

Seasonal Variations of Mulchera Lake with respect to Physico-chemical parameter in Mulchera Tehasil, District Gadchiroli, (M.S.)

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Abstract: A Mulchera lake is situated in Mulchera tehsil of Gadchiroli district of Maharashtra state has been selected for the study of seasonal variations in physico-chemical parameters of water. The period of the study is from December 2019 to November 2020. During study period following parameters were analysed i.e. Temperature, pH, transparency, conductivity, D.O., free CO₂, BOD, COD, total hardness, chlorides, phosphate, sulphate and nitrates, etc. The present study showed that the atmospheric temperature is higher than that of water temperature. It is maximum during summer season while the minimum in the winter season. Conductivity, pH and BOD are also observed maximum in summer while minimum in winter. DO as well as transparency is found maximum in the winter and minimum in monsoon. Free CO₂, BOD, COD, hardness, chlorides, phosphates, sulphates and nitrates are maximum in summer and minimum in winter. Alkalinity is more in monsoon season and minimum were found in winter. Comparatively higher values of conductivity, total alkalinity, chlorides, phosphates and nitrates in Mulchera lake indicate of its contaminated and polluted status.

Keyword: Mulchera lake, Water pollution, physico-chemical parameters, Chamorshi, etc.

INTRODUCTION

Water is elixir of life. Life is never possible without water in our planet and is a most necessary component for living beings. It is one of the most important elements for the human environment. It is useful for many purposes like drinking, irrigation, agriculture, aquaculture and in many industrial purposes. 71.9 % of the earth surface has been covered by water (CIA, 2008) out of this 96.5 % is the sea water and is not directly used for any purpose. 1.7 % is in the form of glaciers, and 1.7 % is ground water. Only 0.1 % of water is available for all of the processes of living beings. This particular topic has been chosen for the study to bring forward the pollution status of Mulchera Lake, in terms of its physico-chemical parameters, as no such information about it is available. Shrivastava and Kanungo (2013), has estimated that 70 % of available water has been polluted due to the discharge of industrial effluents, domestic sewage, and agriculture drainages. Pesticides and fertilizers also add to water pollution. Though the water is the most important commodity of life, its quality is being degraded day by day. Several factors are responsible for the deterioration of water bodies. Some of them are the fast increasing human population, industrialization and excessive use of fertilizers. Some contagious diseases spread through water, so water quality must be good.

Mulchera lake is situated at Mulchera tola in Mulchera tehsil is about 188 meters above mean sea level. Its geographical position is 19° 57' North and 79° 09' East. Water spread area of the lake is about 12 acres. The depth of water in monsoon is about 14-15 feet and 3-4 feet during summer season. The water from this lake is being used for agriculture and other domestic activities along with fishing. The present study deals with the seasonal variations of the physico-chemical parameters from January 2019 to December 2019.

MATERIALS AND METHODS

Water sample collected has been done at a depth of 1-1.5 meters from three marginal areas of the

Mulchera lake. Sampling has been done in 2-5 liter capacity dried plastic cans/bottle with Reffner's sampler. Samples were collected in the morning hours between 8 am to 10 am, every month for One years from December 2019 to January 2020. Recorded data was separated in three different seasons like Winter (Oct-Jan), summer (Feb-May) and Monsoon (Jun-Sept).

Atmospheric temperature and water temperature was measured with the help of mercury thermometer at sampling spot, pH with pH meter, transparency with the help of Sacchi disc, conductivity by using conductivity meter (Electronic India, Model EQ-660). Dissolved Oxygen measures with Winkler's method, BOD by APHA method (2005), COD distillery assembly were used to estimate COD. Free CO₂, alkalinity, chlorides and hardness was done with titrimetric methods while phosphates, sulfates, and nitrates estimation are done withby spectrophotometer (Model UV-108).

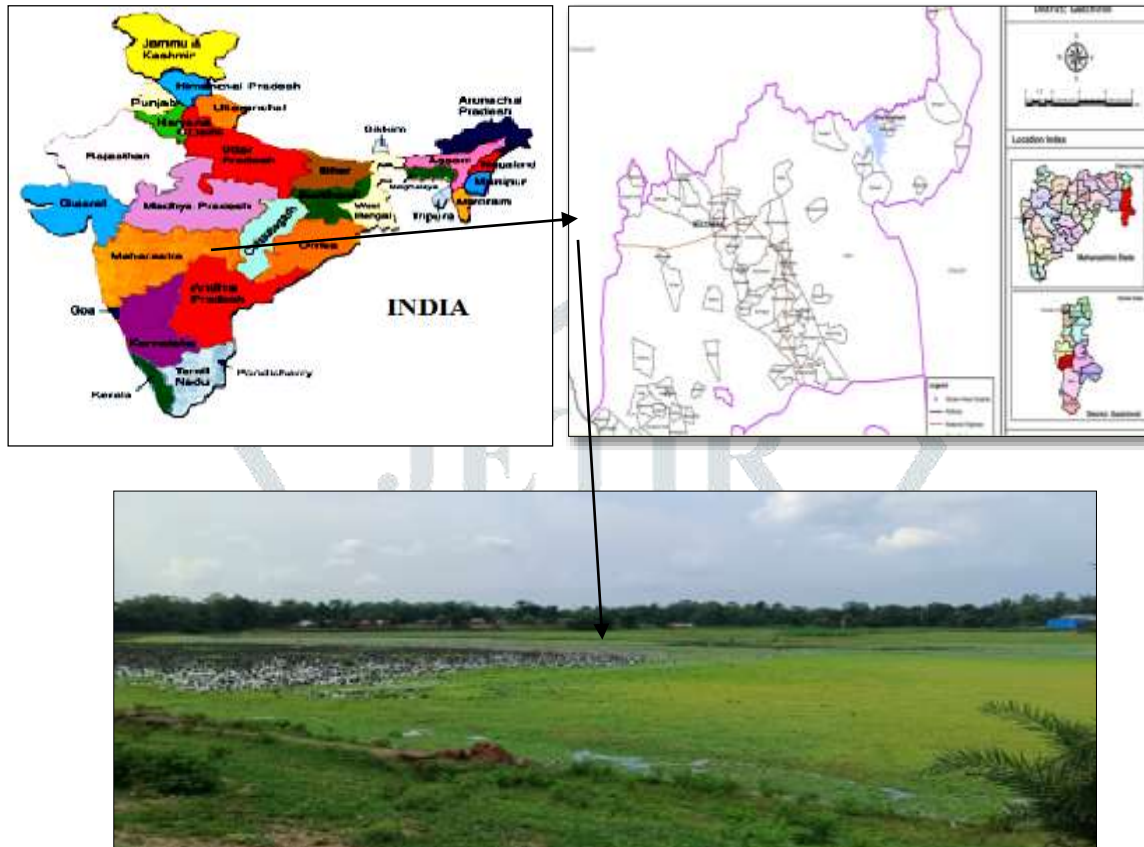


Fig: Original view of Mulchera lake.

RESULTS AND DISCUSSION

The physico-chemical parameters are the necessary basic characteristics to understand the tropical status of every ecosystem. Table- 1 represents the average of the physico-chemical parameters of one years, while Table 2 shows the seasonal variations of the pond under study. The present study of atmospheric temperature shows variations from 24.82°C to 45.82°C. As the temperature rises, it accelerates the biochemical reaction reducing the solubility of gases. Water temperatures are fluctuating from 23.55°C to 33.89°C. Atmospheric temperature has always observed more than the water temperature. All metabolic and physiological processes have been controlled by the water temperature, and thus it is a significant factor for calculating the solubility of Oxygen and Carbon Dioxide along with carbonate and bicarbonate equilibrium.

pH is an essential ecological factor and is the result of interactions of various substances in the solution form in water. pH is a scale to know the intensity of acidity and alkalinity of any water body. pH recorded in the study pond ranges from 6.87 to 7.77. In the present work, higher pH values, recorded in summer, shows the correlation in the rise of temperature with the increased rate of photosynthesis resulting in the higher consumption of Carbon Dioxide.

Dissolved oxygen levels are considered as the most commonly used measurements and are very important for each fauna. In precipitation and dissolution of organic substances dissolved oxygen plays a key role. In the present investigation, dissolved oxygen values are seen running from 2.78 mg/lit to 3.50 mg/lit. and are found maximum in the winter while minimum during summer. The higher values of dissolved oxygen in winter are because of low water temperature and high photosynthetic activities, while the lower in summer are due to high atmospheric temperature along with the high rate of oxidation of organic matters.

Free carbon dioxide dissolved in water is essentially the only source of carbon which is being assimilated and incorporated into the skeleton of living matter of all the aquatic autotrophs. Most of the carbon in fresh water system occurred as equilibrium products of carbon dioxide. Carbon dioxide is added to the aquatic ecosystem by other factors like rainwater, flowing ground water and respiration of aquatic flora and fauna. In the present investigation, the range of free carbon dioxide recorded is 2.15 mg/lit. to 6.32 mg/lit. in Mulchera lake. In the present investigation, seasonal free carbon dioxide is maximum in monsoon and minimum in the winter season. The maximum values of free carbon dioxide in monsoon is due to the decomposition of organic matter and the respiration of aquatic flora and fauna. However, minimum free carbon dioxide during winter is probably due to a decreased photosynthetic activity of aquatic flora.

Transparency is a physical variable significant for primary production of the water body. It is mainly affected by the suspended particles and indirectly influenced by the physico-chemical parameters. In the present investigation, Secchidisc transparency was recorded at 19.95 cm to 31.34 cm in Mulchera lake. In the present study, maximum transparency was recorded during winter seasons and minimum during the monsoon.

The specific conductivity of water or a solution is its capacity to conduct electric current and depends on the nature and concentration of ionized salts. The conductivity of a sample is a numerical expression of its ability to carry an electric current which, in turn depends on the ionic strength. In the present investigation, the values of conductivity recorded are 156.50 $\mu\text{mhos/cm}$ to 206.50 $\mu\text{mhos/cm}$ in Mulchera lake. In the present investigation, maximum seasonal conductivity was recorded during the summer season and minimum during the monsoon season.

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. In the present investigation, the total alkalinity ranged 9.50 mg/lit. to 21.00 mg/lit. in Mulchera lake. In this present research work, seasonal variations in total alkalinity were minimum in summer and maximum in winter in Mulchera lake. In the present research work, maximum values of alkalinity during winter may be due to household detergent products added in the pond only in the winter season, due to flooding of city channels after their saturations in summer, while the minimum values during summer may be due to the moderate use of bicarbonates by the pond biota directly for their load. Thus the concentration of bicarbonates leads to the depletion in water resulting in low values of total alkalinity.

Total hardness of the water is a sum of the concentrations of alkaline earth metals cations. Hardness is generally governed by calcium and magnesium salts which largely combines with bicarbonates and carbonates giving temporary hardness and with sulfates, chlorides and others anions of a minerals acids causing permanent hardness. In the present investigation, the total hardness was recorded in the range of 71.19 mg/lit. to 150.40 mg/lit. in Mulchera Lake. The maximum values of total hardness observed during summer and minimum in the winter season. The higher values in summer may be due to the higher temperatures which increases the concentrations of salts by excessive evaporation.

Calcium is an important constituent in natural water. It has been known that calcium content plays an important role in the biological productivity of the lakes and ponds. Magnesium is one of the main constituents in natural waters and is a vital component of chlorophyll. In the present investigations, in Mulchera lake, the calcium hardness recorded is in the range of 36.50 mg/lit. to 95.18 mg/lit. While magnesium observed ranging from 15.75 mg/lit to 51.25 mg/lit. In the present investigation, calcium and magnesium hardness was minimum during winter and maximum during the summer season. An increase in calcium and magnesium concentrations during pre-monsoon may be the effect of bacterial decompositions. In

the present investigation, the maximum values of calcium and magnesium hardness were due to low water levels and bacterial decompositions of the organic matter in the lake.

Chlorides as anions were found in all natural waters in widely differing concentrations. The origin of chlorides in surface waters is from leaching of sedimentary rocks, domestic and industrial wastes discharged by municipal influents, and weathering of rocks, etc. In the present investigation, the values of chloride recorded are 11.42 mg/lit. to 26.24 mg/lit. in Mulchera lake. In the present investigation, minimum chloride was recorded during monsoon season and maximum during the summer season in Mulchera lake.

Biochemical Oxygen Demand is an indicator parameter to know the presence of biodegradable matter in the waste and expresses the degree of contamination. Biochemical oxygen demand is being used as a major indicator of the amounts of organic materials in an aquatic solution which supports the growth of microorganisms. In the present investigation, the biochemical oxygen demand values recorded are 5.50 mg/lit. to 13.50 mg/lit. in Mulchera lake. In the present investigation, the maximum biochemical oxygen demand value was recorded during monsoon and minimum during the winter season. Patel (1999) reported higher biochemical oxygen demand values in summer and stated that it may be due to higher microbial activities. In the present investigations, the maximum biochemical oxygen demand in summer is probably due to high microbial activities during summer.

The Chemical Oxygen Demand (COD) test is commonly used indirectly to measure the number of organic compounds in water. An amount of organic pollutants found in surface water is determined by so many applications of COD determination which makes COD as a useful domain of water quality. In the present investigation, the chemical oxygen demand values recorded are 9 mg/lit. to 20.50 mg/lit. in Mulchera lake. Thirumala et al., (2006) 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. However, minimum chemical oxygen demand in winter is due to low temperature, low decomposition activities and dilution effect.

Phosphorus is found naturally in rocks and other mineral deposits. Phosphorus moves in a cyclic manner through rocks, water, soil and sediments of organisms. Overtime rain and causes rocks to release phosphorus as phosphate ions which are soluble in water. In the present investigation, phosphate is recorded between 0.12 mg/lit. to 0.19 mg/lit. in Mulchera lake. In this research work, the higher values of phosphorus are observed in summer while lower values in winter. The higher values of phosphate during summer seasons may be due to rapid evaporation and mineralization of decomposed materials in pond water.

In natural water, sulphide is the second most common anion, being from most sedimentary rocks. In the present investigation, the values of sulphate recorded are 0.90 mg/lit. to 1.65 mg/lit. in Mulchera lake. In the present investigation, maximum sulphate level was recorded during summer and minimum during the winter season. In the present study, higher concentration of sulphur recorded in summer is probably due to the activity of biodegradation whereas dilution and utilization of sulphate by the aquatic plants gradually brought down the sulphate concentration in monsoon followed by winter.

Nitrate content is an excellent parameter to judge organic pollution and it represents the highest oxidized form of nitrogen. The nitrates are an important source of nitrogen for phytoplankton. In the present investigation, the values of nitrate range between 0.12 mg/lit. to 0.30 mg/lit. in Mulchera lake. In the present investigation, maximum nitrate was recorded during the monsoon and minimum during the winter season. The seasonal physico-chemical parameters of Mulchera lake exhibit cyclical variations. The slight high value of conductivity, total alkalinity, chloride, Phosphate and Nitrate in Mulchera lake indicate towards its slight polluted nature and it exhibits a slightly polluted status.

CONCLUSION :

The present study was conducted to find out the seasonal variations in the water quality parameters of a water body situated at the heart village at Mulchera tehsil of district Gadchiroli (M.S.) India. The period of the

study was from December 2019 to January 2020. DO, transparency and alkalinity was observed maximum in the winter seasons, while the values of DO and alkalinity are seen less in the summers.

Atmospheric temperature, water temperature, conductivity, pH, hardness, COD, chlorides, phosphate and sulphate values are more in the summers but these values are less in the winters. Higher values of CO₂, BOD and nitrates observed in the monsoon while the values of these parameters are less in the winters.

Thus by studying the seasonal variations in the physico- chemical parameters of this Mulchera lake it become clear that the pond is slightly polluted in nature and can't be used for the drinking purpose, though the water from this pond may be used for irrigation and other household purposes.

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Observations:

Observations have been recorded in the following tables.

Table 1: Monthwise physico-chemical parameters of Mulchera lake during period 2019-2020

Sr.No.	Parameters	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.
1	Atmospheric Temperature	25.18	26.43	24.82	26.68	39.73	45.82	44.69	36.17	32.68	33.79	34.52	33.55
2	Water Temperature	24.27	23.55	23.67	25.31	26.64	31.71	33.79	33.89	33.09	31.41	28.57	27.39
3	pH	6.88	7.40	7.33	7.58	7.20	7.77	7.77	7.52	6.87	6.89	7.25	7.20
4	D.O.	3.28	3.30	3.47	3.49	2.81	2.84	2.78	2.79	3.16	2.99	2.85	2.89
5	CO ₂	2.69	2.55	2.25	2.15	3.26	3.34	5.08	6.32	6.22	5.00	5.11	4.99
6	Transparency	29.89	30.58	30.54	31.34	30.64	29.67	28.88	26.32	20.33	20.20	19.95	22.76
7	Conductivity	178.50	182.50	179.50	167.00	168.50	170.50	198.50	206.50	195.00	175.00	168.50	156.50
8	Total Alkalinity - M.O.	17.50	16.00	14.50	13.50	11.00	10.50	9.50	9.50	10.00	14.00	21.00	19.50
9	Hardness – Total	79.20	81.45	71.19	87.15	110.10	145.70	150.40	140.30	137.10	132.15	126.15	110.10
10	Hardness - Cal.	38.60	36.50	48.80	60.40	80.84	92.15	95.18	91.95	87.20	85.70	82.60	70.10
11	Hardness - Mag.	24.55	21.80	20.10	15.75	32.15	48.55	50.30	51.25	42.95	43.45	41.90	39.22
12	Chlorides	18.80	16.75	20.80	22.50	23.20	24.12	26.24	22.46	19.99	15.35	11.42	13.25
13	B.O.D.	5.50	6.00	6.50	7.00	8.00	9.50	11.50	13.50	13.00	12.00	11.50	8.50
14	C.O.D	9.00	9.50	9.00	12.50	18.00	19.50	20.50	20.00	19.00	18.00	15.50	14.00
15	Phosphate	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.18	0.17	0.17	0.16	0.16
16	Sulphate	0.90	1.00	1.30	1.45	1.60	1.65	1.45	1.20	1.60	1.20	1.15	1.20
17	Nitrate	0.18	0.17	0.18	0.12	0.21	0.16	0.20	0.23	0.25	0.26	0.30	0.29

Table 2: Seasonal variations in physico-chemical parameters during 2019-2020 in Mulchera Lake

Sr.No.	Parameters	Winter		Summer		Monsoon	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
1	Atmospheric Temperature	25.777 ± 3.034		41.602 ± 4.340		33.635 ± 3.445	
2	Water Temperature	24.450 ± 2.401		31.507 ± 4.404		30.115 ± 1.627	
3	pH	7.297 ± 0.194		7.427 ± 0.321		7.052 ± 0.673	
4	D.O.	3.385 ± 0.243		2.805 ± 0.262		2.972 ± 0.096	
5	CO ₂	2.410 ± 0.817		4.500 ± 1.809		5.330 ± 0.500	
6	Transparency	30.587 ± 0.942		28.877 ± 1.494		20.810 ± 1.768	
7	Conductivity	176.875 ± 14.841		186.000 ± 17.035		173.750 ± 25.645	
8	Total Alkalinity - M.O.	15.375 ± 2.062		10.125 ± 0.803		11.625 ± 4.969	
9	Hardness – Total	79.747 ± 8.947		136.625 ± 19.990		126.375 ± 13.073	
10	Hardness - Cal.	46.075 ± 10.299		90.030 ± 8.655		81.400 ± 4.028	
11	Hardness - Mag.	20.550 ± 8.718		45.562 ± 11.347		41.880 ± 9.129	
12	Chloride	19.712 ± 3.974		24.005 ± 0.638		12.502 ± 3.099	
13	B.O.D.	6.250 ± 0.500		10.625 ± 2.236		11.250 ± 3.112	

14	C.O.D	10.000 ± 1.871	19.500 ± 0.707	16.625 ± 2.385
15	Phosphate	0.137 ± 0.013	0.180 ± 0.007	0.165 ± 0.005
16	Sulphate	1.162 ± 0.196	1.475 ± 0.499	1.287 ± 0.112
17	Nitrate	0.162 ± 0.043	0.200 ± 0.023	0.275 ± 0.008

