 km
greatest width (bx)	0.68 km
Kilometer shoreline length (L)	3642.8 m
F.T.L. Capacity	4.56 sqkm
Kind of dam	Masonry
District	Udaipur
Distance from Central Udaipur	m

2. Sampling Station

For present study, the following three sampling station was selected in Pichhola Lake for the collection of water sample:

1. Near Pichhola pal side (Eastern shore of lake)
2. Near Pratap Park (Western shore of lake)
3. Near Jungle Safari Park (Southern shore of lake)

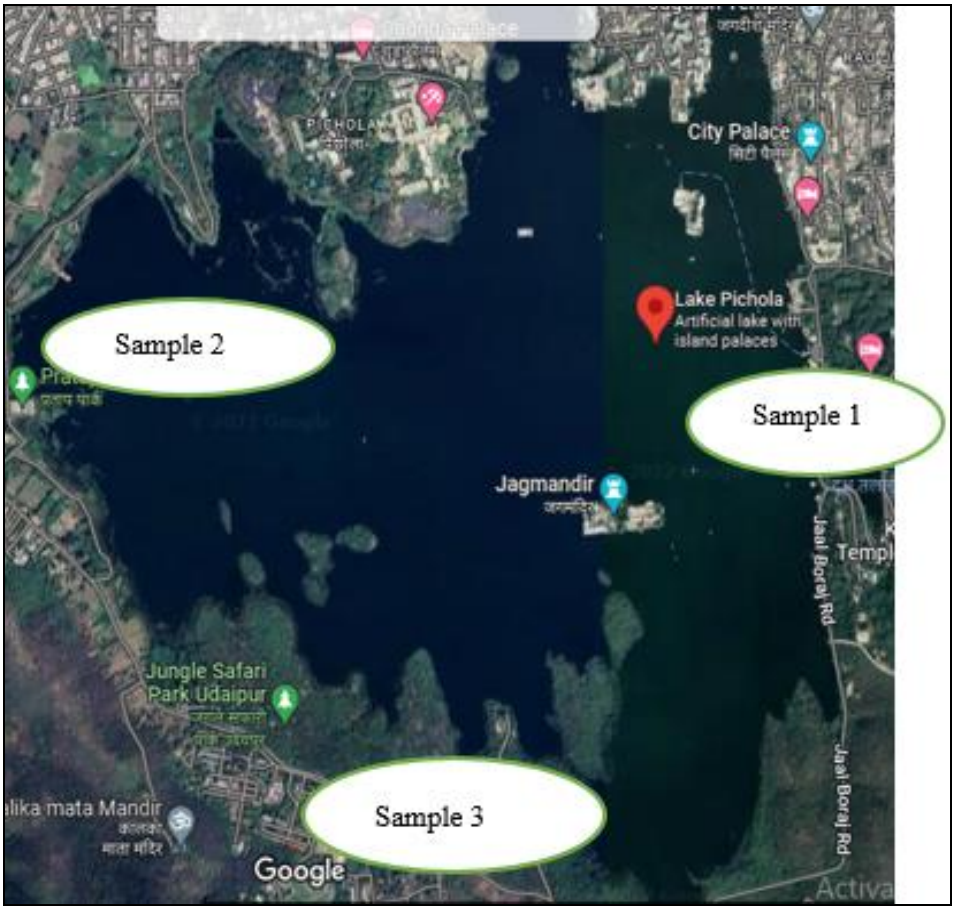

Fig 1: Location of sampling Station

3. Sampling Method and Collection

Grab or Catch sampling method is used for the present study. A grab sample is an individual sample collected without compositing or adding other samples (NEERI, 2011) [10]. During the study period, sample was collected from all three sampling stations manually using grab method of sampling.

4. Testing

Standard techniques were used to analyze the water quality of Pichhola Lake as mentioned in the Manual on Water and Wastewater analysis (NEERI, 2011; Trivedy & Goel, 1984; and APHA, 2005) [10, 3].

In this study, Physical-Chemical and biological characteristics like water temperature, pH, TDS, BOD, COD, DO, Total alkalinity, Total nitrogen content, Total hardness, Calcium Hardness, Magnesium Hardness, Fluoride Content were analyzed using standard method mentioned in the manual. These parameters give a brief knowledge about water quality and pollution status of Pichhola Lake.

Result and Discussion

Table 2: Average water quality parameters of Pichhola Lake

S. No.	Parameters	Average value
1	Temperature	22.40C - 33.90C
2	pH	8.4 - 9.6
3	EC	779 – 860mS/cm
4	TDS	505 – 555 ppm
5	BOD	3.5- 4.89 ppm
6	COD	25.7- 51.2 ppm
7	DO	4.76- 6.32 ppm
8	Total nitrogen content	7.9 - 8.1 ppm
9	Alkalinity	228 - 291 ppm
10	Total hardness	30.8-34.5 ppm
11	Calcium hardness	7.1 -10.2 ppm
12	Magnesium hardness	22.6-26.5 ppm
13	Chloride content	167.2-181 ppm
14	Fluoride content	0.524-0.589 ppm

- **Temperature**

Temperature is the most important factor to characteristic of water. Due to variation in temperature the solubility of water has been affected. If temperature is high then the solubility be reduced and also affects its quality and rate of contamination and the water is in pollution level. In our study the water temperature were recorded with handle with care and it was found between 22.40C-33.90C at all three sampling stations (See Table 2).

- ***Concentration of hydrogen ions (pH)***

Any change in pH has a significant impact on both fish health and water productivity in freshwater bodies of water. The ideal pH for fish culture has been thought to be slightly alkaline, while pH values above 9 are not recommended (Swingle, 1967; Jhingran, 1977) [6]. The pH of the lake water in the current investigation was discovered to range between 8.4 and 9.4 at all three test points (See Table 2). According to testing, Pichhola Lake's pH is alkaline, which is ideal for supporting strong aquatic productivity. However, if the average value rises over previously recorded levels, it will not be suitable for aquatic productivity. Mishara *et al*., 2016) reported an average pH of 7.18 for Pichhola Lake earlier. Such alkaline pH for lakes has also been found in other research work (Dangi and Sharma, 2017).

- ***Conductivity of electricity (EC)***

The ability of water to conduct an electrical current is measured by electrical conductivity. The electrical current that can be conducted increases with the amount of dissolved charged compounds (often referred to as salts) in the water. Charged ions including calcium, potassium, chloride, sulphate, and nitrate can be found in river water naturally. In my investigation, the EC of the water was measured at all three sampling stations between 779 and 860 mS/cm (SeeTable2). Rajkumar (2005) observed values of EC 630 MS/cm in the Daya reservoir, which is consistent with Sarang's (2001) study, which showed comparable ranges of EC values in the Jaisamand Lake in Udaipur.

- ***Total dissolved solids (TDS)***

Water with a TDS level of 1,000 or above is not advised for drinking, while water with up to 300 ppm is deemed safe. [as per WHO]. The ideal TDS level for drinking water is 500 ppm, according to Indian Standard. When essential minerals are absent, water may taste flat but beneficial to health. More dissolved oxygen is present in cold water than in warm water. When TDS levels are high, food becomes unsafe to eat and can cause a number of illnesses, including nausea, lung irritation, rashes, vomiting, and dizziness. Long-term consumption of water with high TDS levels exposes the body to a variety of pollutants and chemicals, increasing the risk of chronic diseases like cancer, liver, and kidney disease.

At all three of the sampling locations used in my study, the TDS content of lake water was slightly higher than the permitted limit, which is between 505 and 555 ppm (See Table 2). Hardik Vashishtha observed values of TDS 509-550 ppm in the Goverdhan Sagar Lake (Hardik Vashishtha: Aug 2020)

- ***Dissolved Oxygen (DO)***

The volume of oxygen that has been dissolved in water is known as dissolved oxygen (DO). Aquatic plants and atmospheric oxygen both contribute to the oxygenation of water bodies. Running water dissolves more oxygen than still water found in ponds and lakes, like that found in a fast-moving stream.

In my investigation, the levels of DO were carefully recorded in accordance with the sampling technique, and it was discovered that they ranged from 4.76 to 6.32 ppm at all three sampling stations (See Table 2). Hardik Vashishtha found values of DO 4.70- 6.20 ppm in the Goverdhan Sagar lake. (Hardik Vashishtha: Aug 2020)

- ***Chemical Oxygen Demand (COD)***

Chemical oxygen demand (COD) is the quantity of dissolved oxygen needed in water for chemical oxidation of organic compounds like petroleum. COD is a measure of how quickly waste water effluents will affect the oxygen content of receiving water.
According to the sample protocol, the values of COD in my study were carefully recorded, and it was discovered that they ranged from 25.7 to 51.2 ppm at each of the three sampling sites (See Table 2). The Central Pollution Control Board's guidelines state that the allowed value of COD is 250 mg/l (ppm). Efficiency of water treatment plants is frequently monitored using the COD test.

- ***Biochemical oxygen demand (BOD)***

BOD is a measurement of the amount of oxygen needed for aerobic bacteria to decompose waste organic matter from water (those bacteria that live only in an environment containing oxygen). Although aerobic organisms are utilised in sewage treatment or wastewater treatment to decompose and eliminate organic pollutants.
According to the sample protocol, the values of BOD in my study were carefully recorded, and it was discovered that they ranged from 3.5 to 4.89 ppm at each of the three monitoring stations (See Table 2). Hardik Vashishtha found values of BOD 3.0- 4.13 ppm in the Goverdhan Sagar Lake. (Hardik Vashishtha: Aug 2020).The Central Pollution Control Board's guidelines state that the acceptable value of BOD is 30 mg/l.

- ***Alkalinity***

The amount of dissolved alkaline chemicals in water is measured as alkalinity (higher than 7.0 pH). It informs us of the water's acid-neutralizing capacity. There are three major categories:
Bicarbonates, Carbonate, Hydroxide
Other kinds of alkalinity, like cyanurate alkalinity, also contribute to total alkalinity. The hydrogen content in pure water is perfectly balanced at 7.0 pH. Its molecules (H2O) split into ions of hydrogen and hydroxide in equal numbers.
At each of the three sampling stations used in my study, water's alkalinity ranged from 228 to 291 ppm (See Table 2). For Pichhola Lake, Mishra *et al*. (2012) discovered a comparable alkalinity value. Rajkumar (2005) and Balai (2006) found higher ranges of alkalinity in various water bodies in Udaipur (2007) [4]. Alkalinity above 40 ppm has been seen as a positive indicator of productivity, while total alkalinity levels above 60 ppm are indicative of nutrient-rich conditions, which are favourable for the growth of organisms that serve as fish food.

- ***Hardness***

Water is said to as soft if it has high concentrations of minerals other than calcium and magnesium, but hard water is defined as having concentrations of calcium and magnesium carbonates, sulphates, and other substances found in limestone, chalk, and gypsum. The hardness of the water will be permanent if it contains cations such as calcium and magnesium chlorides and sulphides.
According to how hard it is, P. Ramya and A. Jagadeesh Babu (June 2015) categorised water as follows:

Table 3

Water Type	Hardness (ppm)
Soft water	0-60 ppm
Moderately hard	61-120 ppm
Hard water	121-180 ppm
Very hard water	>181 ppm

The amount of total hardness, calcium hardness and magnesium hardness for Pichhola Lake were found as 30.8 – 34.5 ppm, 7.1 – 10.2 ppm, and 22.6 - 26.5 ppm respectively (See Table 2). According to the classification described above, these hardness measurements suggest that the water in Pichhola Lake can be categorised as soft water.

- ***Chloride content***

The majority of rivers and lakes have chloride concentrations under 50 mg/l, and any significant rise may be a sign of sewage pollution or, if the increase is seasonal, urban run-off related to the spreading of rock salt (or "grit") on roadways. Chloride concentrations must not be more than 250 mg/L according to public drinking water standards. Natural mineral deposits, irrigation or agricultural runoff, and industrial water are the sources of chloride in water. When chloride was present in large amounts, it meant that sewage or industrial water had contaminated the water.
In my analysis, the three sampling sites found that the water's chloride content ranged from 167.2 to 181 ppm (See Table 2). Hardik Vashishtha: Aug 2020 recorded 149.9- 170.4 ppm of chloride content for Goverdhan Sagar Lake in Udaipur.

- ***Fluoride content***

When the water content is less than 1 ppm, it aids in preventing tooth decay and when permanent teeth are developing, it chemically bonds with tooth enamel, Fluoride in excess can lead to bone fluorosis and other skeleton defects as well as harder, stronger teeth that are more resistant to decay. A sufficient amount of fluoride is necessary for healthy bones because very little fluoride content affects bone density as well.
A range of 0.524 to 0.589 ppm of fluoride was observed in the water throughout my testing. Hardik Vashishtha (Aug 2020) recorded 0.416-0.578 ppm of chloride content for Goverdhan Sagar Lake in Udaipur.

- ***Total Nitrogen content***

Total nitrogen is typically present in lake water in three types of nitrogen that are typically measured in water bodies: ammonia, nitrates, and nitrites. When river water meets lake water, the level of nitrogen is increased due to surface run off. Numerous autotrophic photosynthetic organisms require nitrogen. Nitrogen in water is a sign of the presence of organic materials. The main source of nitrogen into a lake environment is runoff, while there is also a possibility that nitrogenous matter's further oxidation and breakdown will contribute to this (Goldman and Horne, 1993).
The overall nitrogen concentration in Pichhola Lake during my investigation ranged from 7.9 to 8.1 ppm. Hardik Vashistha (2020) found nitrate- nitrogen as 7-7.3 ppm for Goverdhan Sagar Lake.

Conclusion

The Pichhola Lake have a rich of alkaline and nutrient in it. The lake's water is adequate for fishing, according to the water quality. As indicated by the results of biochemical oxygen demand, chemical oxygen demand, and total nitrogen content, the lake's water is heavily contaminated and has a high bacterial intensity. If the same situation persists for an extended length of time, the lake may soon lose its ecological activity. However, it was determined that the lake's water was unfit for consumption and household usage. However, the filtration process is aided by the reverse osmosis system. A suitable restoration effort needs to be started for the lake's sustainable use.

References

1. Ramya P, Jagadeesh Babu A, Tirupathi Reddy E, Venkateswara Rao L. A study on the estimation of hardness in ground water samples by edta tritrimetric method. International Journal of Recent Scientific Research,2015:6(6):4505-4507.
2. Anjana Choudhary, Janak Ah. Analysis of water quality in Polluted Sagar Lake by investigating different physico-chemical parameters, International Journal of Multidisciplinary Research and Development, 2015:2:9:25-30.
3. APHA (American Public Health Association) Standard Methods for the Examination of Water and Wastewater 21th ed. APHA, Inc. Washington, DC, 2005.
4. Balai VK. Current fish and planktonic biodiversity in the Jaisamand reservoir Udaipur, (Rajasthan). Ph.D. Thesis Submitted to Department of limnology of Maharana Pratap University of Agriculture and Technology, Udaipur, 2007.
5. Inu rawal, Harshad joshi, Chaudhary BL. Study of water quality of lake Picchola of Udaipur (India), journal of Herbal Medicine and Toxicology,2012:8(1):72-7.
6. Jhingran VG. Optical appearance and interpretation of Anuli on scales of Gadusia Chapsia (Hama). Journal of the Inland Fisheries society of India,1977:9:138-153.
7. Klein L. The problem of river pollution in Industrial area. The Royal Society for the Promotion of Health Journal,1956:76:348-357
8. Leena Choubisa, Anuradha Dubey. Phytoplanktonic Diversity And Physicochemical Characteristics Of Kishore Sagar, Kota, Rajasthan. Journal of Phytological Research,2017:30(2):31-39.
9. McMath SM, Sumpter C, Holt DM, Delaniue A, Chamberlian AHL. The fate of environment coliform in a model water distribution system. Letters in Applied Microbiology,1999:28:93-97.
10. NEERI (National Environmental Engineering Research Institute) Nagpur Maharashtra, India: Manual on Water and Wastewater Analysis, 2011.
11. Sharma V, Verma BK, Sharma MS. Zoo planktonic and fish fauna of lake Pichhola in relation to its trophic status. JECET,2012:1(3):301-310.
12. IS: 10500 1992. (Reaffirmed 1993). [6] Jawale AK, Patil SA. Physico chemical characteristics and Phytoplankton's abundance of Mangrul dam, Dist-Jalgaon, Maharashtra, J. Aqua Biol,2009:24(1):7-12.
13. Vikal P. Multivariant analysis of drinking water quality parameters of Lake Pichhola in Udaipur, India. Biological forum,2009:1(2):97-102.
14. Negi RK, Johan NS, Negi T. Study of the physicochemical parameters of water of Pongdam reservoir, Himachal Pradesh: A Ramsar site. Him.I. Env. Zool,20:(2):247-256.
15. Pandey J, Sharma MS. Env. Sci. Practical and field manual, Yash Pub. House, Bikaner, 2003.