

# Water Quality of Village Pond for Aquaculture Development

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## ABSTRACT

*Study was conducted from Bhimrad village pond of Surat District in Gujarat. Present study deals with the assessment of physico-chemical characteristics of a village pond located at Bhimrad. Temperature, pH, total dissolved solids (TDS), total hardness (TH), calcium hardness, magnesium hardness, total alkalinity, dissolved oxygen (DO), biological oxygen demand (BOD), chloride, phosphate, silicate, nitrate, nitrite and ammonium nitrogen were analyzed for aquaculture to determine the potential of the pond for aquaculture development. The data was statistically analyzed using SPSS software. The values of these physicochemical parameters during the study period were observed as temperature (21-30°C), pH (8.2-8.7), total dissolved solid (193-580 mg/L), total hardness (82-130 mg/L), calcium (14.42-29.65 mg/L), magnesium (8.28-15.1 mg/L), total alkalinity (96-160 mg/L), dissolved oxygen (1.62-8.91 mg/L), biochemical oxygen demand (0.81-24.3 mg/L), chloride (71-142mg/L), phosphate (0.083-0.581mg/L), silicate (0.044-0.383 mg/L), nitrate (2.468-7.701mg/L), nitrite (0.009-0.255 mg/L), and ammonium nitrogen (Nil-0.161 mg/L). Results obtained suggested that pond could be used for aquaculture activity.*

**Keywords:** Water quality, Village pond, Physico-chemical, Surat.

## 1. INTRODUCTION

Water is most important natural and precious resource for every living organism on the earth. 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 including fish. A healthy aquatic environment is one which supports a rich and varied community of organisms and protects public health (Ramachandra et al., 2002). Ponds are habitats of great importance as they provide water for domestic, industrial and agricultural uses. In spite of their fundamental importance to humans, freshwater systems have been severely affected by multitude anthropogenic disturbances which led to serious negative effects on the structure and function (Parikh and Mankodi, 2012). Without knowledge of water chemistry, it

is difficult to understand the status of water body for fruitful management. Water quality provides current information about the concentration of various solutes at a given place and time and basis for judging the suitability of water for its designated uses and to improve existing conditions and management for the beneficial uses (Lloyd, 1992).

Bhimrad village pond is located near Surat city at 21°07'39.10'' N and 72°48'01.03'' E. The pond is spread over an area of about 1.21 ha and was algae infested (Fig.1).



**Figure 1. Bhimrad village pond**

The main body of the pond remains full of water and is perennial. The pond water is used for domestic purposes. The same can be used for aquaculture which will contribute towards nutrition providing and generating income. Therefore, the present study was conducted to analyze the physico-chemical conditions of the pond water for aquaculture development.

## **2. MATERIALS AND METHODS**

Water sampling was carried out for one year from December, 2011 to November, 2012. Water samples (1.5-2.0 lit.) were collected in acid washed polythene bottles during morning hours between 7.00 a.m. to 10.00 a.m. For Dissolved Oxygen samples were collected and fixed at the site. Water temperature and pH were recorded at the sampling location. Samples were brought instantaneously to laboratory of Department of Aquatic Biology, Veer Narmad South Gujarat University and analyzed for important water quality parameters viz; total hardness (TH), calcium hardness, magnesium hardness, total alkalinity, total dissolved solids (TDS), dissolved oxygen (DO), biological oxygen demand (BOD), chloride, phosphate, silicate, nitrate, nitrite and ammonium nitrogen according to methods of APHA, 2005, Trivedi and Goel, 1986, and Gupta, 1999. Correlation coefficient was calculated using SPSS software.

### 3. RESULTS AND DISCUSION

Values of each parameter recorded during the study period are represented in table 1 and their correlation in table 2.

**Table 1. Water quality of Bhimrad village pond**

S. N.	Parameter	Min. value	Max. value	AV	SD	SE	*Standard
1	Temperature (°C)	21	30	26.75	3.16	0.91	25-32
2	pH	8.2	8.7	8.43	0.16	0.04	7-9
3	TDS (mg/L)	193	580	362.5 0	112.26	32.40	<500
4	TH (mg/L)	82	130	109.6 6	13.12	3.78	50-200
5	Calcium (mg/L)	14.42	29.659	23.50	4.85	1.40	5-100
6	Magnesium (mg/L)	8.28	15.1	12.42	2.20	0.63	5-100
7	TA (mg/L)	96	160	126.5 0	23.34	6.73	50-30
8	DO (mg/L)	1.62	8.91	5.06	1.97	0.56	5-15
9	BOD (mg/L)	0.81	24.3	7.21	7.44	2.15	<10
10	Chloride (mg/L)	71	142	101.1 7	24.05	6.94	1-100
11	Phosphate (mg/L)	0.083	0.581	0.30	0.15	0.04	0.005- 0.2
12	Silicate (mg/L)	0.044	0.383	0.20	0.11	0.03	4-16
13	Nitrate (mg/L)	2.468	33.779	6.76	8.61	2.48	0.2-10
14	Nitrite (mg/L)	0.009	0.255	0.04	0.06	0.01	0-0.5
15	Ammonium nitrogen (mg/L)	0	0.161	0.08	0.05	0.01	-

TDS-Total dissolved solids, TH-Total hardness, TA-Total alkalinity, DO-Dissolved oxygen, BOD-Biological oxygen demand, \*Aquaculture standard as per Boyd (1998).

**Table 2. Correlation coefficient (r) for different parameters of the Bhimrad Village pond water**

Parameters	T	pH	TDS	TH	Ca	Mg	TA	DO	BOD	Chloride	Phosphate	Silicate	Nitrate	Nitrite	AN
T	1														
pH	0.343	1													
TDS	0.445	0.323	1												
TH	-0.4	0.138	0.163	1											
Ca	-0.227	0.41	0.227	0.745	1										
Mg	-0.275	-0.349	-0.066	0.453	-0.255	1									
TA	0.031	0.438	0.472	-0.055	0.192	-0.336	1								
DO	-0.103	0.021	-0.243	0.057	-0.385	0.599	-0.345	1							
BOD	0.43	-0.129	0.365	-0.047	-0.087	0.048	0.116	-0.492	1						
Chloride	0.65	0.305	0.663	0.047	0.106	-0.074	0.012	-0.146	0.409	1					
Phosphate	-0.236	0.025	-0.052	-0.137	0.22	-0.494	0.526	-0.492	0.124	-0.151	1				
Silicate	0.648	0.228	0.707	-0.325	-0.02	-0.444	0.388	-0.547	0.576	0.719	0.13	1			
Nitrate	0.269	-0.08	0.345	0.276	0.179	0.161	-0.351	0.075	-0.039	0.608	-0.183	0.25	1		
Nitrite	0.28	-0.07	0.388	0.286	0.249	0.08	-0.299	0.005	-0.01	0.612	-0.138	0.306	0.989	1	
AN	0.097	0.234	0.05	0.358	0.313	0.101	0.273	-0.056	0.362	0.187	0.083	-0.019	-0.276	-0.241	1

T-Temperature, TDS-Total dissolved solids, TH-Total hardness, TA-Total alkalinity, DO-Dissolved oxygen, BOD- Biological oxygen demand, AN-Ammonium nitrogen

Environmental temperature was found fluctuating both daily and seasonally which is an important physical parameter directly related to chemical reactions in aquatic ecosystem (Goel et al., 1986). Water temperature is important factors which control the behavior, physiology and distribution of

organism in water bodies (Srivastav et al., 2009). The average value of water temperature was 26.75 and was within the permissible range.

The average pH value was found 8.43. The pond water represents alkaline pH during the study period. In the present study pH was found appropriate for aquaculture activities.

Total Dissolved Solids denotes the amount of dissolved solids in water. Total Dissolved Solid signifies the inorganic pollution load of a water system (Usha et al., 2008). The average value of Total Dissolved Solid was found to be 362.50 mg/L. It was found to have positive correlation with chloride and total alkalinity. The values of TDS falls within the range prescribed for aquaculture (Boyd, 1998).

Total hardness is mainly due to the presence of calcium and magnesium. It also acts as buffers regulating the pH of the medium (Shinde et al., 2011). The average value of total Hardness was 109.66 mg/L where as average values of calcium and magnesium were found 23.50 mg/L and 12.42 mg/L respectively.

Total alkalinity is the measure of the capacity of the water to neutralize a strong acid (Trivedy and Goel, 1986). High values of total alkalinity may be attributed to the increase in organic decomposition during which CO<sub>2</sub> is liberated (Bharathi et al., 1973). This reacts to form bicarbonate thereby increasing total alkalinity in warmer months. The average value of total alkalinity was 126.50 mg/L. It was positively correlated with TDS and pH. According to Wurts and Durborow (1992) alkalinity between 75 to 200 mg/L, but not less than 20 mg /L is ideal for aquaculture pond. Present study is agreement with the same.

DO concentration decreases in water during warmer months due to decreased rate of oxygen diffusion from atmosphere to water. The average value of DO was estimated 5.06 mg/L and was found good for aquaculture. DO was negatively correlated with temperature, BOD, phosphate and silicate. Moss, 1972, Morrissette and Mavinic, 1978; Sangu and Sharma, 1987 and Kataria *et al.*, 1996 also observed negative correlation with temperature.

BOD is the amount of oxygen required by microorganism during decomposition of biodegradable organic matter. The average value of BOD from the study area was 7.21 mg/L which follow the prescribed limit for aquaculture. BOD showed positive correlation with temperature and TDS while negative with DO.

The main source of chlorides in the waters is the discharge of domestic sewage; therefore, its concentration serves as an indicator of pollution by sewage. The average chloride value was 101.17

mg/L. Chloride had positive relation with TDS, BOD, silicate and nitrate whereas negative with DO and phosphate. As per Boyd (1998) phosphate in aquaculture ponds should within 0.005-0.2 mg/L. In present study the average value of phosphate was 0.30 mg/L and showed significant positive relationship with total alkalinity, calcium and pH whereas, negative relationship with total dissolved solids, total hardness, temperature, DO and chloride. It was little higher than the prescribed limit.

In the present investigation the average value of silicate was 0.20 mg/L and it was important regulating nutrient for the growth of phytoplankton (Egge and Aksnes, 1992). Silicate had positive co-relation with chloride and temperature where as negative correlation with DO and total hardness.

Nitrogen is considered the primary limiting nutrient for phytoplankton biomass accumulation (Rabalais, 2002). The accumulation of nitrogen in ponds and natural water bodies has become a common phenomenon which alters ecological process in many parts of the world due to intensive human activity.

The forms of nitrogen that affect aquatic ecosystems include inorganic dissolved forms; Nitrite ( $\text{NO}_2$ ), Ammonium ( $\text{NH}_4$ ), Nitrate ( $\text{NO}_3$ ) and a variety of dissolved organic compounds such as amino acids, urea and composite dissolved organic nitrogen, and particulate nitrogen. Nitrate enters in an aquatic body from various sources like erosion of natural body or soil, as well as, artificially fertilized soil and through rainfall and sewage (Kapoor and Bamniya, 2001). Nitrate in its average concentration was 6.76 mg/L during the study period. Presence of nitrate in water indicated the final stage of mineralization (Nema et al., 1984). It was found to have positive relation to nitrite and negative with ammonium nitrogen. In general, nitrite and ammonium nitrogen are present in natural waters in smaller quantities compared to nitrate nitrogen.

Nitrite is the product of intermediate oxidation state of nitrogen produced both in the oxidation of  $\text{NH}_4$  to  $\text{NO}_3$  and in the reduction of  $\text{NO}_3$ . It is an intermediate compound in nitrogen cycle and is unstable. In present study nitrite and ammonium nitrogen concentration were 0.04 mg/L and 0.08 mg/L respectively and found within the permissible limit described for aquaculture. Nitrite has positive relation with nitrate, temperature and negative with total alkalinity whereas ammonium nitrogen showed positive relation with BOD, total hardness and negative with nitrite.

#### **4. CONCLUSIONS**

It was noted that nutrient play important role for productivity of village pond. Thus results obtained from present work suggested that pond water could be used for aquaculture activity.

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