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Study on certain physico-chemical parameters of Mahi Bajaj Sagar dam, Banswara, Rajasthan

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Abstract

The present investigation was done in February to April 2018 dealt with the physico-chemical parameters of Mahi Bajaj Sagar Dam, Banswara. The Mahi Bajaj Sagar lies in village Borekhera about 16 Kms. North East of Banswara town and is one of the biggest artificial dam in South Rajasthan having the catchment area of 6149.00 sq.Kms. The morphometric features of the Mahi Bajaj Sagar indicate that it is a deep reservoir with a maximum depth of 75 meters. The physico – chemical qualities were determined using the methods described by APHA. The mean values of the physico – chemical parameters of water qualities analysed are air temperature-32.34°C, water temperature-26.30°C, depth of visibility-240.65cm., pH-8.45, EC-0.42 mS/cm⁻¹, total dissolved solids-273.86, dissolved oxygen-10.21 mg l⁻¹, free CO₂-absent, carbonates-10.86 mg l⁻¹, bicarbonates-50.53 mg l⁻¹, total alkalinity-61.4 mg l⁻¹, nitrate-N-0.20 mg l⁻¹, orthophosphates-0.33 mg l⁻¹. The water quality of Mahi Bajaj Sagar is low polluted. On the basis of physico-chemical characteristics, Mahi Bajaj Sagar is alkaline and moderately hard water body. The water quality parameters indicated the suitability of Mahi Bajaj Sagar for fishery purpose.

Keywords: water quality, physico – chemical, moderately eutrophic, alkaline

1. Introduction

Rajasthan is India's largest state by area (132,139 sq. mile) or 10.4% of India's total area). It is situated on the North Western side of India. Total water resources available for fisheries in the State are 15838 no. of water bodies covering an area of 4,23,765 hectare excluding rivers and canals (30,000 ha.) and water logged area (80,000 ha.) at Full Tank Level (FTL). In addition to it 1,80,000 hectare salt affected area is also available. The present study was carried out during February to April 2018 in Mahi Bajaj Sagar Dam. In Banswara found total number of water bodies is 441. The dam was constructed during 1983 across the River Mahi at borkhera village 16 kilometres northeast of Banswara district. It is the largest reservoir of Rajasthan with water the spread area of 13500 ha.at full reservoir level (FRL). The Mahi Bajaj Sagar Dam is situated in Banswara district of Rajasthan (74° 32'0"E and 23° 37' 0" N). It has a storage capacity of 32.4 million cubic meter. The average of depth of visibility was 240.65cm. There is found the variety of fishes in natural environment. Now it famous for culturing of catfishes and tilapia in cages. Water is an essential component of the environment and all organisms depend on water for their survival (Smitha *et al.*, 2007) [31]. Optimal water quality varies with species and must be monitored to ensure for proper growth and survival. Water quality measures the condition of water relative to the requirements of one or more biotic species. (Johnson *et al.*, 1997) [15]. The changes in physical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, nitrate and orthophosphate provide valuable information on the quality of the water, the source of the variations and their impact on the functions and biodiversity of the reservoir. (Djukic *et al.*, 1994) [8]. The physical and chemical characteristics of water are important parameters as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (Moses, 1983) [19]. Productive water resources depends on a large number of physico-chemical parameters. Assessing and monitoring of these parameters is essential to identify the magnitude and source of any pollution load (Thirupathiah *et al.*, 2012) [35]. Physico-chemical parameters of water play a significant role in the biology and physiology of fish (Dhawan and Kaur, 2002) [7]. The objective of the study was to investigate certain physico-chemical parameters of Mahi Bajaj Sagar and to find out the relationship between different water quality parameters of a reservoir.

2. Materials and Methods

2.1 Sampling stations

Sampling for estimating Physico-chemical parameters was conducted at five fixed stations viz. A was located on the South, B was located Western, station C was located on South

East, station D was located at the North East and station E was selected East of Mahi Bajaj. At each station 6 surface water samples were randomly collected at fifteen days interval up to 3 months. The study period was conducted for 60 days.

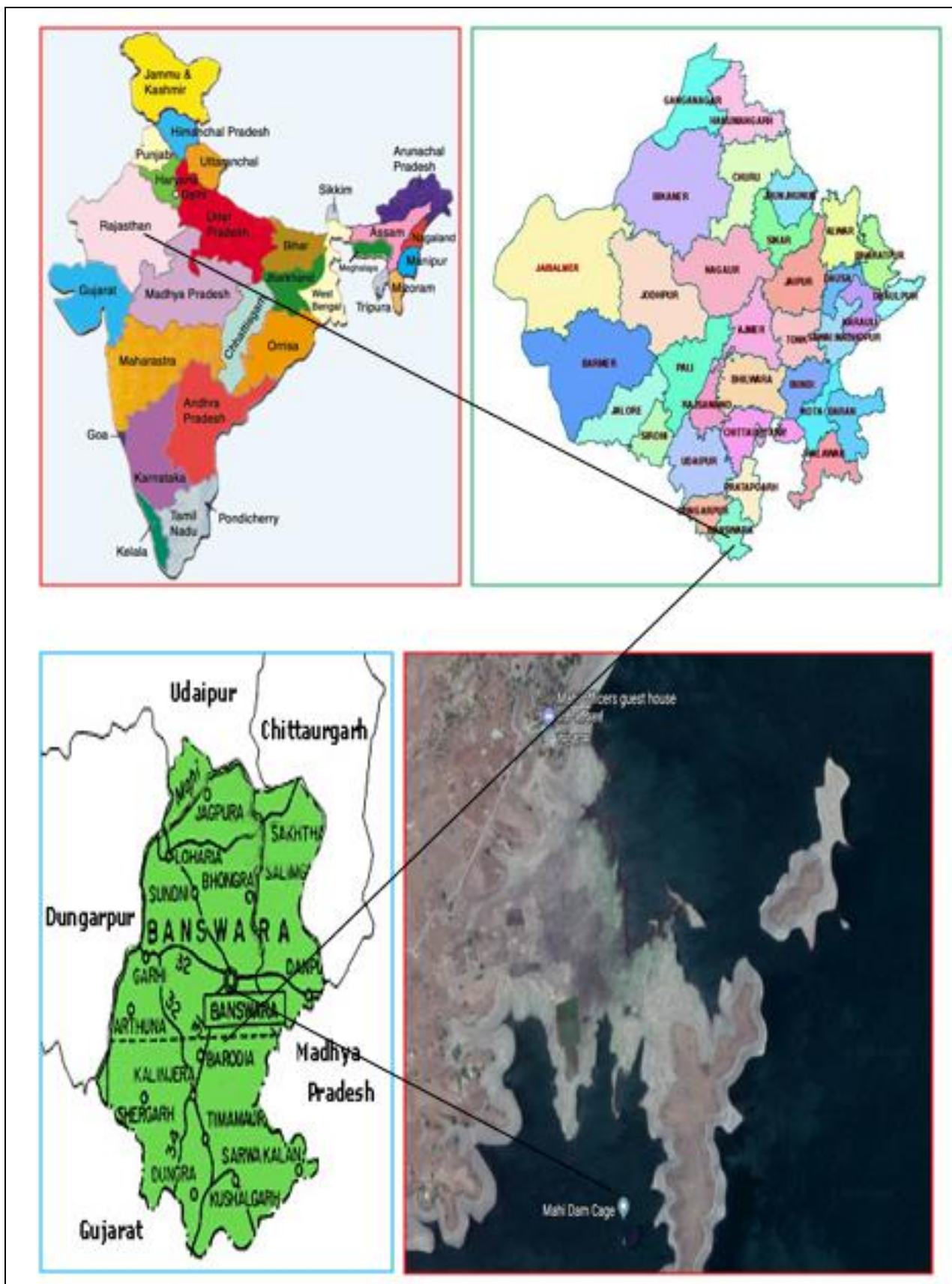


Fig 3.1: Showing Location map of the study area and satellite imagery of Mahi Bajaj Sagar Dam Banswara, Rajasthan

2.2 Sample collection

During the study period, surface water samples were collected using plastic bottles of 1 liter for the analysis of physico-chemical parameters. Then analyzed as soon as possible using the standard method of Trivedy (1987) [36] and APHA (2005) [1].

1. Temperature: Temperature was measured with the thermometer immersed directly in the water body.
2. Depth of visibility: Depth of visibility was determined by using a standard Secchi disc of 20 cm diameter.
3. pH: pH value of water sample is determined by using an electronic digital pH meter.
4. Electrical Conductance: Electrical conductivity was measured with the help of a pen type electronic conductivity meter and results were expressed as mS cm^{-1} .
5. Total dissolved solids (TDS): For the estimation of total dissolved solids in every sample, a factor value 640 was multiplied with the respective value of EC.
6. Dissolved oxygen (DO): The concentration of dissolved oxygen in water was estimated following the basic Winkler's method.
7. Free carbon dioxide: Free carbon dioxide of experimental water was determined by titrating the sample using strong alkali (such as carbonate free NaOH) to pH 8.3.
8. Total alkalinity: The total alkalinity was estimated by titrating the sample with a standard solution of strong acid (H_2SO_4 or HCl). First to pH 8.3 using phenolphthalein as an indicator (carbonate alkalinity) and then further to the second endpoint of pH 4.5 using methyl orange as an indicator (bicarbonate alkalinity).
9. Total Hardness: The estimation of total hardness is based on the fact that Eriochrome black 'T' forms wine red complex compound with metal ions (Ca^{++} and Mg^{++}). The EDTA has got stronger affinity towards Ca^{++} and Mg^{++} . When the solution is titrated by EDTA, the former complex is broken down and a new complex of blue color is formed.
10. Nitrate-nitrogen: This was analyzed using phenol disulphonic acid (PDA) method of APHA (2005).
11. Orthophosphate ($\text{PO}_4 - \text{P}$): The orthophosphate reacts with acidified ammonium molybdate solution and from molybdophosphoric acid, which is then reduced to a blue complex in the presence of stannous chloride. This was measured spectrophotometrically at 690nm.

3. Results and Discussions

The proper balance of water quality of parameters in ponds, lakes and reservoirs is essential for successful production of fish and other aquatic resources (Mustapha and Omotosho, 2005) [20]. Variation in results is found between different sites of the reservoir. However there could be always a chance for a difference in test result in different pre research because of laboratory approach, sample preservation, quality of chemicals used and testing methods applied (Weldemariam, 2013) [39]. Results of the physicochemical parameters obtained from this study are discussed below-

Temperature

Temperature is one of the important physical parameter of water quality to measure because it influences the aquatic life by altering the dissolved oxygen (DO) concentration in the water making oxygen less available for respiration and metabolic activity of aquatic organisms (Tank and Chippa,

2013 [34]; Jalal and Sanalkumar, 2012) [13]. Air temperature during the study period ranged between 30.1°C to 35.1°C at all five stations. The similar range of air and water temperature is commonly found prevailing in and around water bodies of arid and semi-arid regions of Rajasthan (Gupta, 1988 [11]; Sarang, 2001 [25]; Rajkumar, 2005 [24]; and Balai, 2007 [2]). During the present study, water temperature ranged from 24.3 °C to 28.9 °C at all five stations. Sharma *et al.* (2011) [29] observed water temperature of lake Pichhola in range of 18.20 to 33.90 °C during 2005-07. Upadhyay *et al.* (2010) [38] found water temperature between 18.9 to 31.2 °C. Hussain *et al.* (2011) [12] recorded water temperature between 26.0 to 28.0°C in Bellur (V), Ta. Dharmabad, Nanded.

Depth of visibility

The Depth of visibility of water relates to the depth that light will penetrate water. The transmission of light into a body of water is extremely important since the sun is the primary source of energy for all biological processes. In the present investigation, the water clarity values were found within this range (167.64 to 335.28cm.) throughout the study period. Jones and Knowlton (1993) [15] reported reservoir transparencies ranging from 20–470 cm.

pH

pH maintains the acidic or basic property of water bodies. It is a vital characteristic of any aquatic ecosystem since all the biochemical activities and retention of physico-chemical attributes of the water are greatly depending on pH of the surrounding water (Jalal and Sanal Kumar, 2013) [14]. In the present study, the average pH ranged from 8.1 to 8.7 at all the five stations. The pH of Mahi Bajaj Sagar was found to be moderately alkaline which is suitable for supporting fairly good aquatic productivity. Ujjania (2003) [37] also found alkaline water in the three water bodies of southern Rajasthan. Rajkumar (2005) [24] and Balai (2007) [2] found alkaline water in the Daya reservoir and Jaisamand lake of Udaipur (Raj.), respectively. Sumitra *et al.* (2007) [33] reported a pH of 8.3-9.3 in lake Pichhola which is fairly inclined towards an alkaline nature of water.

Electrical conductivity

The electrical conductance (EC) represents total ionic load in water due to dissolved substances and sometimes considered as an index of productivity. In the present study, the electrical conductance of Mahi Bajaj Sagar was found to be range from 0.38 to 0.49 mS cm^{-1} (average EC 0.42 mS cm^{-1}) during the study period. Sharma *et al.* (2008) [29] recorded EC value to range between 0.3 to 0.97 mS cm^{-1} in Udaipur lake. Sharma *et al.* (2011) [30] also reported high electrical conductance during summer season (0.463 mS cm^{-1}) indicating a eutrophic condition of water body in lake Pichhola.

Total dissolved solids

The amount of total dissolved solids (TDS) in water indicates salinity of water and the higher values of total dissolved solids in natural waters are generally due to increased anthropogenic activity, stagnation and concentration of water. During the present study, total dissolved solids (TDS) ranged from 236.8 to 313.6 mg l^{-1} . Chavan *et al.* (1999) [5] reported the TDS values in the range of 5 to 290 mg/l . Pawar *et al.* (2009) [24] recorded TDS values between 186 to 284 mg/l in Paneshewadi dam, Kandhar, Nanded dist.

Dissolved Oxygen

Dissolved oxygen is the most critical water quality variable in an aquatic ecosystem. It is of primary importance both as a regulator of metabolism of plant and animal communities and as an indicator of water condition. During the present study, the dissolved oxygen concentration of lake Pichhola ranged from 8.0 to 12.4 mg l⁻¹. Manjare *et al.* (2010) [18] recorded values of DO fluctuate from 5.09 to 12.78 mg/l in Wadgaon tank, Kolhapur (M. S.). Ghantaloo *et al.* (2011) [10] recorded DO range between 5.6 to 8.3 mg/lit. in Nira left bank canal Sharadnagar, Taluka Baramati.

Alkalinity

Alkalinity expresses the buffering capacity of the water. The main factors responsible for alkalinity are carbonates, bicarbonates, hydroxide ions, organic acid etc. During the present study carbonate alkalinity ranged from 8 to 14 mg l⁻¹. During the present study bicarbonate alkalinity showed fairly good presence which varied from 28 to 68 mg l⁻¹ in Mahi Bajaj Sagar. Lodh *et al.* (2014) [17] reported alkalinity range between 60.68 to 116.9 mg/l at different water bodies of Udaipur (Tripura). Basavaraja *et al.* (2014) [3] reported Total alkalinity range between 40.08 to 61.50 mg/l at Anjanapura reservoir, Karnataka, India.

Total Hardness

Hardness is caused due to the presence of metallic carbonates of Ca⁺², Mg⁺², Fe⁺³ etc. The hardness of water is referred to by three types of measurements: grains per gallon, milligrams per liter (mg/L), or parts per million (ppm). During present study total hardness ranged from 90 to 152 mg l⁻¹. Sathe *et al.* (2001) [26] has reported hardness to vary from 134 to 148 mg/l

and 134 to 1500 mg/l of hardness for Siddhewadi and Ped reservoir of Sangali Dist. Rahane *et al.* (2015) [23] reported total harness mean range between 81.56-151.29 mg/l at Girna, Reservoir in Nasik district. (M.S.).

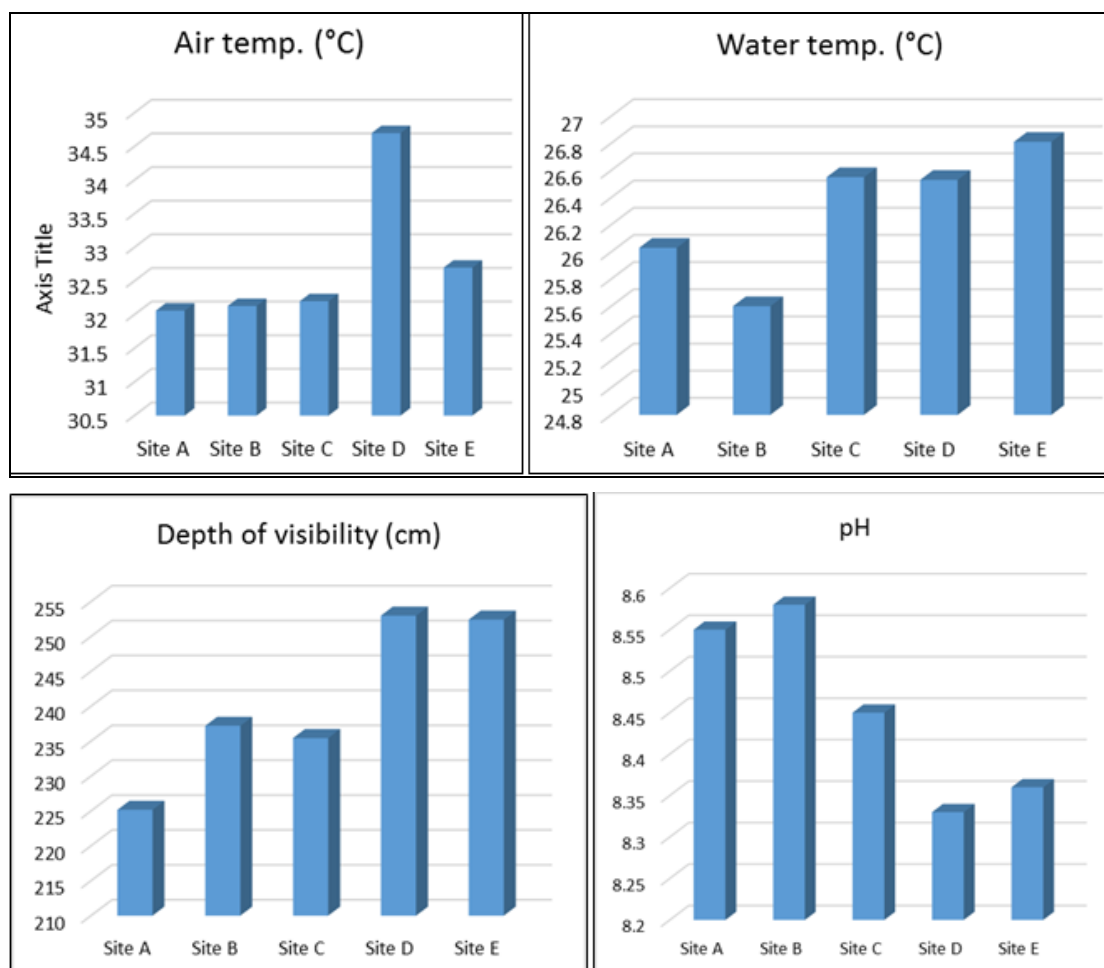
Nitrate-N (NO₃-N)

Inorganic nitrogen that presents in water as Nitrate (NO₃-N) is the main nutrient that accelerates the growth of hydrophytes and algae. Nitrate occurs in water from various natural sources and due to human activities like food production, agriculture and disposal of domestic and industrial sewage. In the present study in Mahi Bajaj Sagar, the value of nitrate-nitrogen varied from 0.07 to 0.33 mg l⁻¹. These values of nitrate were comparable to those reported by Sharma (1980) [27], Nasar and Kaur (1982) [21], Sharma and Gupta (1994) [28], Bharadwaj and Sharma (1999) [4], Das (2000) [6], Dwivedi *et al.* (2000) [9], Sultan *et al.* (2003) [32].

Orthophosphate (PO₄)

Phosphorus is generally recognized as a key nutrient in deciding the fertility of a water body. It frequently limits plant production and ultimately influences fish production. Too much phosphorus is sometimes responsible for the excessive production of blue-green algae or other nuisance plant species in an aquatic body. In the present study, dissolved phosphate concentrations ranged between 0.19 to 0.55 mg l⁻¹. Dwivedi *et al.* (2000) [11] observed phosphate from 0.20 to 0.55 ppm in Naktara reservoir, (M.P.) India. Sultan *et al.* (2003) found nutrients in the form of orthophosphate ranging between 0.07 to 0.50 mg l⁻¹ at Pahunj reservoir, Uttar Pradesh.

Fortnightly average of physico-chemical parameters at all stations



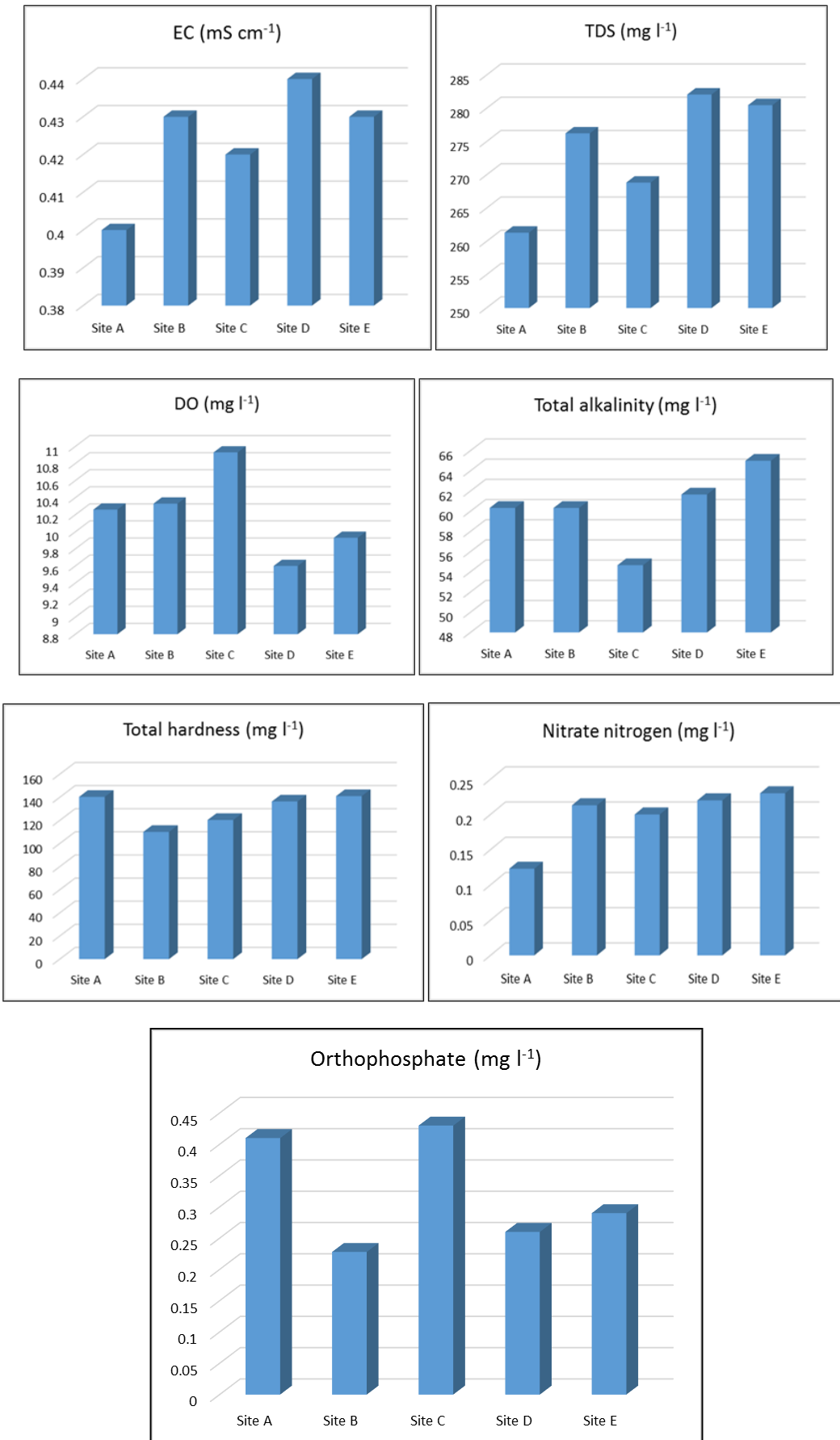


Fig: All figure X axis is denoted stations and Y axis is reading of parameters

Table 1.1: Standard deviation, minimum- maximum range and mean value amongst different stations surface water parameters of Mahi Bajaj Sagar dam Banswara, rajasthan.

Parameters	Air temp (°C)	water temp (°C)	depth of visi (cm)	pH	EC (mS/cm)	TDS (mg l ⁻¹)	DO (mg l ⁻¹)	CO ₂	CO ₃ (mg l ⁻¹)	HCO ₃ (mg l ⁻¹)	Total alkali (mg l ⁻¹)	Hardness (mg l ⁻¹)	Nitrate-N (mg l ⁻¹)	Orthophosphate (mg l ⁻¹)
1	30.62	24.78	313.818	8.3	0.39	254.04	11.68	0	8.0	58.4	66.4	134.4	0.194	0.302
2	31.12	25.24	313.154	8.38	0.40	261.12	11.44	0	11.2	38.8	50.0	118.4	0.21	0.248
3	31.92	25.84	247.978	8.54	0.40	254.84	10.56	0	10.4	44.0	54.4	132.4	0.176	0.314
4	32.52	26.52	196.706	8.66	0.43	280.4	9.92	0	12.4	58.4	70.8	135.2	0.192	0.368
5	33.26	27.24	193.714	8.48	0.45	290.56	9.28	0	11.2	52	63.2	130	0.208	0.35
6	34.62	28.22	178.552	8.38	0.46	296.96	8.4	0	12	51.6	63.6	146.4	0.22	0.398
MEAN	32.34	26.30	240.6	8.456	0.42	273.82	10.21	0	10.86	50.53	61.4	132.8	0.2	0.33
MINI	30.62	24.78	178.552	8.3	0.39	254.04	8.4	0	8.0	38.8	50.0	118.4	0.176	0.248
MAXI	34.62	28.22	313.818	8.66	0.46	296.96	11.68	0	12.4	58.4	70.8	146.4	0.22	0.398
SD	1.462897	1.285592	61.08078	0.130486	0.011662	17.9274	1.266596	0	1.568014	7.841088	7.751129	9.040354	0.015748	0.0533

Table 1.2: Correlation matrix amongst physico-chemical and microbial parameters of Mahi Bajaj Sagar, Banswara.

Parameter	Air temp	Water temp	Depth of visibility	pH	EC	TDS	DO	CO ₂	CO ₃	HCO ₃	Total Alkalinity	hardness	NO ₃ -N	PO ₄
Air temp	1													
Water temp	.998**	1												
Depth of visibility	-.918**	-.928**	1											
pH	.221	.239	-.544	1										
EC	.957**	.973**	-.909*	.222	1									
TDS	.951**	.968**	-.910*	.245	.999**	1								
DO	-.994**	-.996*	.952**	-.287	-.965**	-.960**	1							
CO ₂	-							1						
CO ₃	.688	.699	-.715	.603	.694	.718	-.682	-	1					
HCO ₃	.152	.171	-.336	.132	.257	.264	-.216	-	-.157	1				
Total Alkalinity	.293	.315	-.484	.255	.400	.413	-.357	-	.043	.980**	1			
Hardness	.663	.637	-.633	.034	.553	.544	-.667	-	.126	.602	.635	1		
NO ₃ -N	.518	.531	-.240	-.467	.616	.617	-.464	-	.363	-.061	.012	.121	1	
PO ₄	.859*	.859*	-.917*	.354	.833*	.832*	-.889*	-	.484	.596	.701	.872*	.226	1

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

4. Conclusions

1. This study has provided information on about the water quality status of Mahi Bajaj Sagar and its suitability for fish production and uses. The study revealed that most of the physico – chemical parameters were within the observed ranges in unpolluted water bodies and also were found to be within tolerable limit for high yield for fish production.
2. The present investigation clearly shows that water body found relatively moderate levels of nutrients. So That these can be placed under the category of ‘moderately eutrophic’ water.
3. On the basis of physico-chemical characteristics, Mahi Bajaj Sagar is alkaline and moderately hard water body.
4. The water quality parameters indicated that the suitability for culture based fisheries at Mahi Bajaj Sagar.

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