RESEARCH ARTICLE

Studies on Physico-chemical analysis of Mohabala Lake near Bhadrawati, District - Chandrapur (MS), India

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ABSTRACT

The Mohabala lake is principal fresh water body located within Bhadrawati tahsil in Chandrapur District of Maharashtra state. Now a day lakes are degraded by both natural and anthropogenic activities, which deteriorate their quality of lake water. Normally, lakes perform the functions directly related to their physical, chemical and biological integrity to decide quality status of water. The analysis of various physico-chemical characteristics of water quality of Mohobala lake at different sites under study viz. Site A, Site B and Site C were carried out for two years i.e. from June 2013 to May 2015 for the detection of level of pollution, physic-chemical parameters analysis like, Atmospheric temperature (°C), Water temperature (°C), Transparency (cm.), Conductivity (µmhos/cm.), pH, D.O. (mg/lit.), Free CO_2 (mg/lit.), Total alkalinity (mg/lit.), Phenolphthalein alkalinity (mg/lit.), Total hardness (mg/lit.), Calcium hardness (mg/lit.), Magnesium hardness (mg/lit.), Chloride (mg/lit.), B.O.D. (mg/lit.), C.O.D. (mg/lit.), Phosphate (mg/lit.), Sulphate (mg/lit.), Nitrate (mg/lit), Total solids (mg/lit.). Total dissolved solids (mg/lit.), Total suspended solids (mg/lit.).

Key words: Physico-chemical, Analysis, Mohabala lake.

INTRODUCTION

Water is the prime requirement for the existence of life and thus it has been man's endeavor for the time immemorial to utilize the available resources. The unbridled exploitation of water for irrigation, drinking and industrial purposes has caused a drastic decline of the quality and availability of water. Lakes, rivers and reservoirs are the very important water resources and used for various purposes. Physico-chemical parameters are the important component of the aquatic system as they indicate the water quality of aquatic ecosystem. This present study was conducted at three different sites in the Mohobala lake. Monthly and Seasonal variations in the physico-chemical parameters in Mohobala lake were studied during the study period of June 2013 to May 2015. This study indicates that the lakes of central India exhibit substantial variation in their biotic and abiotic characteristics

MATERIAL AND METHODS

The water samples were collected from the three sites of Mohabala lake and name them site 'A' site 'B' and site 'C'. Marginal areas at 1 to 1.5 m depth with the help of Ruffner's sampler. The water samples were collected in dried plastic cans of 5 lt. capacity. The water sample collected during the morning hours between 8.30 to 10.30 am. The samples were collected each month for the period of 2 years i.e. from June 2013 to May 2015. The recorded data was separated in 3 seasons, Monsoon (June to September), Winter (October to January) and Summer (February to May). During the determination, physicochemical parameter like atmospheric temperature, water temperature, pH and transparency were determined on the sampling spot.

The mercury thermometer was employed to record the temperature of the Atmosphere Temperature and for Water temperature. Transparency was determined with the help of Secchi disc (Secchi 1865). The conductivity of water was measured directly with the help of Conductivity Meter. The instrument (model no. EQ- 660) was checked constantly by using standard potassium chloride solutions. Cell constant of the conductance 822 mho cm^{-1}.Total solids are determined as the residue left after evaporation of the unfiltered sample. Total dissolved are determined as the residue left after evaporation of the filtered sample. Total Suspended Solids are determining as the difference between the total solids and the total dissolved solids. The pH was measured by pH meter (model no.EQ-614). Dissolved oxygen (DO) was measured by modified Winkler's method (1988). Free carbon dioxide in water was measured by titrometric method of APHA (1985). Alkalinity was measured by titrometric method using phenolphthalein and methyl orange indicator. Total Hardness was measured by titrometric method using Eriochrome Black-T indicator.

Calcium hardness and Magnesium hardness was measured titrometrically by using EDTA and Eriochrome Black-T indicator. Magnesium Hardness was estimated by subtracting the calcium hardness from total hardness. Chloride was measured by titrometric method using potassium chromate indicator. Biochemical Oxygen Demand was estimated by Iodometric Method of APHA (1985). Chemical Oxygen Demand was measured by titrometric method of Open Reslus Method of APHA (1985) using Ferroin indicator. Phosphate is measured by turbidometric method with the help of Spectrophotometer at 690 nm against a standard curve drawn from different known concentrations. Sulphate was measured Spectrophotometrically at 420 nm against a standard curve drawn from different known concentrations. Nitrate was measured by Spectrophotometer by cadmium reduction colorimetric method at 410 nm against a standard curve drawn from different known concentrations. APHA (1985). Total solids are determined as the residue left after evaporation of the unfiltered sample. Total dissolved are determined as the residue left after evaporation of the filtered sample. Total Suspended Solids are determining as the difference between the total solids and the total dissolved solids.

RESULT AND DISCUSSION

The atmospheric temperature was always found higher than the temperature of water. In the present investigation the atmospheric temperature was recorded is higher than the water temperature at all sampling three sites. It is fluctuated between 21.11°C to 45.28°C in site A, 21.56°C to 45.23°C in site B and 21.15°C to 45.21°C in site C. Similar findings were also recorded by Rawat and Jakher (2007) in Gulab Sagar lake, Rajasthan. The water temperature fluctuated between 19.03°C to 36.55°C in site A, 18.07°C to 34.57°C in site B and 18.68°C to 34.89°C in site C. During the present investigation, water temperature fallows more or less a similar trend as that of atmospheric temperature, there was no great difference in water temperature. Khabade *et.al.,* (2002) recorded the water temperature between 25°C to 33°C in Lodhe water reservoir from Tasgeon tahsil, Sangali (M.S.). In the present investigation there is a gradual lessening in the temperature of water from August to December and it increases till May. Thus it shows the temperature of water affected by seasonal changes in atmospheric temperature. Transparency is a physical variable significant to primary production. In the present investigation, Sacchi disc transparency was recorded at 11.00 cm to 63.99 cm in site A, 11.78 cm to 67.23 cm in site B and 9.23 cm to 72.33 cm in site C. Upadhyay (2014) recorded the values of transparency between 6.0 cm to 92.0 cm in ponds of Ratanpur of Bilaspur District, Chhattisgarh. Seasonally maximum transparency was recorded during summer

Table 1: Seasonal variation of physico-chemical parameter in Mohabala lake at site-A during 2013-14

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	31.23	±	1.59	23.66	±	1.64	39.26	±	3.85	31.38	±	1.05
2	**Wat. Temp.**	28.75	±	3.15	20.48	±	1.36	30.04	±	1.24	26.42	±	0.87
3	**Trans.**	13.75	±	2.81	30.08	±	5.41	50.14	±	9.83	31.32	±	2.90
4	**Cond.**	274.25	±	173.03	154.00	±	57.19	590.00	±	22.86	339.42	±	64.25
5	**pH**	7.00	±	0.16	7.30	±	0.07	7.55	±	0.11	7.28	±	0.04
6	**D.O.**	2.540	±	0.387	4.100	±	0.474	1.750	±	0.568	2.797	±	0.074
7	**CO_2**	1.575	±	0.363	2.900	±	0.548	4.250	±	0.269	2.908	±	0.116
8	**Alk. Total**	38.50	±	16.77	71.25	±	5.12	86.00	±	7.07	65.25	±	5.10
9	**Har. TO**	39.063	±	5.049	26.192	±	2.454	109.018	±	25.395	58.091	±	10.258
10	**Har. MG**	37.344	±	4.414	17.682	±	4.308	62.219	±	7.354	39.082	±	1.412
11	**Har. CA**	35.750	±	3.700	23.750	±	3.700	71.000	±	4.899	43.500	±	0.565
12	**CHL**	3.852	±	0.561	4.936	±	0.893	12.759	±	3.076	7.182	±	1.116
13	**B.O.D.**	2.850	±	0.610	3.950	±	0.502	5.375	±	0.853	4.058	±	0.146
14	**C.O.D.**	13.800	±	0.447	4.450	±	1.001	23.000	±	1.281	13.750	±	0.346
15	**PHO**	1.838	±	0.225	0.615	±	0.068	3.748	±	0.511	2.067	±	0.183
16	**SUL**	4.835	±	0.411	3.295	±	0.219	5.418	±	0.721	4.516	±	0.206
17	**NIT**	0.507	±	0.035	0.237	±	0.018	0.345	±	0.025	0.363	±	0.007
18	**T.S.**	800.00	±	0.00	400.00	±	70.71	600.00	±	70.71	600.00	±	33.33
19	**T.D.S.**	500.00	±	70.71	200.00	±	70.71	300.00	±	70.71	333.33	±	0.00
20	**T.S.S.**	300.00	±	70.71	250.00	±	50.00	325.00	±	82.92	291.67	±	13.59

Table 2: Seasonal variation of physico-chemical parameter in Mohabala lake at site-A during 2014-15

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	33.14	±	4.69	24.24	±	2.95	35.65	±	7.88	31.01	±	2.04
2	**Wat. Temp.**	28.13	±	4.37	21.72	±	1.22	28.95	±	5.52	26.27	±	1.82
3	**Trans.**	21.52	±	6.90	38.71	±	2.19	55.25	±	5.83	38.49	±	2.01
4	**Cond.**	290.50	±	112.29	145.00	±	6.20	505.50	±	20.67	313.67	±	46.97
5	**pH**	7.30	±	0.19	7.53	±	0.08	8.05	±	0.21	7.63	±	0.05
6	**D.O.**	2.980	±	0.966	6.300	±	0.778	2.300	±	0.644	3.860	±	0.132
7	**CO_2**	2.450	±	0.269	3.575	±	0.356	6.125	±	1.703	4.050	±	0.657
8	**Alk. Total**	56.50	±	9.53	78.25	±	5.63	111.25	±	2.59	82.00	±	2.84
9	**Har. TO**	72.855	±	5.193	35.804	±	2.460	137.735	±	46.215	82.131	±	20.013
10	**Har. MG**	39.844	±	5.971	35.182	±	3.224	94.719	±	5.190	56.582	±	1.156
11	**Har. CA**	50.750	±	6.016	41.250	±	6.016	103.500	±	7.921	65.167	±	0.898
12	**CHL**	8.718	±	0.393	13.697	±	1.980	24.672	±	1.271	15.695	±	0.649
13	**B.O.D.**	6.225	±	0.683	9.175	±	1.748	12.100	±	1.377	9.167	±	0.441
14	**C.O.D.**	15.700	±	2.304	10.950	±	1.135	25.250	±	2.012	17.300	±	0.497
15	**PHO**	2.025	±	0.218	2.958	±	0.616	5.778	±	1.315	3.587	±	0.453
16	**SUL**	5.148	±	0.925	3.390	±	0.651	5.383	±	0.146	4.640	±	0.323
17	**NIT**	0.463	±	0.038	0.201	±	0.052	0.305	±	0.033	0.323	±	0.008
18	**T.S.**	2407.50	±	819.86	750.00	±	111.80	1825.00	±	739.51	1660.83	±	316.55
19	**T.D.S.**	1380.00	±	379.74	325.00	±	192.03	1075.00	±	601.56	926.67	±	167.38
20	**T.S.S.**	1027.50	±	512.12	375.00	±	129.90	750.00	±	206.16	717.50	±	165.17

and minimum during the monsoon. Similar observations are also seen by Oomachand (1981) reported minimum transparency of water in rainy seasons and maximum in winter from lower lake of Bhopal (M.P.). Maximum transparency was recorded during summer due to, settling of particles, sand slit, clay, high light penetration and less phytoplankton productivity and minimum during the monsoon due to the turbid conditions of water influenced of suspended slit with colloidal particles. Conductivity measures the capacity of water to conduct an electric current. In the present investigation the values of conductivity recorded are 103 µmhos/cm to 617 µmhos/cm in site A, 102 µmhos/cm to 657 µmhos/cm in site B and 116 µmhos/cm to 636 µmhos/cm in site C. Chouhan and Sharma (2007) recorded the values of conductivity between 0.80 mmhhos/cm to 1.65 mmhhos/cm in the lake Budha, Pushkar near Ajmer, Rajasthan. Seasonally maximum conductivity of water was recorded during summer and minimum during the winter. Similar observations also seen by Chandrashekhar and Kodarkar (2004) from Saroornagar lake, Hyderabad. Maximum conductivity was recorded during summer due to increase in the concentration of minerals, salts, evaporation of water and also by discharge of domestic sewage and organic matter from the nearby residential areas into the lake and minimum during the winter due to nutrients uptake by plants, increase in bacterial degradation and stabilization of water. pH measures the intensity of acidity and alkalinity of water. In the present investigation, the pH is range between 6.80 to 8.30 in site A, 6.70 to 8.50 in site B and 6.60 to 8.40 in site C. Seasonally the maximum pH was recorded during summer and minimum during monsoon similar findings were also founded by Jakher and Rawat (2003) observed the maximum pH of water during summer. Maximum pH was recorded during the summer season due to high photosynthetic activity in water. Dissolved oxygen is important for aerobic metabolism of aquatic ecosystem. In the present investigation the values of dissolve oxygen recorded ranges between 1.2 mg/lit. to 7.2 mg/lit. in site A, 1.3 mg/lit. to 7.5 mg/lit. in site B and 1.1 mg/lit. to 6.5 mg/lit. in site C. Similar findings were also observed by Pawar and Pulle (2005) reported the value ranges of dissolved oxygen from 2.8 mg/lit to 9.6 mg/lit in Pethwadaj dam, Nanded (M.S.) and Rawat and Jakher (2007) reported the dissolve oxygen between 1.94 mg/lit. to 9.25 mg/lit. in a fresh waterbody of the desert of Rajasthan, India. Seasonally the maximum dissolved oxygen was recorded during the winter and minimum during the summer. Gayathri, *et.al.,* (2013) recorded maximum dissolve oxygen during the winter and minimum during the summer in Shoolkere Lake, Bangalore. The higher values of dissolve oxygen during winter was due low atmospheric temperature and intensive photosynthetic activity by plants, while minimum values during summer was due to high atmospheric temperature and high metabolic rate of organisms and decreased oxygen holding capacity of water at high temperature. The free carbon dioxide recorded in the present study is 1.30 mg/lit. to 8.60 mg/lit. in site A, 1.10 mg/lit. to 7.20 mg/lit. in site B and 1.5 mg/lit. to 9.30 mg/lit. in site C. Pejawar and Gurao (2008) reported free carbon dioxide upto 5.70 mg/lit in Kalwa lake and upto 9.9 mg/lit in Jail lake of Thane (M.S.). Seasonally the free carbon dioxide of water is maximum in summer and minimum in monsoon. Maximum carbon dioxide of water in summer recorded by Jain and Seethapati (1996) at Halalli reservoir of Vidisha district, Madhya Pradesh. The maximum free carbon dioxide in summer is due to the high rate of decomposition of organic matter in the warmer months and high rate of respiration of aquatic organisms, however minimum free carbon dioxide during monsoon may be due to a decrease in the photosynthetic activity of aquatic organisms.

Alkalinity is a measure of buffering capacity of the water. In the present investigation the total alkalinity ranged between 22.00 mg/lit. to 115.00 mg/lit. in site A, 32.00 mg/lit. to 128.00 mg/lit. in site B and 27.00 mg/lit. to 109.00 mg/lit. in site C. Garg *et.al.,* (2010) recorded the of total alkalinity values between 64.25 mg /lit. to146.25 mg/lit. in Ramsagar reservoir of Datia District, Madhya Pradesh. Seasonally maximum values of alkalinity founded during summer and minimum during rainy season Goldman and Wetzel, (1963) and Sreenivasan (1966) found maximum alkalinity during the summer which declined subsequently in the monsoon. Total alkalinity was maximum during summer due to decrease in water level and also by entry of more domestic waste, sewage attributed to increase in the rate of decomposition from which CO_2 is liberated, which reacts with water to form bicarbonates, due to which is total alkalinity increases in summer and minimum in monsoon due to dilution caused by the rain water during monsoon This was further supported by many researchers, Moss (1973) and Wetzel (1983). Similar observations were also made by Bhongade and Patil (2010), Patil (2012) and Gayathri (2013).

Table 3: Seasonal variation of physico-chemical parameter in Mohabala lake at site-B during 2013-14

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	31.04	±	1.54	23.76	±	1.40	39.33	±	3.87	31.38	±	1.13
2	**Wat. Temp.**	29.14	±	3.65	19.76	±	1.57	28.75	±	2.34	25.88	±	0.86
3	**Trans.**	18.76	±	4.50	34.07	±	5.04	42.93	±	8.97	31.92	±	1.99
4	**Cond.**	381.50	±	38.64	209.00	±	55.98	581.00	±	47.71	390.50	±	7.08
5	**pH**	7.03	±	0.19	7.40	±	0.12	7.98	±	0.13	7.47	±	0.03
6	**D.O.**	2.825	±	0.750	3.450	±	0.826	1.600	±	0.308	2.625	±	0.228
7	**CO_2**	1.475	±	0.249	3.025	±	0.668	5.750	±	0.568	3.417	±	0.179
8	**Alk. Total**	42.25	±	10.11	54.25	±	7.76	94.00	±	11.38	63.50	±	1.50
9	**Har. TO**	43.988	±	8.593	29.351	±	2.127	82.359	±	10.643	51.899	±	3.629
10	**Har. MG**	31.073	±	7.783	15.884	±	3.071	53.274	±	6.407	33.410	±	1.978
11	**Har. CA**	33.250	±	9.523	21.250	±	1.479	53.500	±	6.538	36.000	±	3.320
12	**CHL**	4.168	±	0.697	6.568	±	0.693	17.005	±	2.385	9.247	±	0.797
13	**B.O.D.**	2.900	±	0.346	3.775	±	0.998	6.125	±	0.743	4.267	±	0.268
14	**C.O.D.**	21.450	±	1.322	8.350	±	3.093	27.000	±	2.615	18.933	±	0.748
15	**PHO**	2.368	±	0.386	0.700	±	0.084	5.003	±	0.762	2.690	±	0.278
16	**SUL**	6.445	±	0.383	4.825	±	0.669	8.430	±	0.800	6.567	±	0.174
17	**NIT**	0.645	±	0.036	0.310	±	0.054	0.367	±	0.074	0.441	±	0.015
18	**T.S.**	1675.00	±	334.48	625.00	±	147.90	725.00	±	43.30	1008.33	±	120.43
19	**T.D.S.**	900.00	±	122.47	225.00	±	43.30	375.00	±	43.30	500.00	±	37.32
20	**T.S.S.**	775.00	±	294.75	400.00	±	141.42	350.00	±	50.00	508.33	±	100.98

Table 4: Seasonal variation of physico-chemical parameter in Mohabala lake at site-B during 2014-15

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	33.13	±	4.65	24.21	±	2.92	35.62	±	7.86	30.99	±	2.04
2	**Wat. Temp.**	28.10	±	4.41	22.19	±	2.71	30.43	±	4.92	26.91	±	0.94
3	**Trans.**	14.29	±	1.74	31.20	±	11.60	56.56	±	8.96	34.01	±	4.17
4	**Cond.**	295.25	±	168.71	157.50	±	48.71	447.25	±	21.19	300.00	±	64.05
5	**pH**	3.65	±	0.42	7.30	±	0.12	8.38	±	0.13	6.44	±	0.14
6	**D.O.**	2.550	±	0.206	6.825	±	0.698	2.400	±	0.255	3.925	±	0.221
7	**CO_2**	2.750	±	0.112	3.700	±	0.524	6.600	±	0.430	4.350	±	0.177
8	**Alk. Total**	57.25	±	4.21	64.50	±	2.69	107.00	±	14.51	76.25	±	5.25
9	**Har. TO**	61.483	±	6.915	46.808	±	2.633	149.564	±	55.633	85.952	±	24.039
10	**Har. MG**	40.573	±	1.608	27.384	±	1.243	82.524	±	19.958	50.160	±	8.738
11	**Har. CA**	50.750	±	6.759	31.750	±	0.829	100.750	±	20.204	61.083	±	8.105
12	**CHL**	12.192	±	0.678	25.574	±	2.007	25.519	±	1.354	21.095	±	0.542
13	**B.O.D.**	6.225	±	0.164	10.250	±	1.645	14.675	±	1.460	10.383	±	0.659
14	**C.O.D.**	24.150	±	2.095	14.500	±	2.748	34.300	±	0.640	24.317	±	0.881
15	**PHO**	3.410	±	0.339	2.613	±	0.490	6.653	±	0.938	4.225	±	0.254
16	**SUL**	5.310	±	0.971	3.608	±	0.712	6.318	±	0.725	5.078	±	0.119
17	**NIT**	0.430	±	0.029	0.140	±	0.022	0.283	±	0.033	0.284	±	0.005
18	**T.S.**	2775.00	±	672.22	675.00	±	227.76	1150.00	±	455.52	1533.33	±	181.47
19	**T.D.S.**	1525.00	±	511.74	250.00	±	86.60	550.00	±	335.41	775.00	±	174.40

The hardness of water is mainly due to concentration of alkaline earth metals cation such as Ca ++, Mg++. In the present investigation the total hardness was recorded in the range of 22.044 mg/lit. to 217.474 mg/lit. in site A, 26.470 mg/lit. to 245.450 mg/lit. in site B and 27.448 mg/lit. to 219.231 mg/lit. in site C. Sunkad and Patil (2004) observed the values between 59.8 mg/lit. to 217.4 mg/lit. in Fort lake of Belgaum, Karnataka, Andhra Pradesh. Seasonally the total hardness value was maximum during summer and minimum in winter. Kataria *et.al.,* (1996) also observed the maximum value of total hardness in summer, moderate in monsoon and minimum in winter at Kolar reservoir in Bhopal, Madhya Pradesh. High value in summer is mostly due to rising in temperature due to which increase the solubility of Ca and Mg salt and decrease in water volume similar observations also made by Manish Upadhyay (2014). In the present investigations the calcium hardness was recorded in the range of 18.00 mg/lit. to 117.00 mg/lit. in site A, 9.00 mg/lit. to 125.00 mg/lit. in site B and 17.00 mg/lit. to 108.00 mg/lit. in site C. In the present investigations the magnesium hardness was recorded in the range of 12.313 mg/lit. to 103.179 mg/lit. in site A, 11.00 mg/lit. to 112.905 mg/lit. in site B and 16.146 mg/lit. to 67.103 mg/lit. in site C. Airsang, R.V. and H.C. Lakshman (2013) recorded the values of calcium hardness between 36 mg/l to 240 mg/l, and for magnesium hardness 11.6 mg/l to 129.3 mg/l. in Shetter lake of Navalgund, Dharwad District in Karnataka.

Seasonally calcium and magnesium hardness was minimum during winter and maximum during the summer. Bhongade and Patil (2010) recorded the maximum value of calcium hardness was recorded in May 2005 and minimum in August 2004 of Mohgavhan lake of Karanja (Lad) of District Washim (M.S.). Maximum values of calcium and magnesium hardness in summer is due to low water levels which increases concentration and decomposition by bacteria of the organic matter in the lake. Chloride as anion occurs in all natural waters. In the present investigation, the values of chloride recorded are as 3.110 mg/lit. to 26.583 mg/lit. in site A, 3.398 mg/lit. to 28.549 mg/lit. in site B and 5.638 mg/lit. to 35.585 mg/lit. in site C. Ahmed and Krishanamurthy (1990) recorded the chloride range of 8.58 to 29.52 ppm and 13.37 to 46.64 ppm during 1976 to 1977 and 1977 to 1978, respectively. Seasonally minimum chloride was recorded during rainy season and maximum during the summer season in all the three sites of lakes. Pejawar *et.al.,* (2004) reported low chloride range during rainy seasons and high in summer and Minimum values of chloride recorded during rainy seasons suggesting dilution by rain water and renewal of water mass alter. It is high in summer may be due to from evaporation and discharge of domestic sewage from nearby residential peoples. Similar observations have been reported by Chouhan and Sharma (2007) and Narayana, *et.al*., (2008). Biochemical Oxygen Demand has been used as a major of organic materials in an aquatic solutions which supports growth of microorganisms. In the present investigation, the biochemical oxygen demand values recorded are 2.1 mg/lit. to 13.6 mg/lit. in site A, 2.3 mg/lit. to 17.1 mg/lit. in site B and 3.2 mg/lit. to 22.5 mg/lit. in site C of pond. Kamat *et.al.,* (2006) reported the biochemical oxygen demand values 1.23 mg/lit to 4.5 mg/lit in Husalli tank and 4.8 mg/lit to 32.00 mg/lit in Purle tank of Shimoga district, Karnataka.

Seasonally the maximum biochemical oxygen demand value is recorded during summer and minimum during the monsoon season. Bhatt *et.al.,* (1999) documented that the maximum range of biochemical oxygen demand in summer and minimum in winter and stated that high values of biochemical oxygen demand may be due to higher rate of organic decompositions and gradual decline of biochemical oxygen demand from monsoon followed by winter, which could be due to decrease in temperature which in turn retards the microbial activities. In the present investigation, the chemical oxygen demand values recorded are 3.4 mg/lit. to 28.4 mg/lit. in site A, 5.2 mg/lit. to 35.20 mg/lit. in site B and 8.8 mg/lit. to 36.60 mg/lit. in site C of pond. Kamat *et.al.,* (2006) observed the value of chemical oxygen demand fluctuated between 226.5 mg/lit. in Husalli tank and 12 mg/lit. to 18 mg/lit. in Purle tank of Shimoga district, Karnataka. Seasonally maximum chemical oxygen demand was recorded during the summer and minimum during the winter. Salve and Hiware (2006) observed the maximum values of chemical oxygen demand in summer and monsoon and minimum in winter in Wanparakalpa Reservoir, Nagapur of Dist. Beed and stated that minimum value of chemical oxygen demand in winter due to fewer amounts of water, death and decay of aquatic flora and fauna and minimum chemical oxygen demand in winter due to settlement and dilution effect. Maximum chemical oxygen demand value is recorded during the summer season may be due to

Table 5: Seasonal variation of physico-chemical parameter in Mohabala lake at site-C during 2013-14

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	31.23	±	1.53	23.59	±	1.55	39.27	±	3.92	31.36	±	1.12
2	**Wat. Temp.**	28.69	±	2.41	20.56	±	1.67	30.80	±	1.79	26.69	±	0.32
3	**Trans.**	17.18	±	4.73	33.72	±	7.88	44.29	±	4.80	31.73	±	1.47
4	**Cond.**	415.75	±	86.96	340.75	±	97.96	580.00	±	44.72	445.50	±	22.95
5	**pH**	6.83	±	0.18	7.43	±	0.11	8.00	±	0.07	7.42	±	0.04
6	**D.O.**	2.825	±	1.415	3.700	±	0.552	1.950	±	1.021	2.825	±	0.353
7	**CO_2**	1.600	±	0.071	3.375	±	0.753	4.775	±	0.589	3.250	±	0.291
8	**Alk. Total**	46.25	±	11.34	59.50	±	4.72	93.75	±	4.97	66.50	±	3.07
9	**Har. TO**	49.379	±	5.744	30.223	±	2.998	108.592	±	13.678	62.731	±	4.528
10	**Har. MG**	29.202	±	2.712	14.052	±	1.608	60.013	±	4.788	34.422	±	1.319
11	**Har. CA**	34.000	±	2.121	19.500	±	2.179	60.500	±	6.874	38.000	±	2.227
12	**CHL**	8.476	±	2.049	12.829	±	1.482	18.766	±	1.489	13.357	±	0.265
13	**B.O.D.**	3.475	±	0.363	5.250	±	0.844	7.200	±	0.707	5.308	±	0.202
14	**C.O.D.**	15.400	±	2.358	11.150	±	1.824	28.500	±	4.736	18.350	±	1.266
15	**PHO**	2.520	±	0.334	1.380	±	0.364	4.724	±	0.291	2.875	±	0.030
16	**SUL**	5.903	±	0.556	5.458	±	0.414	7.510	±	0.491	6.290	±	0.058
17	**NIT**	0.518	±	0.068	0.173	±	0.044	0.323	±	0.023	0.338	±	0.019
18	**T.S.**	3800.00	±	452.77	1050.00	±	229.13	2050.00	±	335.41	2300.00	±	91.34
19	**T.D.S.**	2125.00	±	178.54	500.00	±	254.95	925.00	±	178.54	1183.33	±	36.02
20	**T.S.S.**	1925.00	±	711.95	575.00	±	108.97	1125.00	±	303.11	1208.33	±	251.31

Table No. : 6: Seasonal variation of physico-chemical parameter in Mohabala lake at site-C during 2014-15

S.N.	Parameters	Monsoon			Winter			Summer			Total		
1	**Atm. Temp.**	33.15	±	4.65	24.26	±	2.96	35.61	±	7.87	31.00	±	2.04
2	**Wat. Temp.**	27.99	±	4.90	20.47	±	0.80	29.18	±	4.45	25.88	±	1.84
3	**Trans.**	17.27	±	2.71	35.53	±	6.91	59.05	±	12.33	37.28	±	3.93
4	**Cond.**	259.50	±	64.49	158.50	±	51.24	467.50	±	64.06	295.17	±	6.15
5	**pH**	7.23	±	0.08	7.35	±	0.11	8.05	±	0.32	7.54	±	0.11
6	**D.O.**	2.200	±	0.982	4.700	±	1.206	3.225	±	1.487	3.375	±	0.207
7	**CO_2**	3.550	±	0.269	4.075	±	0.642	7.775	±	1.132	5.133	±	0.353
8	**Alk. Total**	54.50	±	6.65	76.50	±	7.83	105.50	±	2.69	78.83	±	2.20
9	**Har. TO**	68.765	±	4.731	55.493	±	3.412	135.168	±	48.763	86.476	±	21.075
10	**Har. MG**	35.702	±	4.386	24.052	±	1.608	84.513	±	6.349	48.089	±	1.945
11	**Har. CA**	44.000	±	6.285	30.500	±	2.062	97.500	±	6.344	57.333	±	2.005
12	**CHL**	15.197	±	1.939	20.716	±	3.198	29.278	±	4.049	21.731	±	0.867
13	**B.O.D.**	7.925	±	0.521	14.150	±	2.134	19.950	±	2.156	14.008	±	0.765
14	**C.O.D.**	13.000	±	3.842	7.850	±	1.090	30.150	±	5.833	17.000	±	1.945
15	**PHO**	4.075	±	0.895	2.868	±	0.480	6.840	±	0.690	4.594	±	0.170
16	**SUL**	4.148	±	0.143	3.398	±	0.255	6.120	±	0.689	4.555	±	0.235
17	**NIT**	0.471	±	0.019	0.225	±	0.027	0.300	±	0.073	0.332	±	0.024
18	**T.S.**	4250.00	±	502.49	1275.00	±	216.51	1250.00	±	269.26	2258.33	±	124.26
19	**T.D.S.**	2650.00	±	807.77	650.00	±	259.81	625.00	±	178.54	1308.33	±	279.45
20	**T.S.S.**	1475.00	±	601.56	525.00	±	326.92	625.00	±	238.48	875.00	±	154.59

higher decomposition activities and low level of water. Minimum in winter is due to low temperature, low rate of decomposition activities. Phosphorous is one of the most important nutrients of the living organisms. The major sources of phosphorus are detergents, domestic sewage, agricultural effluents, and industrial waste waters, weathering of phosphate bearing rocks and leaching of soil. In the present investigation, phosphate is recorded between 0.550 mg/lit. to 7.430mg/lit. in site A, 0.560 mg/lit. to 5.990 mg/lit. in site B and 1.030 mg/lit. to 7.680 mg/lit. in site C. Manish Upadhyay (2014) recorded the values of phosphate between 0.12 mg/lto 12.38 mg/l in ponds of Ratanpur, Bilaspur District, Chhattisgarh. Seasonally maximum phosphate was recorded during summer and minimum during winter similar observations also made by Patil, *et.al.,* (2008) also founded maximum phosphate during summer and minimum during the monsoon in two water bodies in Washim district (M.S.). Maximum phosphate was recorded during summer due to entry of domestic sewage in pond water and due to the washing of large amount of clothes by residential peoples. The sulphate ion occurs naturally in most water supplies and in wastewater also. During the present investigation, the values of sulphate recorded are 2.310 mg/lit. to 6.300 mg/lit. in site A, 2.460 mg/lit. to 9.120 mg/lit. in site B and 3.110 mg/lit. to 8.210 mg/lit. in site C. Sushmitha (2015) recorded the average amount of sulphate in the tank was found to be 8.01 mg/l in Kavoor tank in Dakshina Kannada, Karnataka. Seasonally maximum sulphate level was recorded during summer and minimum during winter. Ahmad and Krishnamurthy (1990) observed maximum sulphate during summer and minimum during the winter from Wohar reservoir, Aurangabad (M.S.). Higher concentration of sulphate in summer is mainly due to utilization of sulphate by aquatic plants and discharge of domestic sewage from residential people. Minimum values of sulphate in winter probably due to biodegradation and low water level (Gayathri, 2013). Nitrate content is most important parameter in studies of pollution. In the present investigation, the values of nitrate range between 0.134 mg/lit. to 0.547 mg/lit. in site A, 0.110 mg/lit. to 0.660 mg/lit. in site B and 0.110 mg/lit. to 0.560 mg/lit. in site C. Mohekdar *et al.,* (2003) observed the values of nitrate between 0.1 mg/lit. to 0.48 mg/lit. from Manjara reservoir (M.S.). Seasonaly maximum nitrate was recorded during the monsoon and minimum during the winter. Jakher and Rawat (2003) observed the maximum level during the monsoon and minimum during the winter in a trophical lake of Jodhpur, Rajasthan. Maximum value of nitrate was recorded during the monsoon due to entry of domestic sewage, surface run off. Water as a universal solvent, dissolved different type of materials as compare to other solvents (Welch, 1952). Total solids include all of the solid constituent of water, organic or inorganic or the total of the suspended and dissolved solids. In the present investigation, the values of total solids range between 300 mg/lit. to 3600 mg/lit. in site A, 400 mg/lit. to 1900 mg/lit. in site B and 800 mg/lit. to 1600 mg/lit. in site C. The values of total dissolved solids range between 100 mg/lit. to 1400 mg/lit. in site A, 200 mg/lit. to 1100 mg/lit. in site B and 200 mg/lit. to 800 mg/lit. in site C. and the values of total suspended solids range between 200 mg/lit. to 2200 mg/lit. in site A, 200 mg/lit. to 900 mg/lit. in site B and 400 mg/lit. to 900 mg/lit. in site C. Narasimha *et.al.,* (2011) recorded the values of total solid between 556.50 mg/l to 785.75 mg/l in a Perennial Tank in Warangal District, A.P. Ugale (2011) reported the values of total dissolved solid between 210 to274 mg/l. in Jakekur project (Reservoir). Kulkarni *et.al.,* (2013) recorded the values of total suspended solid between 50mg/lit. to 90 mg/lit in Kala Talao, Kalyan. Seasonally total solid, total dissolved solid and total suspended solid follow the same trend maximum in monsoon and minimum in winter season. Maximum values in in monsoon due to siltation, precipitation, increased surface runoff from nearby catchment area, sand, clay and other suspended particles entering into lake with the rain water.

CONCLUSION:

Lakes are important part of urban as well as rural ecosystem. Lakes are comparatively small in size but it perform significant role in environmental, drinking water, recharging groundwater social and economic functions. From the above observations, it may be concluded that the physico-chemical characteristics of three sites of Mohobala lake water varied consideratbly and showed characteristic change in relation to the seasonal changes.

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