International Journal for Research in Applied Sciences and Biotechnology

ISSN: 2349-8889
Volume-9, Issue-1 (January 2022)

www.ijrasb.com

https://doi.org/10.31033/ijrasb.9.1.17

Assessment of Physico-Chemical Characteristics of Sagar Tal in Budaun, U.P.

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ABSTRACT

Present work deals with the assessment of variations in physico-chemical parameters of Sagar Tal in Budaun, U.P., during July 2019 to June 2021. The location of this pond is at a distance of 2.5 km from Budaun Junction in the Nawada region at latitude 28.0512° N and longitude 79.1305° E. Analysis of various Physico-chemical parameters were performed using APHA standard methods for water analysis. The ranges of monthly mean values were obtained after analysis of water samples in triplicates, for air temperature (17.03-38.03°C), water temperature (18.03-38.97°C), transparency (10.00-26.00 cm), pH (8.00-9.80), dissolved oxygen (08.00-11.23 mg/l), free Carbon dioxide (0-8.0 mg/l), carbonate alkalinity (0-120 mg/l), bicarbonate alkalinity (29.48-117.93mg/l), chloride (9.98-16.66mg/l), calcium (44.11-107.47 mg/l), magnesium (21.95-67.71 mg/l) and total hardness (205.67-466 mg/l). The data were administered to various statistical analysis in order to explore the remarkable relationship among these parameters. A positive outcome of relationship of air temperature with water temperature (0.864), magnesium with both total hardness (0.915), dissolved oxygen was observed along with a negative relationship of water temperature and pH (-0.913).

Keywords- Sagar Tal, water quality, Physico-chemical parameters.

I. INTRODUCTION

In India ponds, rivers and ground water are utilized for homely and agricultural purposes. Water plays an unique role from the human point of consideration, as well as the aquatic medium functions as a habitat for several organisms. For the proper understanding of such aquatic life a thorough knowledge of water is required and also other external influences affecting them. The physical and chemical properties of freshwater bodies are characterized by the climatic, geochemical, geo morphological and pollution conditions. The aquatic life resembles the quality of water. For the successful utilization of freshwater bodies for fish production, it is very meaningful to examine the physico-chemical characteristics which affects the biological potency of the water body. Several studies have been performed on the limnology of freshwater bodies in India (Harshey,1982; Walia, 1983; Kumar, 1992 ; Ansari *et al.*, 2000; Patil and Tijare, 2001; Singh, 2013; Mahobe, 2013; Gupta *et al.*,2014; Azmi*et al.*, 2015; Mishra *et al.*, 2014; Dixit *et al.*, 2015; Sheeja *et al.*, 2016; Kumar *et al.*, 2017; Nama and Raj, 2018; Das and Dey, 2020; Javed et *al.*, 2020; Deepti *et al.*, 2021 and Kumar *et al.*, 2021).

While analyzing the literature, it appears that almost no work is conducted on physico-chemical aspects of Sagar Tal in Budaun. It is located near Dargah of Hazrat Syed Ahmed Sahab at a distance of 2.5 km from Budaun junction in the Nawada area at latitude 28.0512° N and longitude 79.1305° E which is proposed to be develop as a Picnic spot by government. Hence, the purpose of this study is to revealed out the water quality in terms of important physico-chemical characteristics of water of Sagar Tal in Budaun (U.P.).

II. MATERIALS AND METHODS

This Study for assessment of Physico-chemical parameters was conducted from July 2019 to June 2021 except April 2020 due to COVID-19 pandemic limitation. Water samples were collected every month during morning hours, between 7.00 a.m. to 9.00 a.m. from three sites in pre cleansed plastic cans and immediately carried to the laboratories for analysis. Parameters such as temperature, transparency, D.O and pH were analyzed on the spot, whereas analysis of other parameters were performed in the laboratory following the standard methods of Trivedi and Goel (1986) and APHA (2005) and co-related with standard values of aquaculture pond water (BIS, 1991). Various statistical analyses including values with coorelation matrix, mean± standard deviations and descriptive statistical parameters were worked out by using data analysis pack of M.S. Excel, (Windows 10) among several physico-chemical parameters are provided in Table 1-3.

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Table 1: Coorelation Matrix

	Air Temp.	Water Temp.	Depth	Transparency	pH	D.O.	Free CO_2	Carbonate Alkalinity	Bicarbonate	Chloride	Calcium	Magnesium	Total Hardness
Air Temp.	1.000												
Water Temp.	0.824	1.000											
Depth	0.142	0.302	1.000										
Transparency	-0.346	-0.572	0.058	1.000									
pH	-0.365	-0.573	-0.517	0.498	1.000								
D.O.	-0.456	-0.730	-0.289	0.748	0.643	1.000							
Free CO2	0.251	0.372	0.409	-0.509	-0.344	-0.663	1.000						
Carbonate Alkalinity	-0.072	-0.360	-0.799	0.423	0.650	0.570	-0.681	1.000					
Bicarbonate	0.067	-0.224	-0.657	0.399	0.550	0.402	-0.519	0.928	1.000				
Chloride	0.101	-0.114	-0.639	0.371	0.491	0.278	-0.506	0.863	0.839	1.000			
Calcium	-0.242	-0.485	-0.767	0.183	0.484	0.391	-0.534	0.724	0.626	0.561	1.000		
Magnesium	-0.592	-0.824	-0.245	0.834	0.651	0.922	-0.622	0.568	0.446	0.339	0.376	1.000	
Total Hardness	-0.532	-0.792	-0.547	0.732	0.731	0.871	-0.695	0.794	0.659	0.587	0.629	0.934	1.000

Table 2: Mean and Standard Deviation

	AIR TEMPERATU		Water Temperature		Depth		Transparency		pH		D.O		Free CO2		Carbonate Alkalinity		Bicarbonate		Chloride		Calcium		Magnesium		Total Hardness	

	RE																									
Month	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
July	31.97	0.25	32.97	0.15	11.93	0.21	10.00	0.20	8.00	0.20	8.00	0.20	8.00	0.20	0.00	0.00	36.60	3.05	9.98	0.20	46.65	0.61	21.95	0.37	205.67	2.52
August	35.00	0.20	32.50	0.20	12.50	0.20	10.97	0.25	8.30	0.20	8.80	0.20	5.97	0.25	0.00	0.00	40.67	4.66	10.21	0.15	47.32	0.80	24.30	0.48	217.67	1.53
September 2019r	37.00	0.20	38.03	0.15	12.00	0.20	12.00	0.20	8.47	0.25	9.20	0.20	0.00	0.00	37.00	4.58	43.72	4.66	10.58	0.20	49.59	0.62	28.19	0.48	239.67	1.53
October	29.97	0.15	34.00	0.20	11.60	0.20	13.97	0.25	8.60	0.20	9.50	0.20	0.00	0.00	42.00	6.00	48.80	3.05	10.78	0.10	50.66	0.61	37.91	0.49	282.00	2.00
November	28.00	0.20	21.97	0.15	11.00	0.20	15.00	0.20	8.80	0.20	9.60	0.20	0.00	0.00	50.00	4.58	55.92	4.66	10.75	0.15	107.47	0.80	42.77	0.49	344.00	2.00
December	17.03	0.25	20.00	0.20	10.60	0.10	16.03	0.15	9.20	0.20	9.83	0.15	0.00	0.00	61.00	4.58	58.97	4.66	12.00	0.15	70.71	1.01	56.45	0.37	408.00	2.00
January	17.97	0.25	18.03	0.15	10.00	0.20	17.97	0.25	9.40	0.20	10.20	0.20	0.00	0.00	68.00	4.58	61.00	6.10	12.37	0.20	72.18	0.80	64.72	0.37	446.33	1.53
February	28.97	0.25	20.97	0.15	9.97	0.25	21.00	0.20	9.47	0.25	11.23	0.15	0.00	0.00	97.00	4.58	68.12	4.66	12.84	0.15	75.25	0.62	64.64	0.49	454.00	2.00
March	27.97	0.15	21.03	0.15	9.00	0.20	18.03	0.25	9.67	0.15	10.60	0.20	0.00	0.00	114.00	3.00	76.25	3.05	13.37	0.20	76.99	0.80	66.58	0.49	466.00	2.00
April	Covid Situation																									
May	33.03	0.25	27.97	0.25	8.57	0.15	16.00	0.20	9.50	0.20	9.40	0.20	0.00	0.00	113.00	4.58	85.40	6.10	16.17	0.20	83.41	0.80	44.63	0.61	392.00	2.00
June	35.00	0.20	34.50	0.20	7.97	0.25	14.00	0.20	8.83	0.15	9.03	0.15	0.00	0.00	120.00	6.00	97.60	6.10	16.66	0.20	86.48	0.61	30.62	0.49	342.00	2.00
July	32.53	0.25	33.67	0.15	13.93	0.21	17.03	0.15	9.80	0.20	8.97	0.25	6.00	0.20	0.00	0.00	29.48	6.35	11.37	0.20	44.11	0.80	34.50	0.49	252.00	2.00
August	36.00	0.20	34.00	0.20	15.00	0.20	17.50	0.30	8.00	0.20	9.20	0.20	3.97	0.25	0.00	0.00	36.60	6.10	11.64	0.31	44.91	0.80	37.91	0.49	267.67	2.52
September	38.03	0.15	38.97	0.15	13.93	0.21	18.03	0.15	8.20	0.20	9.40	0.20	0.00	0.00	30.00	6.00	44.73	7.68	11.97	0.40	47.19	1.01	40.34	0.98	284.00	2.00
October	33.47	0.25	31.00	0.20	13.60	0.20	18.03	0.25	8.30	0.20	9.50	0.20	0.00	0.00	36.00	6.00	43.72	6.35	12.14	0.21	48.39	1.23	49.00	0.37	322.00	2.00
November	29.00	0.20	22.93	0.21	12.97	0.25	20.00	0.20	8.50	0.20	9.70	0.20	0.00	0.00	46.00	4.58	53.88	4.66	12.64	0.31	57.08	0.60	54.11	0.50	364.67	2.52
December	17.9	0.25	20.97	0.15	12.97	0.15	21.00	0.20	9.00	0.20	10.00	0.20	0.00	0.00	54.0	6.00	57.95	6.10	12.50	0.31	63.09	0.84	59.13	0.74	402.00	2.00

	7													0										
January	19.03	0.15	19.03	0.15	11.97	0.15	23.00	0.30	9.20	0.20	10.20	0.20	0.00	0.00	68.00	9.17	65.07	7.68	12.90	0.31	65.09	1.01	62.21	0.49	418.00	2.00
February	29.97	0.15	22.03	0.25	11.63	0.15	26.00	0.20	9.40	0.20	10.40	0.20	0.00	0.00	91.00	6.24	93.53	9.32	13.20	0.15	68.04	0.83	66.01	0.51	440.00	2.00
March	31.03	0.15	23.97	0.25	10.97	0.15	20.00	0.20	9.60	0.20	10.63	0.15	0.00	0.00	112.00	7.55	107.77	9.32	13.77	0.20	69.50	1.22	67.71	0.61	453.00	2.00
April	31.97	0.15	24.97	0.15	10.90	0.20	19.47	0.25	9.60	0.20	10.00	0.20	0.00	0.00	114.00	6.00	109.80	6.10	14.24	0.31	71.11	1.23	55.41	0.49	405.67	1.53
May	34.03	0.15	29.03	0.15	10.60	0.20	18.50	0.20	9.50	0.20	9.80	0.20	0.00	0.00	120.00	6.00	112.86	6.08	15.04	0.31	73.25	1.23	51.68	0.61	395.00	2.00
June	36.03	0.15	35.00	0.20	10.00	0.20	18.03	0.15	8.80	0.20	9.20	0.20	0.00	0.00	120.00	6.00	117.93	6.35	15.43	0.30	80.46	1.23	44.23	0.49	382.00	2.00

Table 3: Descriptive Statistics

	Air Temp.	**Water Temp.**	**Depth**	**Transparency**	**pH**	**D.O.**	**Free CO2**	**Carbonate Alkalinity**	**Bicarbonate**	**Chloride**	**Calcium**	**Magnesium**	**Total Hardness**
Mean	30.042	27.719	11.461	17.459	8.963	9.670	1.041	64.913	67.233	12.720	65.171	48.043	355.797
Standard Error	1.316	1.394	0.375	0.783	0.120	0.147	0.500	9.014	5.727	0.385	3.415	2.999	17.049
Median	31.970	27.970	11.600	18.030	9.000	9.600	0.000	61.000	58.967	12.503	68.037	49.000	382.000
Mode	31.970	34.000	10.600	18.030	8.000	9.200	0.000	0.000	36.600	#N/A	#N/A	37.907	#N/A
Standard Deviation	6.313	6.688	1.798	3.756	0.577	0.704	2.397	43.228	27.467	1.845	16.379	14.383	81.762
Sample Variance	39.849	44.725	3.231	14.110	0.333	0.496	5.747	1868.628	754.425	3.405	268.278	206.868	6685.068
Kurtosis	0.177	-1.511	-0.400	0.376	-1.324	0.664	3.118	-1.313	-0.969	-0.237	0.268	-1.114	-1.087
Skewness	-1.069	0.120	-0.003	-0.029	-0.257	0.002	2.104	-0.124	0.583	0.587	0.583	-0.252	-0.449
Range	21.000	20.940	7.030	16.000	1.800	3.233	8.000	120.000	88.450	6.683	63.360	45.760	260.333
Minimum	17.030	18.030	7.970	10.000	8.000	8.000	0.000	0.000	29.483	9.980	44.110	21.953	205.667
Maximum	38.030	38.970	15.000	26.000	9.800	11.233	8.000	120.000	117.933	16.663	107.470	67.713	466.000
Sum	690.970	637.540	263.610	401.560	206.140	222.400	23.933	1493.000	1546.362	292.550	1498.943	1104.990	8183.333
Count	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000	23.000
Confidence Level (95.0%)	2.730	2.892	0.777	1.624	0.249	0.305	1.037	18.693	11.878	0.798	7.083	6.220	35.357

III. RESULTS AND DISCUSSION

Physical parameters:

Temperature- Temperature is the degree of measurement of hotness or coldness of any material. It influences the physical and chemical properties of water and also affects the aquatic vegetation, organisms and their metabolic activities. The temperature of pond water is influenced by atmospheric factors and weather on large scale. Water temperature influences several living and non-living components of aquatic ecosystem, directly as well as indirectly. It also resembles the dynamics of the living organisms such as Bio-chemical and physiological behaviour of aquatic ecosystem. In the present study air temperature was found ranging between 17.03±0.25°C to38.03±0.15°C, of which maximum value (38.03.°C)was noticed in summer season during September 2021 and the minimum value (17.03°C) in winter season during December 2019. Water temperature in the present study varied from 18.03±0.15°C to 38.97±0.15°C.Maximum temperature of water in September may be attributed to the shallowness of pond, low macrophytic production and highest load of suspended matter (Kumar, 1990). Many workers observed similar trends while working on different water bodies (Reid and Wood, 1976; Walia, 1983; Dwivedi and Pandey, 2002). The Ambient temperature is most common ecological factor which is necessary for maintenance of overall temperature of atmosphere. Anusuya (2017), defined the temperature of water is regarded as a controlling factor for all aquatic life. All biological and chemical process in freshwater fish ponds operations are controlled by water temperature. Similar findings were reported by (Vyas and Nama, 1991; Shyamala *et al.,* 2008; Thripathaiah *et al.*,2012; and Prameena *et al.,* 2016).

Transparency- Transparency in the present study ranged between10.00±0.20 to 26.00±0.20cms of which higher value (26.00 cm) was reported in the month of February 2021, while the lower value (10.00cm) during July 2019. Similar conclusion was reported by Kamal *et al.,(*2007).Transparency of water is in inverse relation to turbidity which in turn is directly proportional to the quantity of suspended organic and inorganic matter. Some other workers believed that organic matter and action of wind affects transparency (Edmondson, 1961 and Ganapati, 1962). The transparency of water is influenced in different seasons due to deposition of algal blooms and suspended sediments (Horne and Goldman, 1994).

pH- pH is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. Kisigo, (2016) showed pH as the degree of the hydrogen ions in any water system. It is not used for calculating total acidity or alkalinity. The pH values ranged from 8.00±0.20 to9.80±0.20 during the whole period of study. pH of water is one of the most important chemical parameters since aquatic organisms are well adapted to specific pH range and do not withstand abrupt changes in it (George, 1997). pH also influences other factors like conductivity, bicarbonates, chloride, salinity, phosphate, hardness and magnesium. Shyamala *et al.,* (2008) reported the range of pH 7.5 to 8.4. Choudhary *et al.*, (2014) observed a range of pH in between 7.0 and 8.3. Range of pH between 5.0 to 8.5 was found to be best for planktonic growth (Umavathi *et al.*,2007).

Chemical parameters:

Dissolved oxygen- Dissolved oxygen is one of the important parameter in water quality assessment and is essential to maintain the variety of forms of life in water. The effect of water discharge in a water body are determined by the oxygen balance of the system. The chemical and physiological process undergoing in aquatic bodies are largely reliant upon the presence of oxygen. Kemker, (2013) reported dissolved oxygen concentration that are too high or too low can affect aquatic life and eventually influence water quality. Estimation of dissolved oxygen is a key test in waste treatment process control and water pollution. In the present investigation dissolved oxygen ranged from 8.00±0.20 to 11.23±0.15 mg/l. The acceptable value suggested for D.O. is 5mg/L as per Indian standard .Increase in amount of dissolved oxygen during winter has also been reported earlier by many workers (Pennak, 1968; Vasisht and Sharma, 1975; Das and Pathani, 1978;Vasisht and Jindal, 1980; Kant and Raina, 1985; Thirupathaiah et al.,2012).Increased levels of dissolved oxygen during winter months may be due to the increased solubility of oxygen at lower temperature.

Free CO_2- Carbon dioxide in a water body may be derived from the atmospheric sources, biotic respiration, inflowing ground water which seep into the pond, decomposition of organic matter and may also from within the water body itself in a combination of other substances mainly calcium, magnesium etc. Carbon dioxide is added to aquatic system as it is directly mixed from atmosphere. Bhatnagar, (2004) suggested, 5-8 ppm is essential for photosynthetic activity; 12-15 ppm is sublethal to fishes and 50-60 ppm is lethal to fishes. Free CO2 in the present study varied from 0 to 8.00±.20 mg/L. The highest value (8 mg/L) of free CO2 was recorded in the month of October 2019. The increase in carbon dioxide level may be related to decay and decomposition of organic matter (Munshi,1995). This is strengthened by the observations of Joshi *et. al.* (1995) who have observed the addition of drainage was the main causal factor for increase in carbon dioxide in the water bodies. Inverse relationship of dissolved oxygen and free CO2 is well documented by (Ganpati, 1943; Kadlec, 1962 and Patil *et al.*,1985).

Alkalinity- Water alkalinity is a measure of its capacity to neutralize acids and is a measure of buffering capacity of the water. Akalinity of water during the present study varied from 0 to 120.00±6.0 mg/L. Higher value of Total alkalinity was observed in the monsoon 120 mg/l. While lower value was 0 mg/l. in autumn. Alkalinity of pond

water is due to carbonate, bicarbonates, phosphate, silicates along with hydroxyl ions. An increase in the free CO2 may result in the increase in alkalinity (Singhal *et al*., 1986). Alkalinity of water is important for aquatic life in a fresh water system as it equilibrate pH changes resulting from photosynthesis (Kaushik and Saksena, 1989).

Chlorides- Though chloride is present in all natural water bodies, high concentration is an indication of pollution from sewage, industrial or intrusion of seawater or saline water into fresh water aquifer (Shyamala *et al.*, 2008).The chlorides control the salinity of water and osmotic stress on biotic communities (Banerjee, 1967). In the fresh water discharge of domestic and industrial sewage is the most important source of chlorides. The concentration of chlorides is thus the indicator of pollution (Pejaver and Gurav, 2008). The Chloride concentration in the study area ranged from 9.98±0.20to 16.66±0.20mg/l. The minimum value was recorded in the month of July 2019 and maximum in June 2021.Present summer increase in chloride during summer is in agreement with the observations of (Manawar, 1970; Harshey *et al*.,1982 and Kumar 1992).

Calcium- On the basis of calcium richness water bodies are classified into three categories such as poor, medium, and rich. Calcium as such shows no unsafe effect on health status of human beings. Calcium is a significant nutrient for water organism and it is generally present in all aquatic bodies (Ansari and Prakash, 2000). In the present study, calcium concentration varied from 44.11±.80 to 107.47±.80mg/L. The maximum permissible limit of calcium hardness is 30 mg/l (BIS, 1991).

Magnesium- Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of phytoplankton. The concentration of Magnesium in the present study ranges from 21.95±.37 to 67.71±0.61 mg/L while calcium concentration varied from 44.11±.80 to 107.47±.80 mg/L. Magnesium is often related with Calcium in all varieties of water, but its concentration generally remains lower than the calcium (Venkatasubramani and Meenambal, 2007).

Total Hardness- Total hardness of water is the parameters used to describe the effect of dissolved minerals (mainly Ca. and Mg.), determining suitability for domestic and industrial purposes which is attributed to the presence of bicarbonates, sulfates, chlorides and nitrates. Hardness plays a very important role as a parameter in diminishing the poisonous effect of toxic element. Total hardness of water is a measure of its capacity to form precipitates with soap and scales with certain anions present in the water. It is not a pollution parameter but indicates water quality mainly in terms of Ca2+ and Mg2+ content. Total hardness values ranged from 205.67±2.52 to 466±2.0 mg/L in the study area. APHA (2005), stated the desirable limit for total hardness is 300 mg/l. As the value of total hardness is much more than the desirable limit, this water is not adequate for utilization in cleaning and washing. Wurts and Durbow (1992), reported the hardness range between 25-100 mg/l beneficial for good fish culture. Bhatnagar (2004),opined that the total hardness value of less 20 mg/L would cause stress, an optimum value of 75- 150 mg/L with a lethal value of >300 mg/L.

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ISSN: 2349-8889
Volume-9, Issue-1 (January 2022)

https://doi.org/10.31033/ijrasb.9.1.17

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