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Physico-chemical study of Bansagar reservoir on its potable quality

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Abstract
The aim of the current study was to gain a thorough knowledge on the trophic status of Bansagar reservoir. Variation in physico-chemical parameters of ambient water were assessed over a period of one year (January to December) on monthly basis in Bansagar reservoir. In the present study pH varied from 7.2-8.4 units, turbidity from 3-9 NTU, total dissolved solids from 116-158 mg/l, Specific conductivity from 176-242 mg//l, dissolved oxygen from 4.4-7.6 mg/l, Total hardness from 40-60 mg/l, total alkalinity from 102-134 mg/l, chloride from 10-20 mg/l, nitrate from 0.008-0.54 mg/l and Phosphate phosphorous from 0.0006-0.175 mg/l. The results indicated that the physico-chemical parameters of the water body were within the permissible limits and as such the water from the Bansagar reservoir can be used for drinking, and domestic purpose.

Keywords: Physico-chemical parameters, Bansagar reservoir, tropic status

Introduction
Water is significant natural resources within earth's ecosystem. It is essential for sustaining the life and other activities of all living organisms. Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. Water quality indicates the relation of all hydrological properties including physical, chemical and biological properties of the water body. Water is necessary component of all living organisms including plants. The surface water and ground water resources of the country play a most important role in irrigation, industrial, fisheries and hydropower besides providing potable water.
In the present study authors have tried to analyse the water quality of Bansagar reservoir across the Sone River was constructed near the Deolond village in the Shahdol district. It is surrounded by Satna, Katni, and Rewa districts. The project was called "Bansagar" after Bana Bhatt, the renowned Sanskrit scholar of the 7th century, who is believed to have hailed from this region in India. Bansagar reservoir is located at Latitude 24-11-30 N and Longitude 81-17-15 E. The Bansagar dam has a catchment area of 18,648 square kilometers and is supposed to provide irrigation on 249,000 hectares of land in Madhya Pradesh, 150,000 hectares in Uttar Pradesh and 94,000 hectares in Bihar. Along with irrigation, the project also generates 425 megawatt of electricity in Madhya Pradesh.
The present studies on the physico-chemical parameter of Bansagar reservoir were coursed out in ouder to assess its tropic status.

Material and Methods
Surface water samples were collected from four sampling stations from January, 2016 to December, 2017 on Monthly basis. Samples were collected during first week of every month in the early hours of the day between 7am to 11am.
Bansagar reservoir is located at Latitude 24-11-30 N and Longitude 81-17-15 E and is around 45 m deep near dam sites. For analysis of physicochemical parameters the methods given in Trivedy and Goel, (1986) [24] and APHA (1998) [13] were followed.

Results and Discussion
Based on and the monthly variations in physico-chemical parameters of Bansagar reservoir, minimum and maximum value obtained during this study are given in Table-1.

Table 1: Range of variation, min, max, average and SD of water quality parameters of Bansagar reservoir

S. No.	Parameters	Minimum	Maximum	Average	SD
1.	pH (units)	7.2 (December)	8.4 (May)	7.8	0.35
2.	TUR(NTU)	3 (Jan-Dec)	9 (August)	5.14	2.08
3.	TDS (mg/l)	116 (January)	158 (April)	136.70	14.12
4.	SC (µS/cm)	176 (November)	242 (April)	209.74	21.20
5.	DO (mg/l)	4.4 (May)	7.6 (January)	1.6	1.01
6.	TH (mg/l)	40 (January)	60 (April)	50.26	7.60
7.	TA (mg/l)	102 (November)	134 (May)	120.32	9.34
9.	Cl (mg/l)	10 (December)	20 (April)	15.5	4
10.	N (mg/l)	0.008 (February)	0.54 (July)	0.14	0.15
11.	P (mg/l)	0.0006 (January)	0.175 (August)	0.108	0.075

pH, TUR= Turbidity, TDS = Total dissolved solids, SC= Specific conductivity, DO = Dissolved oxygen, TH = Total hardness, TA = Total alkalinity, Cl = Chloride, N = nitrate, P = Phosphate

Table 2: Bansagar reservoir water analysis correlation (Jan 2016 to Dec 2016)

	pH	TUR	DO	TDS	CON	Cl	TH	TA	Nitrate	Phosphate
pH	1									
TUR	0.56284	1								
DO	-0.32153	-0.26744	1							
TDS	0.530537	0.353428	-0.67314	1						
CON	0.567094	0.405756	-0.65675	0.910249	1					
Cl	0.43297	0.242115	-0.59597	0.609123	0.745284	1				
TH	-0.07912	-0.12924	-0.35985	0.508365	0.26268	0.141895	1			
TA	0.558242	0.479891	-0.26478	0.123089	0.385304	0.205676	-0.40874	1		
Nitrate	0.168463	0.390944	0.238549	0.165098	0.194543	-0.05952	-0.14345	0.340365	1	
Phosphate	0.469724	0.477713	-0.64163	0.769384	0.774177	0.519582	0.238245	0.496958	0.295254	1

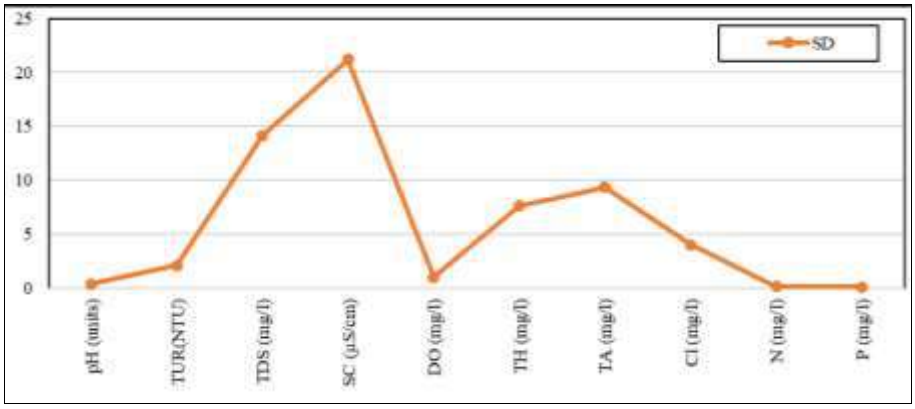

Fig 1: Graph analysis at SD of water quality parameters of Bansagar reservoir

During the present study pH fluctuated between 7.2 to 8.4 units ($\bar{x}$ = 7.8 units; SD = 0.35) Table 1. The pH values indicate alkaline nature of Bansagar reservoir. During the study pH was minimum in winter and maximum during summer season. Similar results were reported by Verma and Mohanty (1995) [1] in Danmukundpur pond. Mishra and Singh (2022b) [2] also get nearly same results in Bansagar Dam. pH showed significant positive correlation with turbidity, TDS, conductivity and total alkalinity (Table 2).

In the present study water turbidity varied from 3 to 9 NTU ($\bar{x}$= 5.14 NTU; SD = 2.08) Table 1. Minimum turbidity value was recorded during winter and maximum during rainy season. Similar results were found by Prajapati (2016) [3] and Shukla & Shukla, (2022) [4] in Sarfa Dam and Mohan Ram Talab respectively. During winter season the settlement of silt and clay parcels lead to lowering of turbidity. Dagaonkar and Saksena (1992) [5] also recorded such a phenomenon in from Kaila sagar. The turbidity incursions during the rainy months were attributed to runoff from the catchment area. During present study turbidity showed significant positive correlation with TDS (Table 2).

Total dissolved solids during present study ranged from 116 to 158 mg/l with an average ($\bar{x}$= 136.70mg/l and SD value 14.12) Table 1. The minimum values of total dissolved solids were also observed during winter and maximum in summer months. Similar results have been reported by Kirubavathy *et al*., (2005) [6] from Orathupalayam reservoir, Prajapati (2016) [3] from Sarfa dam. Total dissolved solids showed significant positive correlation with conductivity and significant correlation with chloride, total hardness, phosphate and Conductivity (Table 2).

The electrical conductivity of water depends the ions present in water. Specific conductivity recorded during present study varied between 176 to 242 µS/cm, ($\bar{x}$ = 209.74; SD value 21.20) Table 1. Similar values were recorded in Anchar lake (Bhat *et al*., 2013) [7] and Vembanoor wetand Priyatharsini and Dhanalakshmi (2016) [8]. Specific conductivity revealed positive significant correlation with chloride and phosphate (Table 2).

Dissolved oxygen is essential aquatic parameters. In the present study the dissolved oxygen values ranged from 4.4 to 7.6 mg/l ($\bar{x}$= 1.6 units and SD = 1.01) Table 1. Maximum

values of dissolved oxygen were recorded in winter minimum during summer. Photosynthetic activities (Sashay and Sinhala, 1969) [9]. Results in enhancement of dissolved oxygen showed significant negative correlation with TDS, conductivity, chloride and phosphate (Table 2).

In the present study the total hardness values found ranged from 40 to 60 mg/l ($\bar{x}$= 50.26 units and SD = 7.60) Table 1. Decrease in water level due to increase in rate of evaporation at high temperature a correspond increase in Total hardness value have been observed. According to WHO (2011) [10] permissible limit for total hardness of water is 150 mg/l. During present study maximum total hardness value were observed during summer season and minimum in winter months. Similar results were recorded by Wanganeo *et al*., (2007) [11] in Sarangpani pond; Hujare (2008) [12] in perennial tank.

Total alkalinity is the sum of total carbonate and bicarbonate. In the present study the total alkalinity ranged from 102 to 134 mg/l with an average value of 120.32 mg/l (SD = 9.34) Table 1. Alkalinity of water body is a measure of its capacity to neutralize acid at a designated pH (APHA, 1998) [13]. The higher alkalinity value indicates the eutrophic nature of water body. In present study maximum total alkalinity was observed in summer months and minimum in winter months. Similar trend were also documented by Pradeep and Dwivedi (2016) [14] in Kshir Sagar; Radhika *et al.*, (2004) [15] in Vellayani lake. Spence (1964) [16] classified water bodies into three major categories based on the value of alkalinity, *viz*, nutrient poor (from 1.0-15.0 mg/l), moderately rich nutrient (from 16.0-60.0 mg/l) and nutrients rich (>60.0 mg/l), As per Spence's categorization Bansagar reservoir falls among nutrients rich categories.

A large content of chloride in clean water is an indicator of organic pollution (Venkatasubramani and Meenambal, 2007) [17]. In the present study, chloride values varied from 10 to 20 mg/l with an average value 15.5 units (SD = 4) Table 1. Minimum value was recorded during winter months and maximum in summer months. Similar results were also reported by Uchchariya (2012) [18] in Tighra reservoir, Prajapati (2016) [3] from Sarfa dam; Shukla & Shukla, (2022) [4] in Mohan Ram Talab have described that the values of chloride ranging from 17-57.6 mg/l fall under the categorized of less domestic pollution; value from 50.9-129.9 mg/l, moderate domestic pollution while high domestic pollution revelled chloride values ranging from 129.9- 206.4 mg/l. Bansagar reservoir as per the classification in categorized among les domestic pollution wetland. Chloride showed significant positive correlation with phosphate (Table 2).

In the present study nitrate fluctuated between 0.008 to 0.54 mg/l ($\bar{x}$= 0.14 units; SD = 0.15) Table 1. High concentration of nitrate-nitrogen was observed during rainy months and low in winter months. Similar results have also been obtained by Telkhade *et al*., (2008) [19] in Chargon lake and Latha (2010) [20] in Kengari lake. Nitrate showed significant positive correlation with sodium during current study.

Macrophysics growth during spring and summer months has resulted in the reduction of nitrate level in ambient water. Where in the winter and fall, when plants stop growing and die, much of the nitrogen is released beak into the water again, increasing the nitrogen concentration.

The source of phosphorous in water body, is the soils of nearby catchment areas, agriculture soli, fertilizer, industrial effluents, depth of water body, aquatic vegetation, bottom fauna and dead eggs of aquatic animals. The Phosphate phosphorous ranged from 0.0006 to 0.175 mg/l wait average value of 0.108 mg/l (SD = 0.075) Table 1. Higher phosphorous content in Bansagar reservoir were observed during rainy months and low during winter months. Similar observation were also record by While these results were also confirmed by the observation of Jayabhaye *et al*., (2008) [21] in Minor reservoir in Sawana; Kumar *et al*., (2009) [22] in Jawahar sagar. Maximum values of phosphate during rainy months are observed due to runoff of forest and agriculture land beside waste them input of the nearby catchment area. Lee *at al*., (1981) [23] on the basis of phosphate content have classified the water bodies into five categories, *viz*., oligotrophic less than 0.007 mg/l, oligomesotrophic between 0.008 and 0.011 mg/l, mesotrophic between 0.012 and 0.027 mg/l, meso-eutrophic between 0.028 and 0.039 mg/l and eutrophic more than 0.040 mg/l. on applying Lee's *et al*., (1981) [23] classification of Bansagar reservoir, it can be placed under oligo-mesotrophic water body.

Conclusion

All the physico-chemical parameters of Bansagar reservoir were observed within the permissible limits of WHO. Hoverer on opening up the catchment area which has resulted in change its land use had better may be coerce of worry in near future if timely conservation strategies as not adopted.

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