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Hydrobiological studies on freshwater reservoir of Malhaniya dam, Pendra Road Bilaspur (CG)

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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 dam and its suitability for drinking purpose was carried out of water of Pendra Road Bilaspur. 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; dam; seasonal variations, malhaniya dam

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 (Efa, 2002) [1]. 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) [2]. Several studies have been made on the limnology of freshwater bodies in India (Naganandi and Hosamani, 1998, Pandey, *et al.* 2000 and Bhadja and Vaghela, 2013) [3-5]. Water resources in India have reached a point of crisis due to unplanned urbanization and industrialization (Pathak and Dwivedi, 2007) [6]. 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) [5]. 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. Material and methods
2.1 Study area
The present aquatic body "Malhaniya dam" was constructed in the year 2002 on local nala of Dewargaon of Pendra road district Bilaspur. It is situated 22°-45'-20" latitude and 81°-96'-36" longitude. The height of the dam is 21.8 mt. and length 2700 mts. Mainly the water of this dam is used for irrigation and fish culturing. Hence, it has been thought worthwhile to investigate the Hydrobiological Characteristic of Malhaniya Dam with Special Reference to Fish Fauna.

2.2 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 2014 to December 2015. For water sample collection plastic sample bottles having capacity of one liter we 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) [7], and the second bottle containing water was kept in darkness at 4 ºC (in iceboxes) till it reached the laboratory.

2.3 Water analysis methods
Physical and chemical analysis of the samples was done according to Standard Methods as per APHA (1998 & 2005) [8, 9] and Trivedi and Goel (1986) [7]. The values obtained were compared with standards prescribed by WHO (1992) [10] and BIS (1991) [11]. 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.

Table 1: Physico-chemical parameters of site – I.

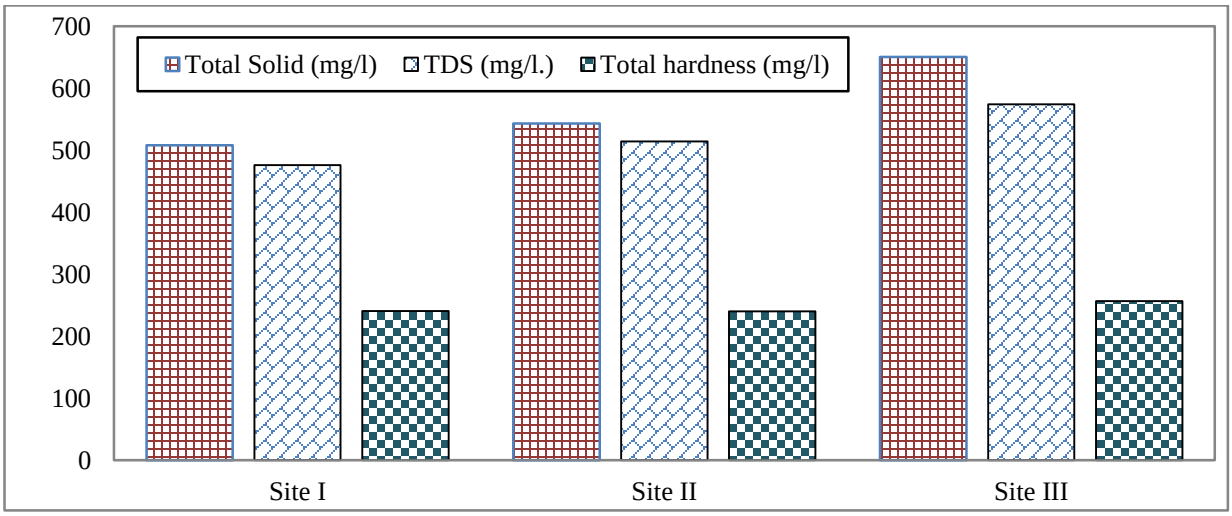
S. No.	Parameters	Monsoon	Winter	Summer	Mean	SD
1.	Temp°C	23.1	21.7	23.6	22.83	1.097
2.	pH	7.955	8.14	8.215	8.10	0.134
3.	Total Solid (mg/l)	564.5	484	476	508.17	48.950
4.	TDS (mg/l.)	535.5	454	439	476.17	51.929
5.	Total Suspense Solid (mg/l)	29	30	37	32.00	4.359
6.	Electric Conductivity (µs/cm)	631.5	584	590.5	602.00	25.754
7.	Dissolved oxygen (mg/l)	7.055	6.985	6.125	6.72	0.518
8.	BOD (mg/l)	2.87	2.715	2.835	2.81	0.081
9.	Total hardness (mg/l)	242	258	221	240.33	18.556
10.	Calcium (mg/l)	36.535	39	33.58	36.37	2.714
11.	Magnesium (mg/l)	35.625	39	31.595	35.41	3.707
12	Free CO_2 (mg/l)	11.5	14.5	14.5	13.50	1.732

Table 2: Physico-chemical parameters of site – II.

S. No.	Parameters	Monsoon	Winter	Summer	Mean	SD
1.	Temp°C	23.06	21.66	23.54	22.75	0.985
2.	pH	7.975	8.15	8.285	8.14	0.155
3.	Total Solid (mg/l)	646	473	510.	543.00	91.099
4.	TDS (mg/l.)	614	444.5	485	514.50	88.517
5.	Total Suspense Solid (mg/l)	32	28.5	25	28.50	3.500
6.	Electric Conductivity (µs/cm)	799	764.5	747.5	770.33	26.241
7.	Dissolved oxygen (mg/l)	6.265	6.155	5.995	6.14	0.136
8.	BOD (mg/l)	3.52	3.62	3.92	3.69	0.208
9.	Total hardness (mg/l)	251	231.5	237	239.83	10.054
10.	Calcium (mg/l)	42.725	35.63	35.67	38.01	4.085
11.	Magnesium (mg/l)	41.09	36.94	34.35	37.46	3.400
12	Free CO_2 (mg/l)	18	17.5	14	16.50	2.179

Table 3: Physico-chemical parameters of site – III.

S. No.	Parameters	Monsoon	Winter	Summer	Mean	SD
1.	Temp°C	23.24	21.84	23.81	22.97	1.005
2.	pH	8.1	8.055	8.515	8.22	0.254
3.	Total Solid (mg/l)	687	658	607	650.67	40.501
4.	TDS (mg/l.)	607	599	516	574.00	50.388
5.	Total Suspense Solid (mg/l)	80	59	91	76.67	16.258
6.	Electric Conductivity (µs/cm)	832.5	785.5	816	811.33	23.845
7.	Dissolved oxygen (mg/l)	6.625	6.96	7.095	6.89	0.242
8.	BOD (mg/l)	3.95	4.995	5.135	4.69	0.648
9.	Total hardness (mg/l)	261	243.5	265	256.50	11.435
10.	Calcium (mg/l)	43.885	43.255	47.46	44.87	2.268
11.	Magnesium (mg/l)	44.4	41.08	44.83	43.44	2.052
12	Free CO_2 (mg/l)	16	15.5	15	15.50	0.500



Graph 1: Graphics analysis of average physico-chemical parameters of Malhaniya dam

The temperature of water varied between 21.7 ºC and 23.6 ºC at the sampling site site I. At the sampling site site II it ranged between 21.66 ºC and 23.54 ºC and at sampling site site III ranged between 21.84 ºC and 23.81 ºC. 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) [5]. 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) [12]. 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 1 0500: 1 991 is 6.5–8.5 (BIS, 1991) [11]. The average pH value at site I was 8.10 whereas at site II and site III it was 8.14 and 8.22 respectively. The total solids at sampling site site I ranged between 476 and 564.5 mg/l and the values at site II ranged between 473 and 643 mg/l, while at the sampling site III 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) [13]. The total dissolved solids at the site I varied between 439 and 535.5 mg/l and at site II ranged between 444.5 and 61 4 mg/l. At the sampling site III it was ranged between 51 6 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) [13]. It elevates the density of water and reduces solubility of oxygen that may prove lethal to aquatic life (Bhadja and Vaghela 2013) [5]. The total suspended solids were ranged between 29 and 30 mg/l at sampling site site I, at the site II it was ranged between 25 and 32 mg/l. It was ranged between 59 and 91 mg/l at the sampling site III (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) [5].

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) [14]. There is currently no official guideline as to what is considered safe level for conductivity (Karikari, *et al.* 2007) [15]. However, the conductivity of most freshwaters ranged from 1 0 to 1 000 S/cm, but many exceed 1 000 S/cm. especially in polluted waters, or those receiving large quantities of land run-off (Bhadja and Vaghela 2013 and Chapman, 1992) [5, 16].

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) [13]. The recorded dissolved oxygen range was within the maximum permissible limit (WHO, 1984) [17]. 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, *et al.* 2009) [18]. 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) [5].

The total hardness values at site I ranged between 221 and 258 mg/l, whereas at site II it was 231.5 and 251 mg/l and at the sampling site III 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) [19]. 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 II. The results revealed that various physico-chemical variables were well within acceptable limits of water quality (Boyd and Tucker, 1998) [20]. Perona *et al.* (1999) [21] 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) [22]. Factors controlling the composition of natural waters are extremely varied and include physical, chemical and biological processes (Boyd, 1981) [23].

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