

## Assessment of Water Quality in relation to some Physico-chemical parameters in Araga pond of Thirthahalli Taluk, Shivamogga, Karnataka.

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**Abstract:** The seasonal variations in the physico-chemical parameters of Araga pond of Thirthahalli taluk, located in Shivamogga district of Karnataka state was studied from June 2001 to May 2003. The parameters that were determined included; temperature, pH, conductivity, dissolved oxygen (DO), free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, biological oxygen demand (BOD), chemical oxygen demand (COD), phosphate, sulphate, total dissolved solids (TDS) and nitrate. The study revealed that, pond water was not much polluted. In the light of standards of water quality recommended by WHO and BIS, the pond water should be used for drinking and cooking after proper treatment.

**Key Words:** Water, Physico-chemical parameters, Araga pond, Thirthahalli.

### Introduction:

Due to over expanding population and industrial settlements, the demand for fresh water is increasing day by day. In today's scenario, unplanned urbanization, rapid industrialization and indiscriminate use of artificial chemicals cause heavy and varied pollution in aquatic environments leading to deterioration of water quality and depletion of aquatic fauna. Physico-chemical parameters play a vital role in determining the distributional pattern and quantitative abundance of organisms inhabiting a particular aquatic ecosystem (Santhoshkumar Singh et al., 2009; Vasantha Naik, 2013). Several investigators have studied the physico-chemical dynamics of varied lentic water bodies with the intent to assess the water quality (Sayeswara et al., 2010; Purushothama et al., 2011; Sayeswara et al., 2011; Sayeswasra et al., 2011a; Mahesh and Sayeswara, 2011; Mahesh et al., 2012; Vasantha Naik, 2013). In the present investigation, an attempt has been made to assess the physico-chemical parameters of Araga pond and suitability of water for human consumption and domestic purposes.

### Materials and Methods:

#### Study area

The Present study involves the analysis of water quality in terms of physico-chemical parameters of Araga pond of Theerthalli taluk at Shivamogga district, Karnataka. Araga pond is located at a distance of 51 km from Shivamogga surrounded by agricultural fields which is utilized by the local people for drinking, irrigation and fishing. The water has undergone moderate changes in its physico-chemical properties due to ecological degradation, overflowing of water from adjacent paddy fields and other human activities.

#### Water Analysis

Water was sampled on monthly basis, between 8 to 10 am from June 2001 to May 2003. The water samples were collected in good quality polythene bottles. Water temperature and pH were recorded at the sampling site itself. Dissolved oxygen was fixed on the spot itself in BOD bottles. Various

parameters like turbidity, total hardness, sulphate, free CO<sub>2</sub>, alkalinity, BOD, TDS, phosphate, nitrate and chloride were estimated as per the standard methods of APHA(1998).

## Results and Discussion:

The results of monthly and seasonal variations of physico-chemical parameters of Araga pond are given in Table 1 and 2. Mean, standard error and range of physico-chemical characteristics of Araga pond is depicted in Table 3.

### Monthly values of physico-chemical parameters

Table 1 represents the monthly values of physico-chemical parameters recorded from Araga pond. The average air temperature of the pond region is 31.04° C and minimum of 26° C and a maximum of 36° C were recorded. The average water temperature of the pond is 28.04° C and the values were fluctuated between 25° C and 33° C. The pH of water is 7.07, which is the neutral condition and it was fluctuated between 6.5-7.5. The turbidity of the pond water was found in the range between 12-21.4 NTU and the average value was 16.8 NTU recorded in Araga pond. Conductivity of the pond water was fluctuated between 52.0 and 69.5 µmhos/cm and the average was 61.8 µmhos/cm. The average concentration of dissolved oxygen was 4.6 mg/l and the values were ranged between 3.44-5.88 mg/l. The free carbon dioxide in the Araga pond was fluctuated between 7.2 and 12.0 mg/l and the average value of carbon dioxide during the study period is 9.04 mg/l. BOD concentration in Araga pond was fluctuated between 0.98 to 1.69 mg/l and the average BOD was 1.34 mg/l. The average COD value in Araga pond observed 8.38 mg/l; while the values were fluctuated between 6.0-12.4 mg/l. The minimum and maximum values of total hardness of Araga pond water was fluctuated between 10.8-26.5 mg/l and the average hardness value in the pond was 21.31 mg/l. The average value of the total alkalinity in this pond recorded 39.87 mg/l and the range value was between 32.2-48.2 mg/l. The average value of calcium concentration in this pond was 7.68 mg/l and the range of this parameter was between 6.6-9.8 mg/l. The magnesium concentration in the pond water shows less than the calcium concentration and the average magnesium was 2.24 mg/l and the range of this parameter was between 1.02-3.11 mg/l. The average sulphate concentration observed 6.09 mg/l and the range of the sulphate was between 4.0-8.6 mg/l. The average chloride concentration in Araga pond was 12.61 mg/l and the range of this parameter was between 9.8-16.7 mg/l. The ammonical nitrogen of Araga pond was 1.16 mg/l and the range of this parameter was between 0.8-1.92 mg/l. The nitrate nitrogen of the pond water was fluctuated between 0.2-1.33mg/l and its average value 0.80 mg/l recorded. Concentration of the phosphate was fluctuated between 0.06-0.89 mg/l and the average value was 0.49 mg/l. The average total dissolved solids recorded 52.81 mg/l and the range of the parameter was found between 39.0-65.4 mg/l.

### Seasonal variations of physico-chemical parameters

The water temperature is largely influenced by local climatic conditions. The seasonally water temperature was maximum in premonsoon (29.5° C) and minimum in monsoon (27° C). pH values are neutral to slightly alkaline and found within permissible limit of Bureau of Indian Standards (BIS, 1993). The minimum value was observed during pre-monsoon (7.0) and maximum during post-monsoon (7.2). The pH is important because aquatic organisms are well adapted to specific pH range and do not survive abrupt changes in pH.

Turbidity in natural water arises due to the presence of suspended matter such as clay, silts, finely divided organic and inorganic matter, phytoplankton and other microscopic organisms (Vasantha Naik, 2013). The highest and the lowest values were recorded in monsoon (20.78 NTU) and pre monsoon (13.1 NTU) season, respectively.

Seasonally maximum conductivity was recorded during monsoon season and minimum during the post-monsoon season (Table 2). Kedar et al., (2007) recorded the maximum conductivity during the summer and minimum during the monsoon season in Yedshi lake in Mangarulpir tahsil of Washim district,

Maharashtra. Harney et al (2013) also recorded maximum conductivity during the summer in Pindavani pond of Central India. Therefore, our observations are not in conformity with the above researchers.

Dissolved oxygen is an important gaseous factor that determines the quality of water and intern regulates the distribution of aquatic organisms. In this study, the highest and the lowest values of DO were recorded in post-monsoon and pre-monsoon, respectively. The variations of DO depend on the primary production and respiration of aquatic organisms. The permissible standard of DO is above 5mg/L (Perk and Park, 1980; Vasantha Naik, 2013).

The variation of CO<sub>2</sub> was due to the absorption by plants for photosynthesis and activity of other living organisms. The highest and the lowest values were recorded in monsoon and pre-monsoon season, respectively

BOD is the measure of degradable organic matter present in water. BOD and other microbial activities generally increase by the introduction of sewage (Hynes, 1971). The minimum value was noticed in monsoon with 1.26 mg/l while, maximum in pre-monsoon season (1.497 mg/l ). They were found below the permissible limit of 6.5mg/L (WHO, 1991).

In the present investigation, maximum Chemical oxygen demand (COD) was recorded during the monsoon and minimum during the post-monsoon season. In the present investigations, higher value during monsoon maybe due to higher decomposition activities. However minimum chemical oxygen demand in post-monsoon is due to low temperature, low decomposition activities and dilution effect (Harney et al., 2013).

Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca<sup>2+</sup> and Mg<sup>2+</sup> contents. The minimum value was recorded in pre-monsoon (14 mg/l) and maximum in monsoon with 25.45 mg/l. Hence, the pond water is included under soft category.

Alkalinity in the water samples is primarily a function of carbonate, bicarbonate and hydroxide content. Seasonally, the total alkalinity ranged from 35.325mg/L (monsoon) to 44.425mg/L (pre-monsoon). It is within permissible limit of 600mg/L (BIS, 1993). Surface alkalinity may result from the discharge of domestic wastes (Vasantha Naik, 2013).

Calcium and magnesium are the minerals that are both important for bone density and have opposite effects on nerve, muscle and clotting activity. Calcium stimulates and magnesium relaxes or decreases activity. Calcium content was maximum in monsoon with 9.135 mg/l and minimum in post monsoon with 6.825 mg/l. However, magnesium level was lowest in post-monsoon and highest in pre-monsoon (20.07 mg/l).

Sulphate is one of the major anions occurring in natural waters. It may enter natural waters through weathering of sulphate bearing deposits (Vasantha Naik, 2013). The minimum value was recorded in post-monsoon and maximum is monsoon (7.685 mg/l). The total dissolved solids fluctuated from 42.45 mg/l to 61.40 mg/l in monsoon season. The seasonal physico-chemical parameters of Araga pond exhibit cyclic variations.

Chloride is an important anion found in variable amounts in water bodies. Chlorides increase the degree of eutrophication (Goel et al., 1980; Vasantha Naik, 2013). In the current study, chloride levels were maximum and minimum during post-monsoon season ( Table 2). High chloride content indicates the deterioration of water quality usually linked with sewage load (Mini et al., 2003 ; Vasantha Naik, 2013). In the present study, the minimum value of Nitrate was noticed in monsoon season while maximum in post-monsoon. Most of the unpolluted sources of water are deficient of nitrates because it exists only in few natural sources (Trivedi and Goel, 1984; Vasantha Naik, 2013).

Phosphorus occurs in natural water as various types of phosphates. The most important sources of

phosphates are the discharge of domestic sewage, detergents and agricultural runoff. Phosphates ranged minimum value in monsoon with 0.1775 mg/l and maximum in post monsoon ( 0.725 mg/l).

### Conclusion:

In this present investigation it was found that the maximum and minimum parameters during different months and seasons were not at the level of pollution in Araga pond of Thirthahalli taluk. In the light of standard of water quality recommended by WHO and BIS, the pond water should be used for drinking and cooking after proper treatment. In order to maintain the healthy status of the tank with respect to water quality it is essential that authorities should take immediate step - washing of clothes and vehicles should be prevented. Awareness should be created regarding the impact of water pollution on the human health.

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**Table 1. Physico-chemical parameters of Araga pond during 2001-2003**

Parameters		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	
MONTHS	2001	Jun	33	30	7	18.2	66.8	4.32	10.6	1.2	8.8	24.2
		Jul	33	31	6.9	17.2	68.2	4.92	10.4	1.12	8.92	25.3
		Aug	30	28	7.1	15.2	65.08	4.88	12	1.6	9.4	26.4
		Sep	30	27	7.1	15	61.14	4.98	11.64	1.6	9.22	24.32
		Oct	32	27	7.5	14.6	60.66	5.32	11.4	1.42	8.6	21.5
		Nov	30	27	6.8	14.8	60.2	5.62	9.8	1.5	8.62	22
	Dec	26	25	7	12.4	52.4	5.88	7.4	1.4	6.8	23	
	2002	Jan	31	27	7.5	12	54.8	5.12	7.72	1.14	6.4	21.4
		Feb	32	30	7	12.2	52	4.22	7.9	1.34	6	20.4
		Mar	36	30	6.9	14	58.4	4.12	8	1.34	6.8	16
		Apr	35	29	7.1	12.6	64.32	4.12	8.5	1.62	9.2	18.4
		May	33	29	7.2	13.6	68.3	3.98	8.8	1.69	12.4	16.2
		Jun	31	28	6.9	20.62	69.5	4.21	8.9	0.98	9.6	26.5
		Jul	30	28	7.1	20.8	68.9	4.58	8.8	1.2	9.2	24.2
		Aug	27	25	7	21.4	66.4	4.52	9.2	1.28	8.8	24.8
		Sep	30	27	7.1	20.3	64.3	4.82	9.8	1.58	8.6	26.3
		Oct	32	27	7.1	21.2	62.6	5.12	9.68	1.52	7.6	21.3
		Nov	30	27	7.2	20.8	60.62	5.34	8.68	1.28	7.2	20
		Dec	27	25	7.1	18.2	59.8	4.28	8.42	1.15	6.8	24.6
	2003	Jan	30	28	7.1	17.4	59	4.82	8.3	1.18	6.6	23.5
		Feb	28	26	7.1	16.8	58.2	4.12	8.1	1.16	6.4	18.6
		Mar	31	29	6.5	16.4	59.2	3.82	8	1.28	8.4	14
		Apr	33	30	7.2	18.2	60	3.92	7.6	1.28	9.8	12.6
		May	35	33	7.2	18.4	62.4	3.44	7.2	1.36	10.88	10.8
		Avg	31	28.04	7.071	16.763	61.801	4.6029	9.035	1.3425	8.3767	21.31
		Min	26	25	6.5	12	52	3.44	7.2	0.98	6	10.8
		Max	36	33	7.5	21.4	69.5	5.88	12	1.69	12.4	26.5
	A1 = Air Temperature		A5 = Conductivity				A9 = Chemical oxygen demand					
	A2 = Water Temperature		A6 = Dissolved oxygen				A10 = Total hardness					
	A3 = pH		A7 = Free carbon dioxide									
A4 = Turbidity		A8 = Biological oxygen demand										

All parameters are expressed in terms of mg/l except Temperature (°C), pH, Turbidity (NTU) and conductivity (µmhos).

**Table 1 ( Continued..): Physico-chemical parameters of Araga pond during 2001-2003**

Parameters		A11	A12	A13	A14	A15	A16	A17	A18	A19
2001	Jun	36.4	7.38	2.12	7.42	12.6	1.08	0.6	0.14	46
	Jul	38.2	6.68	1.98	8.12	11.8	1.3	0.2	0.225	39
	Aug	34.5	8.4	2.3	7	11.6	1.65	0.4	0.11	42
	Sep	32.2	7.9	2	8.2	12.2	1.24	0.3	0.24	44
	Oct	33.4	6.6	1.88	6.5	16.7	1.28	0.44	0.82	43.2
	Nov	36.4	6.8	1.5	6.25	15.4	1.22	0.88	0.76	42.4
2002	Dec	37	6.8	1.46	5.96	13.2	1.02	1.02	0.82	48.6
	Jan	38	7.1	2	4.82	12.1	0.9	1.01	0.5	49.4
	Feb	38.6	8	1.66	4.5	11.2	1.06	1	0.4	60.4
	Mar	39.44	7.5	1.6	5.6	11.6	1.28	1.33	0.26	52.2
	Apr	44.6	6.8	2.9	5.8	15.4	0.88	0.36	0.64	52
	May	46.4	7.4	2.12	6.4	15.2	1.25	0.33	0.14	56.6
	Jun	43.2	8.45	2.96	6	13.4	1.01	0.88	0.67	65.4
	Jul	41.5	9.6	2.88	6.3	12.1	0.8	1.02	0.12	61.3
	Aug	40.3	9.8	3.1	6.1	9.8	1.1	0.89	0.76	60.6
	Sep	35.4	8.69	2.6	5.8	11.44	0.8	0.62	0.86	58.3
	Oct	37.4	7.2	2.2	5.5	11.2	0.98	1.04	0.06	56.24
Nov	42.2	7.1	2.96	5.3	10.66	1.1	1.2	0.12	58.2	
2003	Dec	42.1	7.46	3.11	4.9	11.2	1.1	0.93	0.82	62
	Jan	42	8.2	3.1	4.2	10.6	1	1.01	0.82	59
	Feb	41	7.6	2.8	4	11.3	1.92	1.28	0.8	56.4
	Mar	43.1	7.22	1.89	5.2	12.81	1.84	1.02	0.72	49.3
	Apr	45.4	7.92	1.75	6.8	14.2	1.1	0.63	0.89	48.4
	May	48.2	7.8	1.02	8.6	14.8	1.06	0.89	0.1	56.7
	Avg	39.873	7.6833	2.2454	6.09	12.605	1.1654	0.8033	0.4913	52.818
	Min	32.2	6.6	1.02	4	9.8	0.8	0.2	0.06	39
	Max	48.2	9.8	3.11	8.6	16.7	1.92	1.33	0.89	65.4

A11 = Total alkalinity	A15 = Chloride
A12 = Calcium	A16 = Ammonical Nitrogen
A13 = Magnesium	A17 = Nitrate-nitrogen
A14 = Sulphate	A18 = Phosphate
	A19 = Total dissolved solids

All parameters are expressed in terms of mg/l except Temperature (°C), pH, Turbidity (NTU) and conductivity (µmhos).

**Table 2: Seasonal variation of physico-chemical parameters of Araga pond**

Parameters	2001-2002			2002-2003		
	Monsoon	Post-monsoon	Pre-monsoon	Monsoon	Post-monsoon	Pre-monsoon
Air temperature	31.5	29.75	34.00	29.5	29.75	31.75
Water temperature	29	26.5	29.5	27	26.75	29.5
pH	7.025	7.2	7.05	7.025	7.125	7.00
Turbidity	16.14	13.45	13.1	20.78	19.4	17.45
Conductivity	65.305	57.015	60.755	67.275	16.505	59.95
Dissolved oxygen	4.775	5.485	4.11	4.5325	4.89	3.825

Free carbon dioxide	11.16	9.08	8.3	9.175	8.77	7.725
Biological oxygen demand	1.38	1.365	1.497	1.26	1.2825	1.27
Chemical oxygen demand	9.055	7.605	8.6	9.05	7.05	8.87
Total hardness	25.055	21.975	18.26	25.45	22.35	14.0
Total alkalinity	35.325	36.2	42.26	40.1	40.925	44.425
Calcium	7.59	6.825	7.425	9.135	7.49	7.635
Magnesium	2.1	1.71	20.07	2.885	2.8425	1.865
Sulphate	7.685	5.882	5.575	6.05	4.975	6.466
Chloride	12.05	14.35	13.35	11.085	10.915	13.277
Ammonical nitrogen	1.3175	1.105	1.1175	0.9275	1.045	1.48
Nitrate-Nitrogen	0.375	0.8375	0.755	0.8525	1.045	0.955
Phosphate	0.1775	0.725	0.36	0.6025	0.455	0.627
Total dissolved solids	42.75	45.9	55.3	61.4	58.86	52.7

**Table 3. Physico-chemical characteristics of Araga pond with Mean, Standard Error and Range (mg/l, except pH and temperature)**

Parameters	2001-2002		2002-2003	
	Mean $\pm$ S.E.	Range	Mean $\pm$ S.E.	Range
Air temperature	31.75 $\pm$ 9.16	26 – 36	30.33 $\pm$ 8.75	27 – 35
Water temperature	28.33 $\pm$ 8.17	25 – 31	27.75 $\pm$ 8.01	25 - 33
pH	7.09 $\pm$ 2.04	6.8 – 7.5	7.05 $\pm$ 2.03	6.5 – 7.2
Turbidity	14.31 $\pm$ 4.13	12 – 18.2	19.21 $\pm$ 5.54	16.4 – 21.4
Conductivity	61.02 $\pm$ 17.61	52 – 68.3	62.57 $\pm$ 18.06	58.2 – 69.5
Dissolved oxygen	4.79 $\pm$ 1.38	3.98 – 5.88	4.41 $\pm$ 1.27	3.44 – 5.34
Free carbon dioxide	9.51 $\pm$ 2.74	7.4 – 12	8.55 $\pm$ 2.47	7.2 – 9.8
Biological oxygen demand	1.41 $\pm$ 0.40	1.12 – 1.69	1.27 $\pm$ 0.36	0.98 – 1.58
Chemical oxygen demand	8.43 $\pm$ 2.43	6 – 12.4	8.32 $\pm$ 2.46	6.4 – 10.88
Total hardness	22.08 $\pm$ 6.05	16 – 26.4	20.6 $\pm$ 5.94	10.8 – 26.5
Total alkalinity	37.92 $\pm$ 10.44	32.2 – 46.4	41.81 $\pm$ 12.07	35.4 – 48.2
Calcium	7.28 $\pm$ 2.10	6.6 – 8.4	8.08 $\pm$ 2.33	7.1 – 9.8
Magnesium	1.96 $\pm$ 0.56	1.46 – 2.9	2.53 $\pm$ 0.73	1.02 – 3.11
Sulphate	6.38 $\pm$ 1.84	4.5 – 8.2	5.77 $\pm$ 1.74	4 – 8.6
Chloride	13.25 $\pm$ 3.82	11.2 – 16.7	11.95 $\pm$ 3.45	9.8 – 14.8
Ammonical nitrogen	1.18 $\pm$ 0.34	0.88 – 1.65	1.15 $\pm$ 0.33	0.82 – 1.92
Nitrate-Nitrogen	0.65 $\pm$ 0.18	0.2 – 1.33	0.95 $\pm$ 0.27	0.62 – 1.28
Phosphate	0.42 $\pm$ 0.12	0.11 – 0.82	0.56 $\pm$ 0.16	0.06 – 0.89
Total dissolved solids	47.98 $\pm$ 13.85	39 – 60.4	57.6 $\pm$ 16.64	48.4 – 65.4