Study on Physico-Chemical Parameters of Harsi Reservoir Dabra, Gwalior District, Madhya Pradesh

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Abstract— this study was aimed to estimate physico-chemical characteristic of Harsi reservoir. Harsi reservoir located in Dabra, Gwalior district, Madhya Pradesh is constructed on parwati River. Monthly study in Physico-chemical parameters such as water temperature, depth, transparency, electrical conductivity, turbidity, total dissolved solids, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chlorides, sulphates, nitrate, nitrite, phosphate, silicates, ammonia, BOD, COD, calcium, magnesium, sodium, potassium were analyzed from January 2011 to December 2011. The results indicated that Physico-chemical parameters of the water were used for drinking, domestic use, irrigation and pisciculture.

Key words: Harsi reservoir, physical parameters, chemical parameters, Correlation coefficient.

I. INTRODUCTION

Quality of an aquatic ecosystem is dependent on the physic-chemical parameters of water. The healthy aquatic ecosystem is depended on the physico-chemical and biological characteristics (Venkatesharaju et al 2010). Among the fresh water resources of the world pond, river, lakes, reservoirs and wetlands are important because they supply water for the population in the whole year. This they do by collecting rainwater through the water cycle, and sustain the stationary component of the hydrological cycle. They maintain the balance of the ecosystem components on which other systems depend. The lakes and reservoirs represent very complex and fragile ecosystems. The fresh water habitats are considered worthwhile not only as a supply resource but as a living system by which the global ecosystem is balanced. The physicochemical characteristics play an important role in assessment of the water quality and trophic status of a water body. In Madhya Pradesh, there are many freshwater bodies in the form of rivers, lakes and man-made reservoirs in the state. The small, medium and large reservoirs in this state are estimated to be 1,72,575; 1,67,502 and 1,18,307 ha respectively with a total of 0.458 million ha (Sugunan 1997), contribute to the maximum water spread of all Indian states under manmade lakes. Gwalior and Chambal divisions are rich in water resources and have approximately 54,839 ha water area falling under reservoirs. The determination of good growth in water body include temperature, water temperature, dissolved oxygen, free carbon dioxide, hardness, turbidity, alkalinity etc. other parameters like biological oxygen demand and chemical oxygen demand indicate pollution of a given water body.

II. STUDY AREA

Harsi reservoir is constructed on Parwati River situated near Harsi village in Dabra, Gwalior District (Madhya Pradesh). It is situated about 100 km from Gwalior. Harsi reservoir was built over the Parwati River during 1928-1935. The reservoir is covered by hills and small hillock by its three sides. The reservoir is geographically located between the latitude 25'470 North and longitude to 77'580East. The maximum height of reservoir is 29.26 m, length is 21,333 m, total catchment area is 777.5 m2 and total area cover by reservoir is 308,252 Km^3.

III. METHODS AND MATERIAL

Water Samples were collected from four sampling stations A, B, C, and D from Harsi reservoir. The sampling was done in the first week of every month in early hours of the day i.e, around 9.00 to 11.00 a.m. during January to December 2011. The physico-chemical characteristics of water including water temperature, depth, transparency, pH, dissolved oxygen, free carbon-dioxide, total alkalinity, total hardness, chlorides, calcium and magnesium, were analyzed at the sampling stations, while other parameters including turbidity, electrical conductivity, total dissolved solids, nitrate-nitrogen, nitrite-nitrogen, sulphate, phosphates, silicates, biochemical oxygen demand, chemical oxygen demand, ammonia, sodium and potassium were analyzed in the laboratory within the 6 to 8 hr following the methods of APHA (1995) and Trivedy and Goel (1986). Four sampling stations viz., Station-A, B, C and D were established for analysis of physico-chemical parameters of water covering whole area of reservoir (Fig. 1).

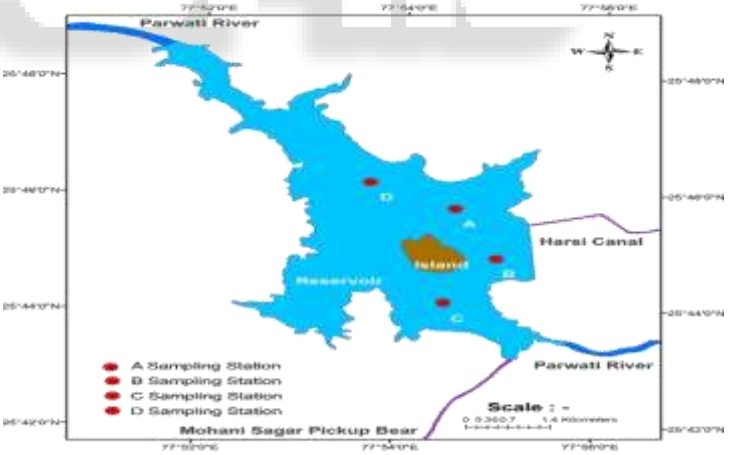

Fig 1: Location map and the sampling stations in Harsi reservoir

IV. RESULT AND DISCUSSION

The physico-chemical parameters are determinant of the quality of water. The average value of physico-chemical parameters of water during 2011 are given in table 1. The value of correlation coefficient (r) between physico-chemical parameters of water in harsi reservoir were calculate and given in table 2.

Water Temperature of reservoir water ranged from 18.10 °C to 32.08 °C in different month. temperature increased during summer month and decrease during winter

month. Transparency indicates the productive nature of this water on the basis of clarity values as proposed by Sharma and Durve (1991). Transparency of the reservoir ranged from 106.25 cm to 153.50 cm.

Electrical conductivity measures the capacity of a substance or solution to conduct electrical current. Electrical conductivity of the reservoir ranged from 177.62 µS.cm-1 to236.90 µS.cm^{-1}.

Turbidity is a measure of water clarity how much the material suspended in water decreases the passage of light through the water. Water turbidity value from 0.91 NTU to 3.14 NTU. The results supported by Dagaonkar and Saksena (1992), Garg et al (2006b), Medudhula. Thirupathaiah (2012) have also reported high turbidity during rainy season. During rainy season silt, clay and other suspended particles contribute to the turbidity values, while during winter and summer seasons settlement of silt, clay results low turbidity.

Total dissolved solids value ranged from 131.25 to 201.0 mgl^{-1} in different month. Similar result has been reported by Rao et al 2003, Kirubavathy et al 2005, Garg et al 2006b. pH value is very important for plankton growth (Chisty, 2002).

During present study water pH values were found 8.19 to 9.09. It is indicating alkalinity nature throughout the study period. This is in accordance with earlier reports by Wetzel (1975), who reported that the value of pH range from 8-9 units in Indian water.

Dissolved oxygen is an important aquatic parameter. It plays crucial role in life processes of flora and fauna. In the present study the DO values found from 7.74 to 10.20 mgl^{-1}. Range of free carbon dioxide of the reservoir from Nil to 2.76 mgl^{-1} . The carbon dioxide content of water depends upon the water temperature, depth, rate of respiration, decomposition of organic matter, chemical nature of the bottom and geographical features of the terrain surrounding the water body (Sakhare and Joshi, 2002).

Total alkalinity is the total sum of carbonates and bicarbonates alkalinity. Total alkalinity range from 30.50 to 76.22 mgl^{-1}. In the present study total hardness ranged from 63.0 to 103.0 mgl^{-1}in different seasons. Khanna et al 2010 was also found higher total hardness during monsoon season and lowest total hardness during winter season.

Chloride play an important role in water quality determination. Chloride ranged from 21.43 to 30.86 mgl^{-1}. In this study High chloride value during summer season and low value during winter season. Similar observation have also been made by Lendh & Yeragi 2004; and Babar & Raje 2009.

Sulphates is an important constituent of hardness with calcium and magnesium and is one of the key nutrients in the aquatic environment. In the present study sulphates range from 1.11 to 4.16 mgl^{-1}. The higher value of sulphates recorded in summer moth and lower value of sulphates measured in winter month These result observed by Kirubavathy et al (2005), Khare et al (2007).

During the study Nitrate fluctuated between 0.027 to 0.222 mgl^{-1}. High concentration of nitrate is drinking water is toxic (Umavathi et al 2007). Nitrogen is a major component of all organic matter. High concentration of nitrates are usefulfor irrigation but their entry into the water resources increases the growth of nuisance algae, macrophytes and triggers eutrophication and pollution (Trivedy & Goel 1986). High value of nitrate was observed during monsoon season and low during winter season. Similar result were observed by Saxena (1992), Garge et al (2006), Mustapha (2008).

Nitrite represent an intermediate form during de-nitrification reactions in nitrogen cycle. Nitrate concentration found from 0.0075 to 0.0290 mgl^{-1}. High concentration of nitrate found in monsoon season and low in winter season. Similar result was also also observe by Thialaga et al (2005).

Phoshpahtes is one of the most important nutrient and a limiting factor in the maintenance of reservoir fertility. During the study phosphate concentration ranged from 0.004 to 0.032 mgl^{-1} in different seasons. High concentration of phosphates observed during monsoon month and low phosphates value during winter. The variation may be due to the various processes like adsorption and desorption of phosphates and buffering action of sediment under varying environmental conditions (Rajasegar, 2003).

Silicate is most abundant in sedimentary rocks and therefore, occurs generally in higher concentration in water located in such regions. During the study silicates ranged from 1.76 to 3.95 mgl^{-1}. Higher concentration of ammonia is harmful for fishes and other life. In the present study, the ammonia content varied from 0.39 to 0.74 mgl^{-1}. Higher values of ammonia found in summer season and lower value in winter season.

Biological oxygen Demand (BOD) is an important parameter to the oxygen required to degradation of organic matter. During the study period BOD recorded from 0.95 to 3.0 mgl^{-1}. higher value of BOD found in monsoon season and lower value in winter season. Garg et al., 2010 has also made similar observations in Ramsagar reservoir.

Chemical oxygen demand (COD) is the oxygen consumed by the chemical break down of organic and inorganic substances in water. The COD of water increases with increasing concentration of organic matter (Boyd, 1981). In the present study, COD ranged from 18.46 to 36.16 mgl^{-1}. Calcium is an important micronutrient for all organism. Calcium content range from 18.46 to 36.12. The calcium value was high in rainy month and low in winter month. Khanna et al. 2010 has also reported the similar observation.

Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of phytoplankton (Dagaonkar and Saksena, 1992). Therefore, depletion of magnesium reduces the phytoplankton population. In the present investigation, the magnesium content from 3.02 to 7.87 mgl^{-1}. Sodium is a naturally occurring element in all water bodies. In the present investigation, Sodium content found from 10.02 to 20.79 mgl^{-1}.

Potassium is also a naturally occurring element, but the concentrations in freshwater bodies remain quite lower than the sodium and calcium. In present study potassium varied from 1.54 to 4.80 mgl^{-1}.

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Water temperature (^{0}C)	18.10	22.75	26.0	28.61	30.39	32.08	27.50	26.34	24.43	22.56	21.27	20.48

Transparency (c. m)	141.75	132.25	139.25	127.25	131.50	127.0	114.50	106.25	121.75	138.25	141.75	153.50
E. conductivity ($\mu S.cm^{-1}$)	183.07	177.62	200.92	209.87	214.55	212.05	234.50	236.90	228.97	204.45	199.65	186.87
Turbidity (NTU)	1.03	1.23	1.66	1.86	2.08	2.27	2.45	2.66	3.14	1.68	1.55	0.91
Total dissolved solids(mgL^{-1})	138.0	143.75	147.50	155.25	162.25	173.25	201.0	194.75	182.50	147.57	146.50	131.25
pH	8.54	8.19	8.35	8.62	8.79	9.09	8.59	8.18	8.19	8.51	8.49	8.55
Dissolved O_2 (mgL^{-1})	10.20	8.86	8.58	8.38	7.81	7.74	8.33	8.37	8.78	8.86	8.93	9.08
Free CO_2 (mgL^{-1})	0.897	1.08	0.560	NIL	NIL	NIL	NIL	1.02	2.21	1.40	2.76	1.59
T. Alkalinity (mgL^{-1})	52.45	30.50	39.40	38.45	59.87	76.22	55.77	69.10	45.22	56.0	42.07	61.57
T. Hardness (mgL^{-1})	72.0	74.50	76.50	81.0	85.25	90.50	103.0	94.25	83.0	79.75	70.0	63.0
Chloride (mgL^{-1})	21.43	25.05	29.19	26.83	26.19	30.86	29.49	25.26	21.47	23.12	21.90	21.53
Sulphate (mgL^{-1})	1.68	2.14	2.73	2.66	3.68	4.16	3.06	2.68	2.34	2.33	2.11	1.11
Nitrate-nitrogen (mgL^{-1})	0.027	0.046	0.049	0.071	0.068	0.069	0.113	0.222	0.074	0.057	0.064	0.045
Nitrite-nitrogen (mgL^{-1})	0.0075	0.0098	0.0117	0.0102	0.0137	0.019	0.0237	0.029	0.0212	0.015	0.012	0.0114
Phosphates (mgL^{-1})	0.007	0.008	0.005	0.010	0.015	0.025	0.032	0.021	0.022	0.014	0.007	0.004
Silicates (mgL^{-1})	1.93	2.47	2.78	3.23	3.46	3.67	3.95	3.45	3.93	2.72	2.22	1.76
Ammonia (mgL^{-1})	0.53	0.51	0.62	0.57	0.66	0.84	0.74	0.59	0.62	0.54	0.48	0.39
BOD (mgL^{-1})	1.39	1.67	1.81	1.98	2.32	2.66	2.79	3.0	2.81	1.27	0.95	0.97
COD (mgL^{-1})	24.62	28.25	34.48	30.34	36.40	44.89	51.08	42.43	41.25	44.36	38.25	21.13
Calcium (mgL^{-1})	18.84	18.46	20.72	30.15	32.72	28.48	36.16	26.49	20.59	22.15	23.48	22.32
Magnesium (mgL^{-1})	3.57	4.80	6.14	5.27	6.42	5.54	7.87	6.58	4.48	3.80	3.98	3.02
Sodium (mgL^{-1})	12.40	13.33	14.78	13.45	13.80	15.54	16.67	17.94	20.79	18.62	14.48	10.02
Potassium (mgL^{-1})	1.54	2.05	2.76	3.23	3.70	4.17	4.53	4.80	3.87	3.40	2.29	2.55

Table 1: Average value of physico-chemical parameters of the Harsi reservoir (Jan to Dec 2011)

	WT	TR	EC	TU	TDS	pH	DO_2	FC_{02}	TA	TH	Cl	SO_4	NO_3	NO_2	PO_4	Si	NH_3	BOD	COD	Ca^{-}	Mg^{-}	Na^{-}	K^{-}
WT	1																						
TR	-0.55	1																					
EC	0.59	-0.83	1																				
TU	0.6	-0.83	0.92	1																			
TDS	0.52	-0.88	0.97	0.9	1																		
pH	0.5	0.17	-0.005	-0.07	-0.14	1																	
DO_2	-0.93	0.49	-0.58	-0.57	-0.54	-0.40	1																
FC_{02}	-0.07	0.02	0.25	0.28	0.19	0.15	-0.07	1															
TA	-0.08	0.22	-0.32	-0.37	-0.29	0.29	-0.34	-0.18	1														
TH	0.69	-0.89	0.84	0.77	0.93	0.16	-0.61	-0.20	0.41	1													
Cl	0.81	-0.42	0.34	0.30	0.44	0.450	-0.72	-0.65	0.20	0.64	1												
SO_4	0.92	-0.53	0.53	0.57	0.57	0.56	-0.84	-0.19	0.38	0.72	0.80	1											
NO_3	0.33	-0.81	0.75	0.61	0.7	-0.26	-0.38	-0.09	-0.18	0.66	0.20	0.26	1										
NO_2	0.42	-0.83	0.88	0.83	0.91	-0.13	-0.78	0.58	0.54	0.82	0.30	0.61	0.85	1									
PO_4	0.58	-0.8	0.82	0.81	0.84	0.21	-0.53	0.43	0.09	0.92	0.46	0.62	0.55	0.83	1								
Si	0.79	-0.83	0.87	0.92	0.89	0.13	-0.72	0.07	0.26	0.88	0.56	0.76	0.51	0.70	0.86	1							
NH_3	0.02	0.07	-0.07	0.1	0.01	-0.45	-0.66	-0.07	-0.27	0.80	0.79	0.91	-0.14	0.50	-0.36	0.81	1						
BOD	0.71	-0.9	0.82	0.88	0.91	0.01	-0.60	-0.06	-0.13	0.87	0.55	0.67	0.65	0.79	0.83	0.91	0.02	1					
COD	0.53	-0.67	0.76	0.76	0.71	0.14	-0.56	0.45	-0.006	0.82	0.45	0.64	0.5	0.76	0.84	0.77	-0.21	0.62	1				
Ca^{-}	0.49	0.28	-0.19	-0.22	-0.34	0.55	-0.69	-0.46	-0.13	0.72	0.59	0.65	0.34	0.43	-0.35	0.63	0.21	-0.12	-0.32	1			
Mg^{-}	0.84	-0.43	0.34	0.31	0.23	0.38	-0.67	-0.42	-0.17	0.85	0.78	0.71	0.22	0.58	0.23	0.74	0.19	0.46	0.26	0.68	1		
Na^{-}	0.24	-0.64	0.72	0.82	0.78	0.29	-0.26	0.52	-0.23	0.58	0.60	0.32	0.74	0.70	0.85	0.68	0.22	0.58	0.79	-0.52	0.4	1	
K^{-}	0.72	-0.8	0.92	0.85	0.84	0.15	-0.74	0.32	-0.05	0.87	0.49	0.64	0.74	0.90	0.85	0.87	-0.11	0.83	0.79	-0.12	0.42	0.64	1

Table 2: The value of correlation coefficient (r) between physico-chemical parameters of water in harsi reservoir (January to December 2011)

V. CORRELATION COEFFICIENT BETWEEN PHYSICO-CHEMICAL PARAMETERS

The correlation coefficient (r) between physico-chemical parameters are presented in table 2. In the present study show the high degree of positive correlation between temperature and electrical conductivity, temperature and total dissolved solids, temperature and total hardness, temperature and calcium, temperature and magnesium, temperature and chloride, turbidity and total dissolved solids, turbidity and electrical conductivity, turbidity and total hardness, electrical conductivity and total dissolved solids, electrical conductivity and total hardness, electrical conductivity and BOD, electrical conductivity and magnesium, total dissolved solids and total hardness, total dissolved solids and chloride, total dissolved solids and magnesium, COD and chloride, free carbon dioxide and pH,

pH and magnesium, total hardness and calcium, total hardness and magnesium, chloride and magnesium, chloride and calcium, calcium and magnesium, BOD and total hardness, COD and chloride. In the present study high degree negative correlation found between dissolved oxygen and other parameters. Negative correlation between temperature and transparency, temperature and total alkalinity, turbidity and pH, turbidity and total alkalinity, electrical conductivity and pH, electrical conductivity and total alkalinity, total dissolved solids and pH, total alkalinity and calcium ,calcium and BOD, calcium and COD, BOD and total alkalinity, COD and Total alkalinity, BOD and COD. Free carbon dioxide has also show negative correlation between most of the parameters. Such a correlation of physicochemical parameters has also been exhibited by several workers like Jha & Barat (2003), Kumar *et al.* (2007), Garg *et al.,* (2009 & 2010) and Ahangar *et al.* (2012).

VI. Conclusion

In conclusion, All physical and chemical parameters in harsi Reservoir water were within desirable limits. This reservoir have rich amount of nutrients which may be due to agricultural practices being done by farmers in surrounding catchment area of this reservoir and support relatively good biota. The results obtained from the present investigation shall be useful in future management of the reservoir.

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