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Hydrobiological Studies on Freshwater Reservoir of Tandula Dam of District Balod (C.G.) India

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Abstract: ***Water quality has become a major concern due to ever increasing human developmental activities that over exploit and pollute the water resources. The physico-chemical parameters like pH, EC, DO, BOD, alkalinity, hardness, calcium and magnesium were analyzed during monsoon and post-monsoon season. A study on physical, chemical and biological characters of River water and its suitability for drinking purpose was carried out of reservoir water of Balod, Chhattisgarh. The results of the present study have been discussed it is clear that the water is not highly polluted, but the variations in physico-chemical parameters were observed as seasonally. The recorded range of physico-chemical parameters were within the maximum permissible limit.***

Keywords: Physico-chemical parameters; Reservoir; Seasonal variations

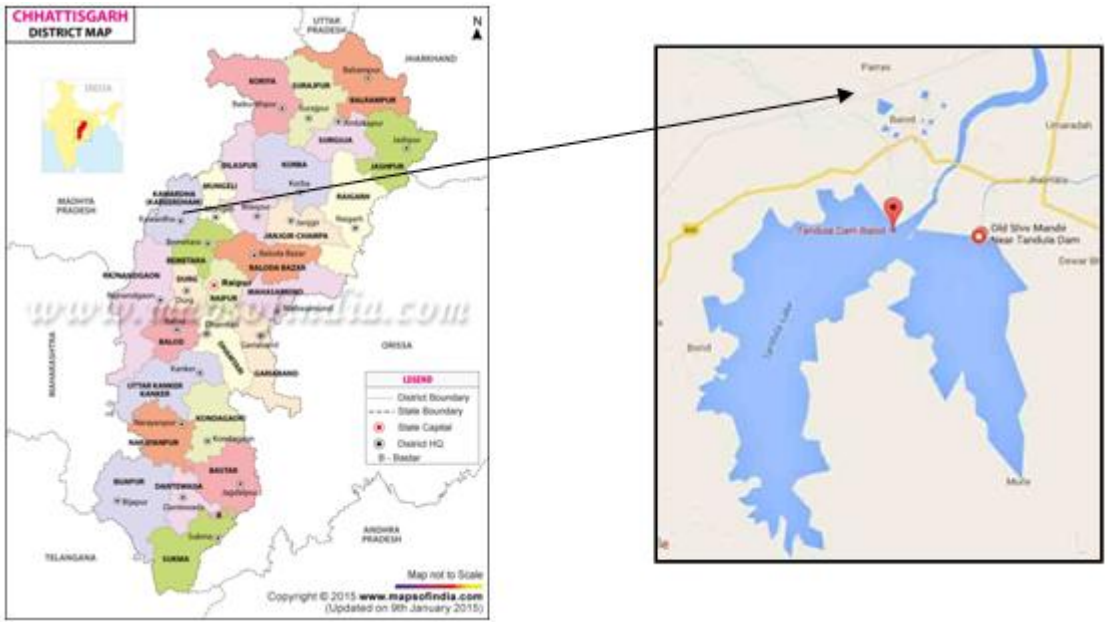
1. Introduction

Water is the base of life and development. The wetland forms unique biological fresh water ecosystem on the planet earth. These water bodies store the freshwater from adjoining are during rainy season. It plays an important role in any ecosystem, hydrology of area and economy. They provide the habitats for migratory birds, aquaculture, plants, animals and microbes. Water is one of the major components of environmental resources (Efe, 2002). Freshwater is a natural home of innumerable living things, many of them harmless or even beneficial, some of them directly or indirectly injurious to man. The environmental pollution affects the general quality of our health (Parimala *et al.* 1994). Several studies have been made on the limnology of freshwater bodies in India (Naganandi *et al.*, 1998, Pandey *et al.*, 2000 and Bhadja and Vaghela, 2013). Water resources in India have reached a point of crisis due to unplanned urbanization and industrialization (Pathak and Dwivedi 2007). Urbanization has directly negative impacts on water bodies. Therefore now a days freshwater has become a scare commodity due to over exploitation and pollution (Bhadja and Vaghela, 2013). River water is one of the most important and widely distributed natural resources which are considered as supplemental resource to meet the domestic, agriculture and industrial requirements. The present work is aimed in assessing the reservoir water quality with respect to drinking purpose.

2. Materials and Methods

Study area

BALOD: Tandula Dam is located in Chhattisgarh in India. It is located 5 km away from headquarter of Balod district. The dam project was completed in 1921 in the confluence of Tandula and Sukha Nala rivers. The dam stores water from catchment area of 827.2 km^2. The gross storage capacity of the reservoir is 312.25 million cubic metres and the highest flood level is 333.415 m. The district Balod is famous for Prachin Kila (Oldest Palace), Mandir (Tamples) & Sati Chabutra.



Map 1: Location map of Chhattisgarh and study area of Tandula dam

Collection of water

The present study deals with few physical and chemical parameters of the water to check the present status of water quality of sampling site. The study was conducted during January 2013 to December 2014. For water sample collection plastic sample bottles having capacity of one liter were filled without disturbing the substratum to avoid the loose sediments in sample. Samples were collected from surface (1-2 cm). After collection of samples, these bottles were labeled and possible efforts were made to transport them to the laboratory as earlier as possible. The samples for DO and BOD analysis were collected from surface from the Sampling site in separate BOD bottles. Two such bottles were used for each sample. One was fixed on the spot immediately after the collection following Winkler method (Trivedi and Goel, 1986), and the second bottle containing water was kept in darkness at 4ºC (in iceboxes) till it reached the laboratory. Water analysis methods Physical and chemical analysis of the samples was done according to Standard Methods as per APHA, 1998, 2005 and Trivedi and Goel 1986. The values obtained were compared with standards prescribed by WHO, 1992 and BIS, 1991. Few parameters such as temperature, pH and Electric Conductivity were recorded on the site by their respective probes. Chemical parameters such as Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Total Solid, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Hardness, Calcium, Magnesium and Free CO_2 were then dealt in the laboratory. The following table reveals the parameters, their units and the methods used for their analysis.

3. Results and Discussion

The results of physic-chemical analysis of three freshwater reservoirs for different seasons are given in Tables 1, 2, and 3. The data presented are discussed on the basis of three seasons. The temperature of water varied between 21.6ºC and 23.7ºC at the sampling site S_1. At the sampling site S_2 it ranged between 21.65ºC and 23.55ºC and at sampling site S_3 ranged between 21.85ºC and 23.80ºC. In all the three sampling locations high temperature was recorded during summer season and lower temperature recorded during winter season, which is a normal feature in freshwater reservoirs. The water temperature is one of the most important physical characteristics of aquatic ecosystem, as it affects the organisms (Bhadja and Vaghela, 2013). It affects a number of water quality parameters that is one of the concerns for domestic, environmental, industrial and agricultural applications (Parashar *et al.* 2007). The lowest pH values were recorded during monsoon season, which implies the influence of run-off water entering into the water bodies. The desirable limit of pH recommended by drinking water specification Indian Standard – IS 10500: 1991 is 6.5–8.5 (BIS, 1991).

The average pH value at Site S_1 was 8.10 whereas at Site S_2 and Site S_3 it was 8.14 and 8.22 respectively. The total solids at sampling site S_1 ranged between 476 and 564.5 mg/l and the values at Site S_2 ranged between 473 and 643 mg/l, while at the sampling site S_3 it ranged from 607 to 687 mg/l. Maximum values of total solids were recorded during monsoon season at all the sampling locations. Run-off water, which carries dissolved solids and also organic wastes from garbage dumping, contributes to higher total solids (Chennakrishanan *et al.* 2008).

Table 1: Physico-chemical parameters of site S_1.

S.No.	*Parameters*	*Monsoon*	*Winter*	*Summer*	*SD*
1.	Temperature (°C)	23.2	21.6	23.7	±1.097
2.	pH	7.955	8.14	8.215	±0.13
3.	Total Solid (mg/l)	564.5	484	476	±48.95
4.	Total Dissolved Solid (mg/L)	535.5	454	439	±51.93
5.	Total Suspense Solid (mg/L)	29	30	37	±4.36
6.	Electric Conductivity (µs/cm)	631.5	584	590.5	±25.75
7.	Dissolved Oxygen (mg/L)	7.055	6.985	6.125	±0.52
8.	BOD (mg/L)	2.87	2.715	2.835	±0.08
9.	Total hardness (mg/L)	242	258	221	±18.56
10.	Calcium (mg/L)	36.535	39	33.58	±2.71
11.	Magnesium (mg/L)	35.625	39	31.595	±3.71
12.	Free CO_2 (mg/L)	11.5	14.5	14.5	±1.73

Table 2: Physico-chemical parameters of site S_2.

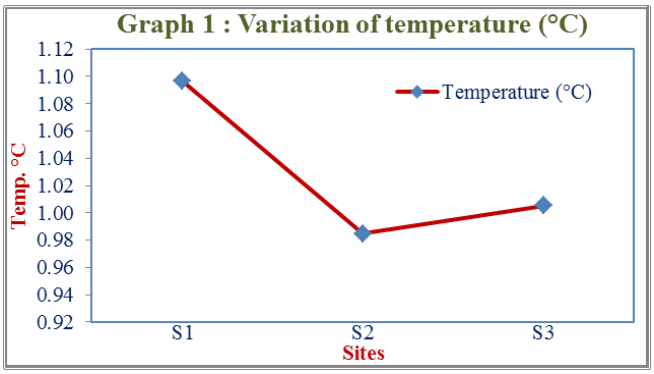
S.No.	**Parameters**	**Monsoon**	**Winter**	**Summer**	**SD**
1.	Temperature (°C)	23.05	21.65	23.55	±0.985
2.	pH	7.975	8.15	8.285	±0.16
3.	Total Solid (mg/l)	646	473	510	±91.10
4.	Total Dissolved Solid (mg/L)	614	444.5	485	±88.52
5.	Total Suspense Solid (mg/L)	32	28.5	25	±3.50
6.	Electric Conductivity (µs/cm)	799.5	764.5	747.5	±26.51
7.	Dissolved Oxygen (mg/L)	6.265	6.155	5.995	±0.14
8.	BOD (mg/L)	3.52	3.62	3.92	±0.21
9.	Total hardness (mg/L)	251	231.5	237	±10.05
10.	Calcium (mg/L)	42.725	35.63	35.67	±4.08
11.	Magnesium (mg/L)	41.09	36.94	34.35	±3.40
12.	Free CO_2 (mg/L)	18	17.5	14	±2.18

Table 3: Physico-chemical parameters of site S_3

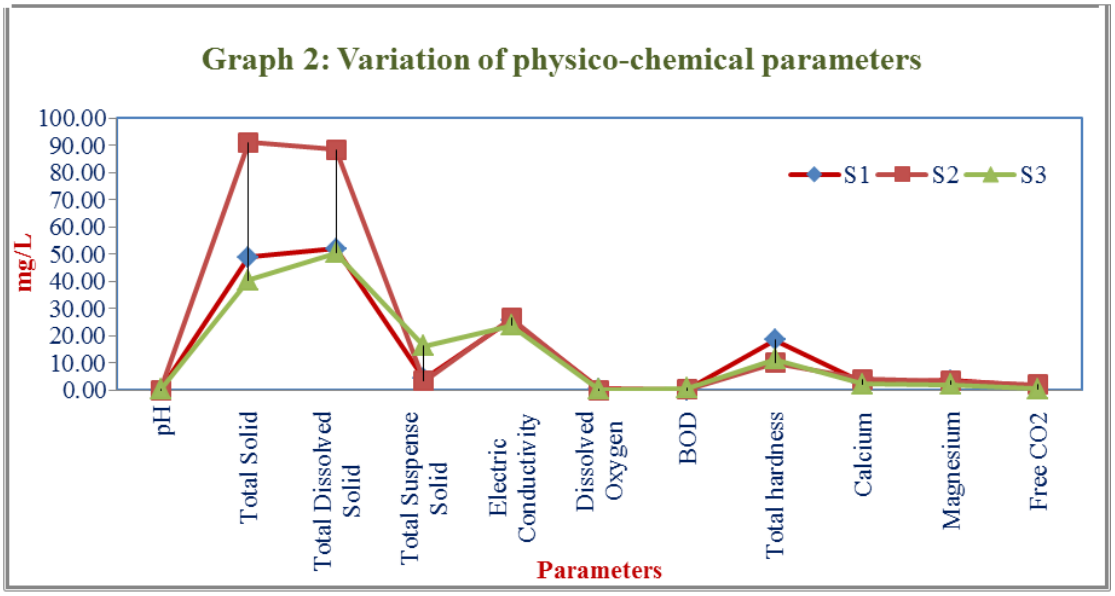
S.No.	*Parameters*	*Monsoon*	*Winter*	*Summer*	*SD*
1.	Temperature (°C)	23.25	21.85	23.8	±1.01
2.	pH	8.1	8.055	8.515	±0.25
3.	Total Solid (mg/l)	687	658	607	±40.50
4.	Total Dissolved Solid (mg/L)	607	599	516	±50.39
5.	Total Suspense Solid (mg/L)	80	59	91	±16.26
6.	Electric Conductivity (µs/cm)	832.5	785.5	816	±23.84
7.	Dissolved Oxygen (mg/L)	6.625	6.96	7.095	±0.24
8.	BOD (mg/L)	3.95	4.995	5.135	±0.65
9.	Total hardness (mg/L)	261	243.5	265	±11.43
10.	Calcium (mg/L)	43.885	43.255	47.46	±2.27
11.	Magnesium (mg/L)	44.4	41.08	44.83	±2.05
12.	Free CO_2 (mg/L)	16	15.5	15	±0.50

The total dissolved solids at the Site S_1 varied between 439 and 535.5 mg/l and at Site S_2 ranged between 444.5 and 614 mg/l. At the sampling site S_3 it was ranged between 516 to 607 mg/l. Maximum values of total dissolved solids were recorded during monsoon season at all the sampling sites.

The desirable level of total dissolved solids is 500 mg/l, presence of excess total dissolved solids may cause gastrointestinal irritation when consumed (Chennakrishanan *et al.* 2008). It elevates the density of water and reduces solubility of oxygen that may prove lethal to aquatic life. The total suspended solids were ranged between 29 and 30 mg/l at sampling site S_1, at the Site S_2 it was ranged between 25 and 32 mg/l. It was ranged between 59 and 91 mg/l at the sampling site S_3 (Table 3). The concentration was high during monsoon season, which may be due to addition of solids from runoff water to the reservoir (Bhadja and Vaghela, 2013).



The electrical conductivity of the water samples ranged between 584 and 832.5 µS/cm throughout the study period at all the sampling sites. Water of higher conductivity may be used with suitable amendments and precautions, but under normal conditions they are harmful to the soil structure and their continuous use will result in salinity hazard, with ultimate effect on plant growth (Dutta and Chowhan, 2009). There is currently no official guideline as to what is considered safe level for conductivity (Karikari *et al.* 2007). However, the conductivity of most freshwaters ranged from 10 to 1000 S/cm, but many exceed 1000 S/cm. especially in polluted waters, or those receiving large quantities of land run-off (Bhadja and Vaghela 2013 and Chapman, 1992).



The dissolved oxygen is an important aquatic environmental factor, which influences the health of an aquatic ecosystem. The higher value of dissolved oxygen may be due to the influence of run-off water from monsoon rain (Chennakrishanan *et al.* 2008). The recorded dissolved oxygen range was within the maximum permissible limit (WHO, 1984). It was found that higher dissolved oxygen values were observed in monsoon may be due to higher water temperature, higher biological oxygen demand on account of decomposition of organic detritus during this period. It revealed that the quality of water at the residential areas was found to be safe and could be used for domestic purpose and without any treatment (Sathya and Shankar, 2009). Biological oxygen demand is the measure of quantity of oxygen required by bacteria and other microorganisms under aerobic condition in order to biochemically degrade and transform organic matter present in the water bodies (Bhadja and Vaghela, 2013).

The total hardness values at Site S_1 ranged between 221 and 258 mg/l, whereas at Site S_2 it was 231.5 and 251 mg/l and at the sampling site S_3 it was 243.5 and 265 mg/l. Total hardness of water is due to the concentration of salts. In particular, it is due to the concentration of multivalent metallic ions of calcium and magnesium. The desirable limit of total hardness is 300 mg/l. Hardness has no known adverse effects on health; however some evidences have been given to indicate its role in heart diseases (Peter, 1974). Calcium and magnesium are common constituents of natural water and important contributor to the hardness of water. The calcium concentration in water samples ranged from 45.0 mg/l to 62.4 mg/l. and in case of magnesium, it was ranged between 35.63 mg/l and 42.72 mg/l at Site S_2. The

results revealed that various physico-chemical variables were well within acceptable limits of water quality (Boyd, 1988). Perona *et al.* 1999 suggested that if physico-chemical variables did not show wide range of variation which is due to the closely associated with the lithological composition of the river basin. The physical and chemical characteristics of water showed seasonal fluctuations interacting with one another and have a combined effect on animals and plants (Odum, 1971). Factors controlling the composition of natural waters are extremely varied and include physical, chemical and biological processes (Boyd, 1981).

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