



Limnological study of Jaisamand Lake (India) and its suitability for aquaculture and fisheries

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Abstract

The aim of this study was to determine the water quality status of Lake Jaisamand and its suitability for fisheries. Water samples were collected from May 2005 to April 2006 at bimonthly interval from preselected sampling stations. The important attributes of water quality such as air temperature (31.88 ± 1.22 °C), water temperature (24.61 ± 0.87 °C), transparency (185.56 ± 2.38 cm), pH (8.20 ± 0.05), electric conductivity (500.0 ± 17.93 μScm^{-1}), dissolved oxygen (9.43 ± 0.18 mgL^{-1}), free carbon dioxide (0.0 mgL^{-1}), carbonates (43.06 ± 2.36 mgL^{-1}), bicarbonates (162.06 ± 2.25 mgL^{-1}), total alkalinity (205.06 ± 4.37 mgL^{-1}), orthophosphates (0.28 ± 0.03 mgL^{-1}), nitrate-N (0.25 ± 0.03 mgL^{-1}) and silicate (9.96 ± 0.31 mgL^{-1}) were observed. Water quality parameters were compared with reported optimum water quality standards prescribed for fish farming or aquaculture and found within the limit. The results revealed that aquatic environment of Jaisamand Lake is conducive for fish growth and water is not only suitable for fish farming purposes but also for irrigation and drinking purposes.

Keywords: Jaisamand, fish farming, Rajasthan, Water quality and physico-chemical.

I. Introduction

Water is a precious natural resource and basic need of human thus considered as a national asset. With growing demands in various sectors it needs appropriate planning, development and management. Water quality gives a good impression of the status, productivity and sustainability of any water body for monitoring water quality which is the first step for management and conservation of aquatic ecosystems. This will also ensure conservation of its habitat by suitably maintaining the physico-chemical quality of water within the acceptable levels. The periodical changes in physico-chemical parameters like temperature, transparency, dissolved oxygen, chemical oxygen demand, nitrate, phosphate etc. of water may provide valuable information on its quality impacts on the productivity and biodiversity of the reservoir. Good water quality like adequate oxygen, proper temperature, transparency, limited levels of metabolites and other environmental factors are known to affect fish culture. The earlier studies on water quality of a fish farming pond in India were conducted by Sewell (1927) and after that many workers have studied the physico-chemical conditions of inland waters either in relation to fish mortality or as part of general hydrological survey (Alikunhiet *al.*, 1952 and Upadhyaya, 1964). The details of various lake ecosystems also have been studied by (Johri, 1990; Pani and Misra, 2000; Chaturbhuj *al.*, 2004; Moundiotiya *et al.*, 2004; Sisodia and Moundiotiya, 2006; Kumar *et al.*, 2009; Mahesha and Balasubramanian, 2010 and Dubey *et al.*, 2013). In the present study, an attempt has been made to study the physico-chemical parameters of Jaisamand Lake situated in Udaipur district, Rajasthan, India to assess the various aspects of the reservoir and so as to suggest ways and means for supporting sustainable fisheries and conservation.

II. Materials and Methods

Study area

Jaisamand is one of the oldest manmade lake constructed during the year 1729 AD by putting an embankment across the Gomti River near the village Veerpura in Udaipur district of Rajasthan state. It covers 7,160 ha water spread area and water source for this lake are nine rivers and several seasonal canals (Nalahas) located in the catchment area. For wide area coverage of this study three sampling stations (A, B and C) were selected (Fig. 1).

Sampling procedure and laboratory analysis

Water samples were collected in the morning hours from preselected three sampling stations during first week of each alternate month from May, 2005 to April, 2006. Water samples were collected from surface area in clean and rinsed polyethylene sampling bottles and brought to the Research laboratory of College of Fisheries, (MPUAT) for analysis.

The important physico-chemical parameters of water including temperature, water temperature, transparency, pH, electric conductivity, dissolved oxygen, free carbon dioxide, carbonates, bicarbonates, total alkalinity, orthophosphate, Nitrate-N and silicate were analyzed following methods given by Welch (1952), Trivedi *et al.* (1987) and APHA (1989).

III. Results and Discussion

The range of variations and their annual mean along with standard deviation of various physico-chemical characteristics of water of Jaisamand Lake and its congeniality for fish farming are given in Table 1.

The temperature is an important factor which affects rate of chemical reactions of water and biological processes of aquatic organisms and thus has profound influence on the biotic communities. During the present investigation the average air temperature was 31.88 ± 1.22 °C and water temperature was 24.61 ± 0.87 °C. Similar results were recorded by Jha and Barat (2003) in Mirik Lake, Darjeeling. Radhika *et al.* (2004) studied the abiotic parameters of a tropical freshwater lake Velayani in Thiruvananthapuram, District (Kerala) and observed the similar findings. Ujjania and Soni (2015) also reported similar findings for water temperature (25.83 ± 0.85 °C) in Vallabhsagar reservoir (Gujarat).

Transparency is directly proportional to the amount of suspended organic and inorganic particulate matters. The other factors which affect the transparency of water body are plankton density, wind velocity, rainfall, nature of water body and prevailing weather conditions. In the present work average value of transparency was 185.56 ± 2.38 cm. The findings of present study are in agreement with Sharma and Sarang (2004) for Jaisamand Lake (India) and Mustapha (2008) for Oyun reservoir (Nigeria), respectively.

During the present investigation average value of pH was observed 8.20 ± 0.05 . The pH of water appears to be dependent upon the relative quantities of Calcium carbonates and bicarbonates. As these being alkaline when the quantities of Carbonates are high (Pearsall, 1930 and Zafar, 1996). Santhosh and Singh (2007) reported that suitable pH range is 6.7 to 9.5 for fish culture whereas above or below this level of pH is stressful to the fishes. The present value of pH lies between the reported pH range which depicts that water condition is grossly suitable for fish and fisheries.

The electrical conductivity depicts the presence of total mineral contents in water. In the present investigation, observed average value of electric conductivity was 500.0 ± 17.93 μScm^{-1} .

Mustapha (2008) reported very low conductivity in Oyun reservoir but results of present study were found lower than the recommended values of WHO (1993) for drinking water and hence the water can be considered suitable from this point of view.

Dissolved oxygen is an important parameter which affects chemical as well as biological reactions in an ecosystem. The average dissolved oxygen during research work was 9.43 ± 0.18 mg/l⁻¹. Similar trends of DO were also observed by Yeoleand Patil (2005 & 2007) in Yedshilake, Washim (M.S.), Ujjania (2003) in Mahi Bajaj Sagar (Rajasthan) and Ujjania and Soni (2015) in VallabhSagar (Gujarat).

Carbon dioxide dissolved in water is the source of carbon that can be assimilated and incorporated into the living matter of all aquatic autotrophs (Hutchinson, 1957). During the present study free carbon dioxide was totally absent. The absence of the free CO₂ may be due to its complete utilization in photosynthetic activity (Sreenivasan, 1971). The absence of CO₂ were also reported by Srivastava *et al.* (2003) in Ramgarh Lake, Jaipur, Ujjania (2003) in Mahi Bajaj Sagar reservoir, Banswara.

Carbonate and Bicarbonates were present due to absence of free CO₂ because it is converted into carbonate and bicarbonate. In the present observation mean value of carbonate and bicarbonate were 43.06 ± 2.36 mg/l⁻¹ and 162.06 ± 2.25 mg/l⁻¹ respectively. Similar trends of carbonates was reported in Chandola Lake, Karnavati (Verma *et al.*, 2012). Whereas such findings of the present study on bicarbonate is evident by Tandale and Dabhade (2014) in Lonar Crater Lake, India.

Total alkalinity is the measure of the capacity of water to neutralize a strong acid. It is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, borates, silicates etc. together with the hydroxyl ions in free-state. During the present investigation average total alkalinity was found 205.06 ± 4.37 mg l⁻¹. Fluctuations in alkalinity might be due to alkaline particles and low production of plankton (Dash (1993). Bhongade and Patil (2012) also reported the similar findings in Mohgavhan Lake (Maharashtra).

Average orthophosphate was 0.28 ± 0.03 mg l⁻¹ during the present investigation which is coinciding to the observations of Ahmed and Krishnamurthy (1990) in Woharreservoir Aurangabad (Maharashtra state) and Singh and Balasingh (2011) in Kodaikanal Lake (Kerala)

In the present investigation average nitrate value was 0.25 ± 0.03 mg l⁻¹. These values of nitrates may be due to agriculture runoff from catchment area. The finding of Ade and Vankhede (2001) in Amravati University Reservoir and Ujjania (2003) in Mahi Bajaj Sagar reservoir were similar to the present investigation.

Silicate is considered as micronutrient for the primary producers and in particular. In the present study, the mean value was 9.96 ± 0.31 mg l⁻¹ and similar findings were reported by Soni and Ujjania (2014) in Vallabhsagar reservoir (Gujarat).

IV. Conclusion

From the present investigations, it may be inferred that physico-chemical characteristics of Lake Jaisamand water varied considerably and comparable to the other freshwater bodies. The results depict that the water of Jaisamand Lake is adequate with respect to essential nutrients necessary for primary producers which in turn is favorable and conducive for better fish growth and production. All the physico-chemical parameters in general appeared within permissible limits prescribed by different researchers. Hence, it can be inferred that the Jaisamand Lake is suitable for drinking, irrigation, pisciculture etc. These findings can be useful for the management and conservation of Lake and its fisheries.

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Table 1 Water quality parameters of Jaisamand Lake.

Water quality parameters	Units	Minimum	Maximum	Mean±SE	Accepted water quality parameters
Air temperature	°C	24.50	41.30	31.88±1.22	-
Water temperature	°C	18.40	30.70	24.61±0.87	20-30 ¹
Transparency	Cm	170.0	199.01	85.56±2.38	30-80 ¹
pH		7.80	8.60	8.20±0.05	6.5-9.0 ¹
Electric Conductivity	μS cm ⁻¹	390.0	670.0	500.00±17.93	30-2000 ²
Dissolved oxygen	mg l ⁻¹	8.50	11.00	9.43±0.18	3.0-5.0 ¹
Free CO ₂	mg l ⁻¹	Ab	Ab	Ab	0 - 10 ¹
Carbonates	mg l ⁻¹	27.00	56.00	43.06±2.36	-
Bicarbonates	mg l ⁻¹	147.0	179.0	162.06±2.25	-
Total alkalinity	mg l ⁻¹	174.00	231.0	205.06±4.37	50-200 ¹
Orthophosphates	mg l ⁻¹	0.11	0.47	0.28±0.03	0.03-2.0 ¹
Nitrate-nitrogen	mg l ⁻¹	0.09	0.47	0.25±0.03	0-100 ¹
Silicate	mg l ⁻¹	8.10	11.70	9.96±0.31	2.0-20.0 ³

¹Bhatnagar and Devi (2003), ²Stone and Thomforde (2004) and ³Marion (1998)

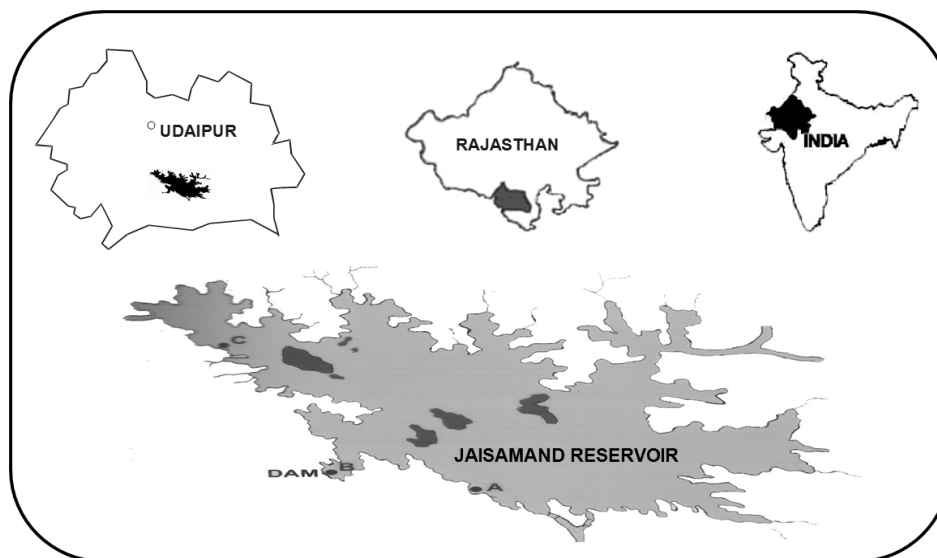


Figure 1. Map of study area in Jaisamand Lake and sampling stations (A is sampling station 1, B is sampling station 2 and C is sampling station 3)

