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Assessment of Physico-Chemical Water Parameters Using Correlation Analysis: A Case Study of Gangapur Dam at Nashik District (M.s.) India

KEYWORDS: gangapur dam, physico-chemical parameters, water quality

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ABSTRACT *Present investigation report shows physico-chemical parameters of water samples collected from Gangapur Dam of Dist. Nashik observed during the years 2009-2010 and 2010-2011. Water samples collected were analyzed for pH, electric conductivity (EC), dissolved oxygen (DO), temperature, total dissolved solids (TDS), suspended solids (SS), biological oxygen demand (BOD). Average values for, pH = 7.93 to 8.00, EC = 215.04 to 292.67 µS/cm, DO = 6.23 to 6.71 mg/L, Temperature = 27.25 to 24.82 0C, TDS = 130.21 to 170.75 mg/L, SS = 25.50 mg/L, BOD = 8.04 to 8.00 mg/L during the years 2009-2010 and 2010-2011 respectively. All parameters studied were found to be within normal limits, and the water was found to be suitable for irrigation as well as different purpose.*

INTRODUCTION

Quality of water plays an important role, whenever it is used for either irrigation to agricultural lands or for domestic purpose, includes drinking. Water pollution may change physico-chemical characters of water, and makes it unfit for either purpose. In India per capita surface water availability in the years 1991 and 2001 were 2309 and 1902 m^3 respectively and these are projected to reduce to 1401 and 1191 m^3 by the year 2025 and 2050 respectively (Kumar et al, 2005). It is also estimated that by the year 2025, two third population of the world would face water stress. Hence, Limnology helps to decide location specific management strategy for all freshwater bodies. Some of the studies on freshwater bodies in India include studies carried out by Subba Rao and Govind (1967), Johri et al, (1989), Tripathy (1992), and Sharma (2009). Frequent assessment is therefore essential to guard quality of water. The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies (Duran and Suicmez, 2007). Though physico-chemical approach to monitor water pollution is most common and plenty of information is available on these aspects, it may not provide all the information required at the local level and thus assessment of water quality of all the water bodies becomes essential.

Hence, a study of physical and chemical parameters was carried out at Gangapur Dam located at Gangapur village in Nashik District of Maharashtra State, during the years 2009-2010 and 2010-2011.

Materials and Methods

(i) Study area

Gangapur Dam is an earth fill dam on Godavari River. It was constructed in the year 1965 and is 10 Km away from Nashik City in the Maharashtra State. The dam area fall within latitude 20°1'15.34"N and longitude 73°39'44.60"E. It has a capacity of holding 7200 mcft of water, which is mainly used for irrigation over 15,960 hectare of agricultural land, apart from its domestic use in Nashik City.

Figure 1: Map of the study area.
Sources: Google earth

(ii) Collection of samples

During present study the water samples were collected twice in a month during May to April 2009-2010 and 2010-2011. Water samples (1000 ml each) were collected manually between 8 am to 10 am at a depth of 35cm from Gangapur Dam site using acid-washed (10%, v/v HCl) Polyethylene bottles. The pre-washed bottles were rinsed thrice with water samples on the site before sample collection. Water in polyethylene bottles were preserved with 2 ml of concentrated hydrochloric acid (pH < 2.0). Then they were carefully sealed, labelled and kept cool using ordinary dry ice in the field and while on carrying to the laboratory. Chemical analyses were performed in the laboratory within four hours of their collection. The pH and Temperature of water was measured at the collection site, while Electrical conductivity (EC), Total dissolved solids (TDS), Biological oxygen demand (BOD), Dissolved oxygen (DO) and Suspended solids (SS) were determined following the standard methods described by APHA (1985). All chemicals of Anal R grade were used for quantitative analysis.

(iii) Statistical analysis

All the data obtained subjected to statistical analysis. In statistical analysis mean, standard deviation (SD), coefficient of variations (CV) and correlation coefficients matrixes were

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estimated between all pairs of measured variables to understanding the dynamic distribution of different parameters under investigation following Mungikar (1997, 2003).

RESULTS AND DISCUSSION

Table 1 and 2 represented the frequencies of different physicochemical parameters and the correlations coefficient matrixes (to conclude the relationships between different physicochemical parameters) between each two pairs of parameters respectively.

TABLE - 1 PHYSICO-CHEMICAL PROPERTIES OF WATER SAMPLES FROM GANGAPUR DAM (2009-2011)

Study period		Parameters						
		pH	EC (µS/cm)	DO (mg/L)	Temp. (°C)	TDS (mg/L)	SS (mg/L)	BOD (mg/L)
2009-10	Mean	7.93± 0.38	215.04± 63.86	6.23± 0.77	27.25± 3.37	130.21± 40.86	25.50± 8.99	8.04± 1.86
	CV	4.82	29.70	12.34	12.38	31.38	35.24	23.12
2010-11	Mean	8.00± 0.58	292.67± 3.49	6.71± 0.53	24.82± 1.02	170.75± 2.67	25.50± 1.03	8.00± 0.58
	CV	7.22	1.19	7.88	4.10	1.56	4.04	7.22

(±) indicates standard deviation;

pH, EC = Electric conductivity, DO = Dissolved oxygen, Temp. = Temperature, TDS = Total Dissolved Solids, SS = Suspended Solids, BOD = Biological oxygen demand

TABLE-2 CORRELATION COEFFICIENTS (R) BETWEEN PHYSICO-CHEMICAL PROPERTIES OF WATER SAMPLES FROM GANGAPUR DAM (2009–2011)

		pH	EC	DO	Temp	TDS	SS	BOD
2009-10	pH	X	-0.18	0.15	0.50	-0.23	0.12	0.12
	EC		X	-0.08	0.07	0.87	-0.07	0.18
	DO			X	0.03	-0.22	0.03	-0.23
	Temp				X	-0.03	0.11	0.37
	TDS					X	-0.13	0.21
	SS						X	0.30
	BOD							X
2010-11	pH	X	0.18	0.27	0.01	0.18	0.04	-0.06
	EC		X	-0.05	0.04	0.99	0.50	-0.39
	DO			X	0.19	-0.05	0.21	-0.21
	Temp				X	0.02	0.51	0.21
	TDS					X	0.48	-0.41
	SS						X	0.07
	BOD							X

The average pH of water was 7.93 and 9.0 during the two years, indicating slight alkaline nature of water. The electrical conductivity was 215 and 291 µs/cm respectively, which is an indicated accumulation of salts in the dam water. The variation in the pH was minimum (CV = 4.82 and 7.22), while it was high for EC (CV = 29.70 and 1.19), during the year 2009-2010. The dissolved oxygen was minimum during both the years (6.23 and 6.71mg/L) indicating minimum biological activity. Average temperature of the water was 27°C and 24°C during the years 2009-2010 and 2010-2011 respectively. The total dissolved as well as suspended solids were within the limits suggested by WHO (1984) and BIS (1991). The biological oxygen demand was 8 mg/L during both the years indicating limited organic pollution.

The correlation matrixes given in Table 2 indicated significant positive correlation between pH and temperature (r = 0.50). Similar findings recorded by Thomas and Azis (2000) while studying Peppara reservoir in Kerala. Acidic pH during monsoon and post monsoon period due to heavy rainfall and consequent run off and alkaline pH in pre-monsoon due to low precipitation. Bade et al, (2009) reported similar observation for Sai reservoir from Maharashtra. According to Anil Kumar et al, (2009) the high value of pH during summer may be due increased photosynthetic activity by phytoplankton and macrophytes. They described Jawahar Sagar Lake of Rajasthan as slightly alkaline. According to Moundiotiya et al, (2004), in summer the high temperature enhances microbial activity, causing excessive production of CO_2 and reduced pH value. Acidic pH attributed to excessive production of CO_2, has also been reported by Subbarao and Govind (1967) and Singh et al, (2002). The pH was observed to decline during winter and increase during summer as is evident from the observations, as well as between electrical conductivity (EC) and total dissolved solids (r = 0.87) during the first year. The level of conductivity is also dependent upon large amount of salt carried out by canals adjacent to agricultural sites. Moundiotiya et al, (2004) reported maximum electrical conductivity in summer and minimum in monsoon in Jamwa Ramgarh wetland. Korai et al, (2008) reported maximum conductivity in winter. The highest values in post monsoon due to the high quantum savage in flow whereas lowered in March, April the water was steady and less disturbed and solid might have settled down resulting in to the lowering of conductivity of water. In subsequent year, however, EC showed highly significant positive correlation (r = 0.99) with TDS.

The suspended solids (SS), during second year showed significant positive correlation with EC, temperature and TDS (r = 0.50, 0.51 and 0.48 respectively). Increased level of suspended solids, result in increased turbidity and decreased photosynthesis, that's rise in water temperature and decreased dissolved oxygen (Sharma et al, 2008). The products of decaying vegetation at the surface when starts sinking may increase the SS as well as TDS (Iqbal and Kataria, 1995). While BOD showed significant negative correlation with EC (r = -0.39) and TDS (r = -0.41). Lower BOD values in winter may be due to lesser quantity of solids, dissolved solids and microbial population. The same findings were reported by Wisniewski and Bledzki, (1989). In study period higher values of BOD were recorded during post monsoon at some stations. This may be due to presence of high amount of organic matter in contact with surface runoff water after heavy rains. The same opinion was given by Singhai et al, (1990) in National Lake. After rainy season the turbulence and wind action get reduced hence the suspended solids settle on the bottom, the water becomes clear, microbial population decreases due to low temperature in winter. The trend is same as observed by Varghese (1992) in Govindgarh Lake.

CONCLUSION

It can thus be concluded that, the water at Gangapur Dam was less polluted and thus suitable for agricultural and domestic use.

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