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RESEARCH ARTICLE

SEASONAL VARIATIONS IN PHYSICO-CHEMICAL PARAMETERS OF RAMAUA POND WATER, GWALIOR, MADHYA PRADESH, INDIA

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ABSTRACT

The present study shows the seasonal and spatial changes in physic-chemical parameters of water. The study was carried out for a period of one year from July 2016-June 2021. Sampling stations were established to keep in mind cover whole water body. Some of water parameters were analyzed at the time of sampling while some of the analyzed in laboratory by using appropriate method. Some physic-chemical parameters of water fluctuated form permissible limit. Poor quality of water is affected primary productivity, aquatic fauna and flora.

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INTRODUCTION

Approximately 71% of earth surface is covered by water, 96.5% of the world's water is sea water which is salty that is not to be directly useful for irrigation, drinking, domestic and industrial purposes.1.7% in groundwater, 1.7% in glaciers and the ice caps. Less than 1% water is present in ponds, lakes, rivers, dams, etc., which is used by man for Industrial, domestic and agricultural purposes. Water is a critical issue for the survival of all living organisms. Water is the basic and primary need of all vital life processes and it is now well established that the life first arose in aquatic environments. Ever since the pre-historic times man has been intimately associated with water, and the evidences of past civilization that all historic human settlements were around inland freshwater recourses has conclusively proved it. Water is the basis of life, a universal solvent and one of the most precious commodities required for survival of any form of life (Mahajan and Billore, 2014). According to an estimate about 70% of all the available water in our country is polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural drainage (Shrivastava and Kanungo, 2013).

The physic- chemical parameters of water play a vital role in determining the distribution pattern and quantitative abundance of organism inhabiting aquatic ecosystem (Kumar et al., 2009). The main objective of the physico-chemical analysis of water is to determine the status of different chemical constituents, which are present in the natural and disturbed aquatic ecosystem. The quality of water may be affected in various ways due to pollution (Elayaraj and Selvaraju, 2015).

Physico-chemical analysis is the prime consideration to assess the quality of water for its best utilization like drinking, irrigation, fisheries, and industrial purpose and helpful in understanding the complex processes, interaction between the climatic and biological processes in the water (Salve and Hiware, 2006). Ramaua Dam is constructed to storage of water, ground water recharge and irrigation purpose. It has high socioeconomic status and also contributes the basic means to provide flood control, production for fish food,drinking water for large numbers of wild and domestic animals, sheltering for large number of fauna and measof recreation to the villagers.

MATERIALS AND METHODS

Four sampling stations were established to cover the whole water body. The stations were selected based on the ecological niche of the system, cognizance of human activities and accessibility to the stations. The water samples were collected from surface between 7:00 am to 9:00 am monthly intervals, only clean and dried polyethline coated bottles of 500 ml were used for collected samples. Some parameters of water were analysed at the sampling stations during collection of water sample. The sample is fixed soon after collection and taken to the laboratory for analysis to rest parameters of water. The water samples were analysed by using standard methods (APHA, 2012).

Study Area: The study region include Ramaua dam in Gwalior near in Ramaua village .The dam is surrounded by hilly area .The river attached with it is the Morar river .The area of this dam is about 3177 hectare , from which 4400 hectare is used for the cultivation of kharif crops the remaining is used for the cultivation of rabi crops .the low reservoir level (214.88 M) and the full reservoir level is (225.55 M) .the difference between the two 10.06 M and the maximum water level capacity is about 226.77 M and the dead store water capacity is 0.141 cubic meter Fig 1)

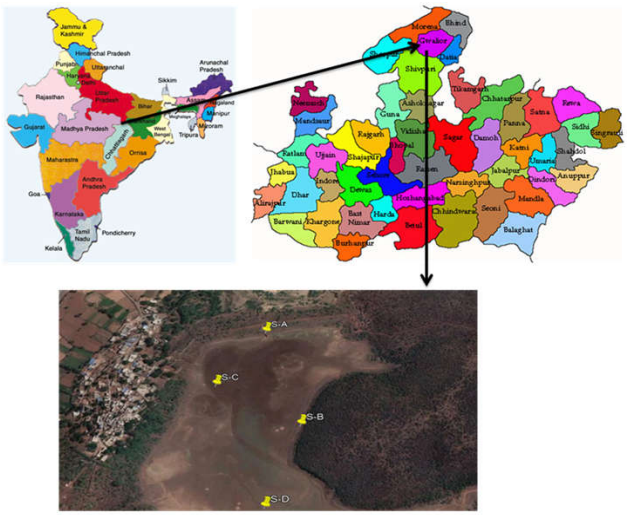

Figure 1. Study area of Ramaua dam

RESULTS AND DISCUSSION

The seasonal physic-chemical parameters of water at selected sampling stations represented in Table 1. Range of variation of observed physico-chemical parameters with their annual mean along with standard deviation is given in Table 2. Odour of water was due to accumulation of dead particle in side water bodies. Pleasant odour was observed at all sampling stations in monsoon, winter and summer season. Delince (1992) stated that the abundance of phytoplankton and zooplankton is responsible for the determination of the color of an aquatic body and Green, bluish green/ brown greenish color of water indicates good plankton population hence, good for fish health. Muddy colour of water recorded in monsoon season at all the sampling station while colour less water was observed at all sampling stations in winter and summer season. Transparency of water ranged from 30.3-65.5 cm with mean and standard deviation 50.79±12.19 cm.

Higher transparency of water recorded 65.5 cm at the sampling station S-B in winter season while lower temperature recorded 30.3 cm at the sampling station S-a in monsoon season. Kadam *et al.,* (2007) and Manjare *et al.,* (2010) have also reported similar observations from different water bodies in Maharastra. The transparency of water is affected in various seasons due to algal blooms and suspended sediments (Horn and Goldman, 1994). Water Temperature is one of the most important factors in the aquatic environment. It affects the physical and chemical properties of water and also affects the aquatic vegetation, organisms and their biological activities. Water temperature fluctuated from 21.4-30.6 °C with mean and standard deviation 25.74±3.38 °C. Higher water temperature recorded 30.6°C at the sampling station S-D in summer season while lower temperature recorded 21.4 °C at the sampling station S-C in winter season. Water temperature increased during warmer months and decreased during colder months. Similar seasonal variations were also observed by Surve *et al.,* (2005).

Conductivity is the ability of an aqueous solution to conduct the electric current. Conductivity is a useful tool to evaluate the purity of water conductivity of water was ranged from 694.2-1012.4 mg/l with mean and standard deviation 822.58±112.14 mg/l. The maximum value of conductively was recorded 1012.4 mg/l at the sampling station S-B in winter season while lower value of conductivity was recorded 694.2 mg/l at the sampling station S-B in summer season. These results coincide with work of Raina (1981) who reported variation in specific conductivity at different sites of a water body. Total dissolved solids were ranged from 511.6-678.2 mg/l with mean value and standard deviation 595.58±55.41 mg/l. The higher total dissolved solids was recorded 678.2 mg/l at the sampling station S-B in summer season while lower total dissolved solids was recorded 511.6 mg/l at the sampling station S-c in monsoon season. Alaka (2014) reported that the amount of total dissolved solids detected from water sample at Borgaon was 347.16 mg/L to 738.0 mg/l. pH of water was fluctuated from 6.3-8.2 with mean and standard deviation 7.36±0.71. The higher ph was recorded at sampling station S-C (8.2) in monsoon season while lower pH was recorded at sampling station S-D (6.3) in summer season. Slight deviation towards acidity in some samples can be attributed to the anthropogenic activities like improper irrigation process and weathering process in the study area. Similarly Pentewar (2018) also recorded pH in the range of 7.3 to 8.6 in Godavari River in Maharashtra.

Dissolved Oxygen was fluctuated from 7.2-9.6 mg/l with mean and standard deviation 8.53±0.80 mg/l. The maximum dissolved oxygen recorded 9.6 mg/l at the sampling station S-A in winter season while minimum dissolve oxygen analyzed 7.2 mg/l at the sampling station S-B in monsoon season. Similar result for dissolved oxygen was also reported by Adedeji *et al.,* (2018). The DO depends upon the temperature, salinity and pressure of the water. The DO value indicates the degree of pollution in the water bodies. The aquatic life distressed when DO levels drops to 4-2 mg/lit and as DO level falls undesirable changes in odor, taste and color reduce the usefulness of water (Barot and Patel, 2014). BOD was observed maximum in summer due to decomposetion of organic matters by excessive activity of microbial organisms and lowest during winter season. Biological oxygen demand of water ranged from 2.6-5.6 mg/l with mean and standard deviation 3.55±1.00 mg/l. The higher value biological oxygen demand was observed 5.6 mg/l at the sampling station S-D in

Table 1. Seasonal value of physico-chemical parameters of Ramaua dam

Parameters	Monsoon Season				Winter Season				Summer Season			
	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D	S-A	S-B	S-C	S-D
Odour	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant
Colour	Muddy	Muddy	Muddy	Muddy	CL	CL	CL	CL	CL	CL	CL	CL
Transparency	30.3	46.5	33.6	34.8	46.8	65.5	62.3	59.2	58.8	53.4	58.5	59.8
W.T.	25.6	25.5	25.8	26.2	21.5	21.8	21.4	22.6	28.4	29.2	30.3	30.6
Conductivity	788.3	754.5	779.4	790.2	840.5	1012.4	997.4	982.6	772.7	694.2	710.2	748.6
TDS	531.6	575.3	511.6	515.1	589.4	609.2	634.5	642.7	665.6	678.2	601.5	592.3
pH	7.3	7.5	8.2	7.9	7.6	7.8	8.1	8.2	6.9	6.6	6.7	6.3
DO	7.4	7.2	7.8	7.7	9.6	9.4	9.1	9.0	8.6	9.0	8.7	8.9
BOD	3.6	4.1	5.3	5.6	2.7	3.2	3.8	3.1	2.8	3.1	2.7	2.6
COD	19.9	20.7	21.6	22.2	31.8	34.3	33.4	33.5	42.2	39.4	35.6	37.3
Free CO_2	5.6	5.9	5.8	5.6	5.2	4.9	5.3	5.8	6.3	7.4	7.8	7.5
Total Alkalinity	240.5	192.6	213.7	218.6	270.6	258.4	294.6	286.5	193.6	221.8	235.2	219.2
Calcium hardness	82.1	80.8	81.3	81.8	76.4	76.2	76.7	79.3	82.5	83.6	84.6	84.8
TH	140.6	139.2	138.6	139.4	162.6	169.3	167.8	162.4	179.5	183.6	173.8	177.3
Chlorides	13.4	10.1	9.2	12.9	9.3	8.2	8.1	7.8	14.3	15.1	15.5	16.4
Sulphates	16.8	16.4	17.6	18.3	19.1	18.6	21.5	22.7	24.2	23.8	24.6	25.2
Mg	18.5	17.9	18.3	18.5	19.6	19.5	19.2	18.6	18.9	19.3	19.6	19.8
Nitrate	0.02	0.01	0.17	0.08	0.03	0.02	0.07	0.06	0.03	0.14	0.4	0.2
Phosphate	0.5	0.3	0.0	0.5	0.4	0.6	0.4	0.4	0.3	0.4	0.8	0.3

CL= Colour Less, W. T. = Water Temperature, TDS= Total Dissolved Solids, DO= Dissolved Oxygen, BOD= Biological Oxygen Demand, COD= Chemical Oxygen Demand, TH= Total Hardness

Table 2. Range of variation, Mean and St. D. of water parameters of Ramaua dam

S. No.	Parameters	Range of Variation		Mean and Standard Deviation
		Maximum	Minimum	
1	Odour	Pleasant	Pleasant	Pleasant
2	Colour	Muddy	CL	CL
3	Transparency	65.5	30.3	50.79±12.19
4	W.T.	30.6	21.4	25.74±3.38
5	Conductivity	1012.4	694.2	822.58±112.14
6	TDS	678.2	511.6	595.58±55.41
7	pH	8.2	6.3	7.36±0.71
8	DO	9.6	7.2	8.53±0.80
9	BOD	5.6	2.6	3.55±1.00
10	COD	42.2	19.9	30.99±7.84
11	Free CO_2	7.8	4.9	6.09±0.96
12	Total Alkalinity	294.6	192.6	237.11±33.92
13	Calcium hardness	84.8	76.2	80.84±3.07
14	TH	183.6	138.6	161.17±17.22
15	Chlorides	16.4	7.8	11.69±3.22
16	Sulphates	25.2	16.4	20.73±3.27
17	Mg	19.8	17.9	18.97±0.61
18	Nitrate	0.4	0.01	0.10±0.11
19	Phosphate	0.8	0.0	0.40±0.20

monsoon season while lower value of biological oxygen demand 2.6 mg/l recorded at the sampling station S-D in summer season respectively. This finding is also supported by Sachidanandamurthy and Yajurvedi (2006). Chemical oxygen demand of water fluctuated from 19.9-42.2 mg/l with mean and standard deviation 30.99±7.84 mg/l. The higher chemical oxygen demand of water was recorded 42.2 mg/l at the sampling station S-A in summer season while lower chemical oxygen demand of water was recorded 19.9 mg/ at the sampling station S-A in monsoon season. Durge *et al.,* (2018) recorded the chemical oxygen demand values between 27.42 ± 22.304 mg/lit. In the present investigation, maximum chemical oxygen demand was recorded during the summer and minimum during the winter season. In these studies, higher values of COD during summer maybe due to higher decomposition activities and low levels of water. Free CO_2 water ranged from 4.9-7.8 mg/l with mean and standard deviation 6.09±0.96 mg/l. Maximum Free CO_2 of water was recorded 7.8 mg/l at the sampling station S-C in summer season while minimum Free CO_2 of water was recorded 4.9 mg/l at sampling station S-B in winter season. The value of CO2 was high in winter season. This could be related to the high rate of decomposition in the warmer months.

Total Alkalinity is a measurement of the buffering capacity of the water. It is generally transmitted by the salts of carbonates, bicarbonates, phosphate, nitrates, borax, silicates, etc., together with the hydroxyl ions in a free state. Alkalinity of water fluctuated from 192.6-294.6 mg/l with mean and standard deviation 237.11±33.92 mg/l. The maximum alkalinity was recorded 294.6 mg/l at the sampling station S-C in winter season while minimum alkalinity of water was recorded 192.6 mg/l at the sampling station S-B in monsoon season. Durge *et al.,* (2018) investigated seasonal variations in total alkalinity were minimum in summer and maximum in winter in Malgujari pond. Calcium hardness ranged from 76.2-84.8 MG/L with mean and standard deviation 80.84±3.07 mg/l. Maximum Calcium hardness was recorded 84.8 mg/l at the sampling station S-D in summer season while minimum Calcium hardness was recorded 76.2 mg/l at sampling station S-B in winter season. Total hardness of water was ranged from 138.6-183.6 mg/l with mean and standard deviation 161.17±17.22 mg/l. The higher value of total hardness was recorded 183.6mg//l at the sampling station S-B in summer season while lowr total hardness was recorded 138.6 mg/l at the sampling station S-C in monsoon season. Harney *et al.,* (2012) reported that the total hardness in Kanhala pond, Chandrapur was 86.50 to 168.00 mg/l.

These high value may be due to the concentration of carbonate and bicarbonate salt of calcium and magnesium (Hujare, 2008). Chloride ranged from 7.8-16.4 mg/l with mean and standard deviation 11.69±3.22 mg/l. Maximum Chloride was recorded 16.4 mg/l cm at the sampling station S-D in summer season while minimum Chloride was recorded 7.8 mg/l at sampling station S-D in winter season. Govindan and Sundaresan (1979) reported that higher concentration of chloride in the summer season could be due to sewage mixing, increased temperature and evaporation of water. Sulphate ranged from 16.4-25.2 mg/l with mean and standard deviation 35.50±42.47 mg/l. Maximum Sulphate of water was recorded 25.2 mg/l at the sampling station S-D in summer season while minimum Sulphate was recorded 16.4 mg/l at sampling station S-B in monsoon season. Similar observation reported in Samoha Reservoir by Lodhi and Rao (2015). Mg was fluctuated from 17.9-19.8 mg/l with mean and standard deviation 18.97±0.61 mg/l. The higher value of Mg recorded 19.8 mg/l at the sampling station S-D in summer season while lower Mg was recorded 17.9 mg/l at the sampling station S-B in monsoon season. Mg increase because of the increase in suspended matter like clay, slit, organic matter, planktons and other microorganisms (Verma and Summarwar, 2012). Nitrate of water fluctuated from 0.01-0.4 mg/l with mean and standard deviation 0.10±0.11 mg/l. The highest value of nitrate 0.4 mg/l at the sampling stations S-C in summer season while lower value of nitrate recorded 0.01 mg/l at the sampling stations S-B in monsoon season. Similar findings were also made by Verma *et al.,* (1971).

Phosphate had a significant role in algal growth and eutrophication (Peterson *et al.,* 1974). Phosphate has a few sources in nature and also acts as a regulating factor for productivity of water body. Phosphate may occur in lake as result of domestic waste, detergent and agricultural run-off containing fertilizer (Gopalkrusna, 2011). Phosphate of water ranged from 0.2-0.8 mg/l with mean and standard deviation 0.40±0.20 mg/l. The highest value of phosphate recorded 0.8 mg/l at the sampling station S-C in summer season while lower value of phosphate recorded 0.0 at the sampling station S-C in monsoon season. It was increase due to agriculture waste by local people inside the wetlands (Prasanna and Panda, 2010).

CONCLUSION

Physico-chemical parameters of pond water clearly shows that they are in permissible so water body can used for increasing biodiversity and conserving ecosystem. But due to anthropogenic activities inside ad surrounding area of water body influencing. There is an immediate need of restoration, improvement and proper management of this water body for the human and environment.

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