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Assessment of seasonal variations of water quality parameters of Gurma Bundh, Hanumana, Rewa (M.P.), India

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Abstract:
The present study assessed the seasonal variations of the selected water quality parameters of Gurma Bundh, Hanumana, Rewa (M.P.), India from July 2005 to June 2006. The Bundh water is mainly used for irrigation and fish culture. The range of the water quality parameters were observed to have a seasonal variation for depth (7.72 to 28.8 m), temperature (19.3-27.1°C), transparency (132.1-213.2 cm), pH (7.85-8.12), conductivity (130.7-261.7 µmhos/cm), dissolved O_2 (7.02-9.57 mg/l), BOD (2.32-3.9), COD (28.25-64.50), total alkalinity (69.2-82.5 mg/l), total solids (379.7-907.7 mg/l), Ca hardness (48.47-55.57 mg/l), Mg hardness (16.07-30.12 mg/l), total hardness (64.54-85.69 mg/l), chloride content (18.37-26.00 mg/l) and phosphate content (0.11-0.17 mg/l). The observed water quality parameters of water samples were compared from standard values. The present study clearly evidenced that Gurma Bundh is suitable for irrigation and fish culture. It is suggested that regular monitoring of Bundh water quality is parameters necessary for proper management.
Keywords: Water quality, Gurma Bundh, Seasonal variations.

Introduction:
A large number of bundhs or reservoirs have come into existence in our country after independence as a part of developmental activities such as irrigation, power generation, flood control and fish culture etc. Reservoir is a unique man made water body by constructing a bundh or dam across river where fluviatile and lentic conditions co-exist along with certain unique peculiarities of their own. The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem and suitability for human use. The water of the dam should fulfill the quality required for human use as well as for the sustainability of the ecology.
Various workers realized that some physico-chemical and biological factors may work as limiting factors. Gerasimov (1983) noticed that due to rapid industrialization and technical progress there has constantly increase in the possibilities of negative influence on the biosphere and created many new grounds for the occurrence of major ecological problems. Although the notable contributions on the water of Indian lakes, reservoirs and rivers are gradually increasing as made by Sreenivasan (1964 b), Kaul (1977), Yadav *et al.* (1987), Mishra and Trivedy (1993), Chavan *et al.* (2004), Mustapha (2008), Shinde *et al.* (2010), Saxena and Saxena (2012), Maurya *et al.* (2012), Lianthuamluaia *et al.* (2013), Tanwar (2014) and Ojha *et al.* (2015). Gurma Bundh is made on Gurma river in 1969 by the Govt. of Madhya Pradesh. The catchment area of this bundh is about 140.64 sq km. It occupies second rank in view of its size in Madhya Pradesh. The assessment of the seasonal variation of water quality parameters of the bundh is the first and foremost task for the scientific management of dam and to find out the suitability of the water for multipurpose.

Material and Methods:
The Gurma Bundh is located in the Mauganj tehsil of District Rewa between 24°43'13" N latitude and 82°2'53" E longitude. It is surrounded by U.P. in east and north, Sidhi district in south and Rewa city in west side. It lies at the elevation of about 350 mt above MSL. It is mostly hilly, rocky and covered with thin shrubby forest.
Water samples were collected monthly for a period of 1 year from July 2005 to June 2006 to cover three seasons i.e. Rainy (July-October), winter (November-February) and summer (March-June). The water samples were collected from five stations namely station A, station B, station C, station D and station E. Water was collected from 0.5 meter depth from each station with 2 liter plastic bottle. The samples were brought immediately to the laboratory for analysis. Depth, temperature, transparency and pH were measured in situ, using nylon rope, mercury-in-glass thermometer, Secchi disc and portable pH meter (Eutech, Malasia), respectively. The conductivity was measured using EUTECHECCON 603 K conductivity meter. Dissolved oxygen, BOD, COD, total alkalinity, total solids, Ca hardness, Mg hardness, total hardness, chloride content and phosphate content were analyzed using standard methods of APHA (2005).

Results and Discussion:
The average depth of Gurma bundh varied between 7.72 meter (summer) to 28.8 meter (rainy) during July 2005 to June 2006. Jhingran (1991) reported that 2 meters depth is fairly congenital for biological productivity. Lewis (1973) reported that thermal stratification of water contributes significantly in controlling the metabolic characteristics of ponds and lakes in both temperate and tropical regions. In the present study, the surface water temperature ranged between the lowest value of 19.3°C (winter) and highest of 27.1°C (summer). Low temperature recorded in winter was due to lesser solar radiation and low atmospheric temperature. Similar pattern of temperature fluctuation was also reported by Jayabhaye (2013) and Lianthuamluaia *et al.* (2013). Bhatnagar *et al.* (2004) suggested the levels of temperature as 28-32°C good for tropical major carps. According to Santhosh and Singh (2007) suitable water temperature for carp culture is between 24 and 30°C. The desirable water temperature of the bundh was noted below 24°C only in winter season.
Transparency is an important limiting factor for growth and distribution of organisms inhibiting in a water body. The average range of transparency of Gurma bundh varied between 132.1 cm (rainy) to 213.2 cm (summer). Welch (1952) also reported the low transparency during monsoon months. The low transparency during rainy season is due to water inflow from vast inland area, which is loaded with silt as well as influence of soil particles. The maximum transparency during summer season may be due to low water level and high intensity of bright light. Sawant and Chavan (2013) reported the range of transparency between 32.5 cm to 62 cm from Mahagaon reservoir, Maharasthra.
Natural water may be acidic, alkaline or neutral. Acid water with pH below 6.0 are much less productive than alkaline water. The water of Gurma bundh is slightly alkaline in nature. The mean values of pH of Gurma bundh varied between 7.85 (rainy) to 8.12 (summer). Verma (1967) has recorded similar results for Budhawari tank of Seoni. Jadhav *et al.* (2013) reported the range of pH between 7.15 to 7.98 in Nirmal lake of Maharashtra. They also observed higher pH during summer months and lower during rainy months. The pH of Gurma bundh was within desirable limit of WHO (6.5-9.2) and BIS (6.5-8.5) water quality standards.

Conductivity reflects the amount of total soluble salts in water. It is related to nature and concentration of ionised substances present in water. The mean values of conductivity of Gurma Bundh varied between 130.7 µmhos/cm (rainy) to 261.7 µmhos/cm (summer). Bhumbla and Abral (1972) reported that a conductivity level of less than 2000 µmhos/cm is considered as suitable for irrigation. ICMR (1975) reported the permissible limits of conductivity of water upto 300 µmhos/cm. During present study, the conductivity of Bundh water was observed below permissible standards of BIS (300 µmhos/cm). The amount of oxygen dissolved in natural water is an unavoidable and extremely significant factor and it always acts as a limiting factor. The average value of DO of Gurma bundh varied between 7.02 mg/l (summer) to 9.57 mg/l (winter). Banatwala *et al.* (2004) also reported the higher values of DO in winter season and lesser in summer season. According to Bhatnagar and Singh (2010) DO level 7.5 ppm is essential to support good fish production. Lianthuamluaia *et al.* (2013) reported the range of DO between 6.4 mg/l to 9.47 mg/l in Savitri reservoir of Maharashtra.

BOD is one of the most important indicator of the pollution and quality of water. WHO reported the minimum limit of pollution is indicated by a BOD of 6 mg/l. BOD of Gurma bundh ranged between 2.32 mg/l (winter) to 3.9 mg/l (summer) which falls within the desirable limit of WHO standards. Shinde *et al.* (2010) reported the range of BOD between 3.4 to 8.3 mg/l in Harsool Sevangi dam, Aurangabad, Maharashtra.

COD of Gurama bundh fluctuated between 28.25 mg/l (rainy) to 64.50 mg/l (summer). Goel *et al.* (1980) reported the values of COD between 48 to 202 mg/l in rainy season, 257 to 387 mg/l in winter and 400 to 499 mg/l in summer season in two fresh water reservoirs in Jaipur. Chaurasia and Karan (2015) reported the range of COD between 32.65 to 62.60 mg/l in Mandakini river at Chitrakoot. The COD values o Gurma bundh falls within desirable limit of WHO standards.

Alkalinity in natural water may be due to hydroxide, carbonates and bicarbonates present in it. The mean values of alkalinity of Gurma bundh fluctuated between 69.2 mg/l (rainy) to 82.5 mg/l (summer). Wetzel (1975) also reported the higher alkalinity during summer season. The BIS standards of alkalinity was 600 mg/l and WHO standards was 200-600 mg/l. Thus, the alkalinity of bundh water falls within desirable limit of BIS and WHO standards. Sawant and Chavan (2013) also reported the lower values of alkalinity in August (69.38 mg/l) and higher in June (89.75 mg/l) in Mahagaon reservoir of Maharashtra. The estimation of total solids is an important factor in determining the general productivity level of a water body. The mean values of total solids of Gurma bundh varied between 379.7 mg/l (winter) to 907.7 mg/l (rainy). WHO sets the international standards of permissible limit for dissolved solids as 500 mg/l and excessive limit as 1500 mg/l. Thus the water of Gurma bundh may be considered within the desirable limit.

Calcium is an essential element for normal plant growth. The mean values of calcium hardness in Gurma bundh varied between 48.47 mg/l (rainy) to 55.57 mg/l (summer) which was within desirable limit of BIS standard (200 mg/l). Magnesium is a micronutrient and essential for normal plant growth. The mean values of magnesium hardness varied between 16.07 mg/l (rainy) to 30.12 mg/l (summer) which was within desirable limit of BIS standards (100 mg/l). The values of total hardness of Gurma bundh varied between 64.54 mg/l (rainy) to 85.69 mg/l (summer). Sawant and Chavan (2013) also reported the minimum values of total hardness during rainy and maximum during summer season. The total hardness of bundh water was found within permissible limit of WHO (200 mg/l) and BIS (300 mg/l) standards. Chloride contents of Gurma bundh varied between 18.37 mg/l (rainy) to 26.0 mg/l (summer) which was within desirable limit of WHO standards (250-1000 mg/l). Sawant and Chavan (2013) also reported the maximum values of chloride in the month of April while minimum amount during August. The phosphorus occurs in natural water body in very small quantity but it is an important element for the pond fertility. The phosphate contents of Gurma bundh varied between 0.11 mg/l (winter) to 0.17 mg/l (rainy) which was within desirable limit of BIS standards (6 mg/l). The high values of phosphorus in the rainy season may be due to rain surface water runoff, agriculture runoff etc. The observed values of phosphate indicated that the bundh water is productive enough to support good fisheries.

S. No.	Parameter	Units	Rainy		Winter		Summer	
			Min	Max	Min	Max	Min	Max
1	Depth	meters	22.60	28.80	17.10	20.90	7.72	8.95
2	Water temperature	°C	24.80	25.50	19.30	20.10	26.50	27.10
3	Transparency	cm	132.10	134.90	167.10	169.70	208.00	213.20
4	pH		7.85	8.00	7.87	8.02	8.12	8.27
5	Conductivity	µmhosh/cm	130.70	135.00	233.00	243.00	257.70	261.70
6	Dissolved oxygen	mg/l	7.60	7.75	9.30	9.57	7.02	7.35
7	BOD	mg/l	2.55	2.92	2.32	2.57	3.40	3.90
8	COD	mg/l	28.25	30.50	47.75	50.50	61.50	64.50
9	Total alkalinity	mg/l	69.20	72.00	76.00	78.65	79.62	82.50
10	Total solids	mg/l	883.00	907.70	379.70	399.00	396.50	410.50
11	Ca hardness	mg/l	48.47	49.45	50.22	52.27	54.10	55.57
12	Mg hardness	mg/l	16.07	17.02	23.52	25.72	28.25	30.12
13	Total hardness	mg/l	64.54	66.47	73.74	77.99	82.35	85.69
14	Chloride content	mg/l	18.37	18.92	20.97	22.75	24.75	26.00
15	Phosphate content	mg/l	0.16	0.17	0.11	0.13	0.13	0.14

Table 1. Seasonal range of variation of water quality of Gurma Bundh (July 2005 to June 2006).

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