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Limnological studies of the perennial waterbody, Bansagar Pond, Rewa (M.P.) India

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Abstract

This paper describes the physico-chemical profile of perennial pond of Bansagar, Rewa (M.P.) India, where limnological studies were conducted during Jan. 2020 to Dec. 2020. Variables analysed from surface water of the pond were temperature, transparency, pH, electrical conductivity, dissolved oxygen, alkalinity, hardness, chlorides, nitrates and phosphate. The seasonal variations of these factors were studied and interrelationships existing between them are discussed. The pH of water was alkaline. Transparency, EC, hardness and alkalinity were tend to increase during summer and decrease in winter. Dissolved oxygen was maximum during winter and minimum during summer. Dissolved oxygen showed inverse relationship with temperature and EC. Nitrate and phosphate were higher in monsoon and postmonsoon, fluctuated directly with dissolved oxygen.

Keywords: Limnology, Bansagar pond, parameters, waterbody

Introduction

India has vast freshwater resources in the form of both lentic and lotic ecosystems. The lentic ecosystems include ponds, lakes, tanks and reservoirs. The perennial ponds play an important role as a valuable water resource for domestic, agriculture and aquaculture. The lentic ecosystems have long attracted the attention of ecologists, both for their importance as the source of drinking water and in the development of fisheries. To employ scientific methods for aquaculture, understanding of environmental conditions prevailing in the water body is essential. Increased attention is, therefore, be given to the physico-chemical factors, since they directly or indirectly affect fishes and other aquatic inhabitants.

The freshwater pond of Bansagar is located in Rewa district 24°32' north latitude and 81°15' east longitude with an elevation 316 meter. Bansagar Colony Pond is constructed near Bansagar Colony, Saman, Tehsil- Huzur, Distt. Rewa (M.P.) area on the Rewa-Sidhi-Shahdol road nearly 0.9 km. away from New Bus Stand, Choona Bhattha, Rewa. The total area of the pond is about 2.5 hect. In which 1.6 hect. area is used for the fish culture. The width of pond is nearly 1298 feet upstream side and 2287 feet at downstream side and minimum and maximum depth is 10 feet and 20 feet in downstream and upstream side respectively. The pond is perennial rain-fed with marginal vegetation around it. The pond store rainwater received from adjoining catchment area and is much influenced by anthropogenic activities.

Several limnological studies have been carried out in past few decades on lakes and ponds of this region, notable among those are of Mishra, *et al.* (2009) ^[1], Tewari, *et al.* (2010) ^[2], Dhurvey and Kashyap (2019) ^[3] and Saket and Pandey (2019) ^[4]. Most of the studies were carried out in water bodies situated in urban areas. The reports on water bodies from rural areas are meagre. Thus, there is lack of baseline data on limnological characteristics of Bansagar pond, which is being used for pisciculture activities. Therefore, the present study was undertaken.

Material and Methods

The samples of surface water were collected fortnightly from four sampling sites of the pond. A few tests particularly for dissolved oxygen and alkalinity were performed at the site. The water temperature was measured using mercury thermometer. The transparency of water was measured by using Secchi disc.

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The pH was determined by using pH meter. The water samples were transferred to the laboratory for further chemical analysis. Standard methods as described by APHA-AWWA-WPCF (1985) [5] and Trivedy *et al.* (1998) [6] were followed for various physico-chemical parameters. Statistical analysis was done to find out the interrelationship among physico-chemical factors.

Results and Discussion

The average minimum and maximum values of each parameter recorded in Bansagar pond during Jan. 2020 to Dec. 2020 are given in Table 1. The values of correlation coefficient between physicochemical factors are given in Table 2. The surface water temperature ranged between 22.1 and 31.8°C. It was recorded minimum during winter and maximum in summer. The monthly variations showed that the water temperature followed the seasonal pattern and fluctuated according to the prevailing atmospheric temperature. The pH of the pond water was always alkaline and ranged from 6.8 to 7.9. The variation in pH was not very wide. The waters having pH range of 6.5 to 9.0 are most suitable for aquaculture (Jhingran, 1982) [7]. The pH in Bansagar pond was found suitable for pisciculture. Maximum pH was recorded during summer and minimum in monsoon. The high pH in summer possibly results from increased photosynthesis; photosynthetic assimilation of dissolved inorganic carbon can increase pH (King, 1970) [8]. The pH showed direct relationship with total alkalinity (Table 2). Such a relationship was also reported by Bharadwaj & Sharma (1999) [9]. The transparency ranged from 26.6 cm to 68.4 cm. Maximum transparency was

recorded in summer, and lowest during monsoon and postmonsoon. The rainwater brought in a lot of dissolved and undissolved inorganic and organic materials that made the water turbid and caused lowest transparency in rainy months. These observations are in agreement with the findings of Timms & Midgley (1970) [10].

The EC values ranged from 358.5 to 414.1 µmhos/cm, being maximum in summer and minimum in winter. The EC showed direct relationship with water temperature, hardness and chlorides (Table 2). The relation of EC with temperature could be explained on the basis of the fact that solubility of minerals and other inorganic matter increases with increase in water temperature. Dhurvey and Kashyap (2019) [3] and Kataria *et al.* (1995) [11] have reported similar seasonal trend of EC, which supports our findings.

Table 1: Average values and (ranges in parantheses) of physical and chemical parameters recorded at Bansagar pond during Jan. 2020 to Dec. 2020.

S. No.	Parameters	Max	Min.	Avg.	Stdev.
1.	Temperature (°C)	31.8	22.1	26.95	±6.86
2.	Transparency (cm.)	68.4	26.6	47.5	±29.56
3.	pH	7.9	6.8	7.35	±0.78
4.	Electrical conductivity (mg./L)	414.1	358.5	386.3	±39.32
5.	Dissolved oxygen (mg./L)	8.8	5.5	7.15	±2.33
6.	Hardness (mg./L)	118.2	66.1	92.15	±36.84
7.	Total alkalinity (mg./L)	164.7	97.66	131.18	±47.40
8.	Chlorides (mg./L)	43.5	25.2	34.35	±12.94
9.	Nitrate (mg./L)	0.22	0.03	0.125	±0.13
10.	Phosphate (mg./L)	0.23	0.02	0.125	±0.15

Table 2: Correlation matrix of physico-chemical characteristics of Bansagar pond.

	Temperature	Transparency	pH	Electrical conductivity	Dissolved oxygen	Hardness	Total alkalinity	Chloride	Nitrate	Phosphate
Temperature	1									
Transparency	0.25	1								
Ph	-0.12	0.66**	1							
Electrical conductivity	0.75*	0.12	-0.38	1						
Dissolved oxygen	-0.92*	-0.37	0.26	-0.79*	1					
Hardness	-0.04	0.77*	0.49**	0.36	-0.04	1				
Total alkalinity	0.80*	0.54**	0.04	0.68*	-0.91*	0.17	1			
Chlorides	0.67*	-0.15	-0.66*	0.78*	-0.71*	-0.43**	0.40	1		
Nitrate	-0.43**	-0.51**	-0.35	-0.08	0.57**	-0.35	-0.57**	0.06	1	
Phosphate	-0.47**	-0.71*	-0.28	0.29	0.59**	-0.45**	-0.743*	-0.01	0.65*	1

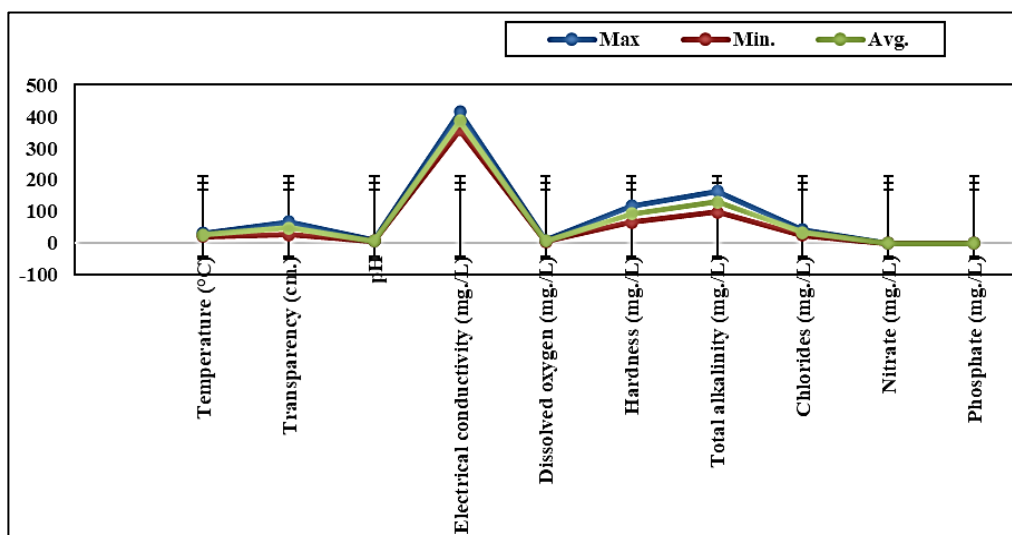


Fig 1: Graph analysis of physical and chemical parameters recorded at Bansagar pond during Jan. 2020 to Dec. 2020.

According to APHA (1985)^[5] the lowest dissolved oxygen for maintaining fish in healthy condition is 5.0 mg/L and the critical value is 3.0 mg/L. In the Bansagar pond average DO value recorded was 7.15 mg/L, indicating favourable condition for fish growth. Dissolved oxygen varied from 5.5 to 8.8 mg/L being minimum in summer and maximum in winter. DO showed significant inverse relationship with water temperature. This might be attributed to two reasons, i.e., in summer at high temperature the rate of oxidation of organic matter increases and oxygen is consumed and secondly at high temperature oxygen holding capacity of water decreases (Welch, 1952 and Nair, 2000)^[12, 13].

The total alkalinity ranged from 97.66 to 164.7 mg/L. It was recorded maximum in summer during both the years of the study, and minimum during monsoon and winter during first and second year respectively. According to Jackson (1961)^[14], alkalinity below 50 mg/L indicated low photosynthetic rate. The alkalinity in Bansagar pond remained always high indicating high photosynthesis rate. Kaur *et al.* (1997)^[18] observed higher alkalinity during summer and lower during monsoon. The high values of alkalinity in present study imply large reserve of total CO₂ which provide supply of inorganic carbon for the support of algal population as Dhurvey and Kashyap (2019)^[3] and Sinada & Abdel Karim (1984)^[15] have observed.

Hardness of Bansagar pond varied from 66.1 to 118.2 mg/L. Patel & Dubey (2019)^[16] has classified water with hardness values ranging from 60-180 mg/L as moderately hard to hard. By these criteria the water of Bansagar pond can be termed as moderately hard. The hardness showed seasonal variation, being maximum in summer and minimum in winter. Patel & Dubey (2019)^[16] have also recorded higher hardness in summer and lower in winter, which support our findings. Hardness showed direct relationship with temperature, EC and transparency (Table 2). Similar relationship was reported by Jhingran (1982)^[7]. Chloride values ranged between 25.2 and 43.5 mg/L. Slightly higher values of chloride were recorded during monsoon.

Freshwater contains 8.3 mg of chlorides per litre, in general, (Swarnalatha & Rao 1998)^[17] but in present investigation the chloride concentration was observed higher indicating polluted nature of the pond. Patel & Dubey (2019)^[16] suggested that higher concentration of chloride in water is an index of pollution of animal origin. Higher chloride values during monsoon might be attributed to run off from the catchment area. Chloride showed direct relationship with water temperature and EC.

Nitrates (NO₃ -N) were reported in lower concentration which might be due to biological destruction. The nitrate ranged from 0.03 to 0.22 mg/L. Though nitrate content of the pond water was lower, higher values were reported in monsoon than in winter and summer. Highest values of nitrates in rainy season may be due to addition of nitrogen in the form of run-off water. The nitrate showed direct correlation with DO, and such a direct relationship was also observed by Dhurvey and Kashyap (2019)^[3] and Patel & Dubey (2019)^[16].

Phosphate (PO₄ -P) content of pond water varied from 0.02 to 0.23 mg/L being higher in monsoon and postmonsoon and lower in summer. Nair (2000)^[13] has observed similar seasonal trend in phosphate concentration. Phosphate showed direct relationship with DO and nitrate, and negative correlation with water temperature, transparency, hardness and alkalinity (Table 2). Patel & Dubey (2019)^[16]

also reported such a relationship of phosphate with other parameters.

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