

Estimation of some abiotic parameters in water of Shivganga pond, Deoghar, Jharkhand

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ABSTRACT

Physico-chemical features are the abiotic parameters to assess the quality of water. Water is the most important ingredient of our life. Natural sweet water i.e. freshwater available in ponds, lakes, rivers, springs, streams and underground water are important sources of freshwater. Pond is the most common source of water for rural and urban public. Scientifically pond is a freshwater, lentic, aquatic ecosystem. Shivganga is a large perennial pond of Baidyanathdham Deoghar, Jharkhand, India which is widely used by lacks of pilgrims and local inhabitants for bathing, washing, cooking, drinking, swimming, fishing and immersion of mud made painted idols and images of Gods and Goddesses throughout the whole year. Some abiotic parameters were assessed during winter months of shivganga pond and got valuable results. Water and air temperature ranged well within the limit. Turbidity fluctuated in between 20.00 to 80.00 N.T.U. pH value varied from 5.8 to 6.5 and remained in acidic range. DO₂ fluctuated in between 0.4 PPM to 2.32 PPM. FCO₂ varied from 24.00 to 64.00 PPM. Carbonate was found completely absent during winter months. Bicarbonate ranged in between 82.00 to 208.00 PPM. Suspended solids fluctuated from 70.00 to 310.00 PPM. Dissolved solid was found in between 200.00 to 300.00 PPM. Chloride ranged in between 23.8 to 26.8 PPM. The range of variation was found of calcium hardness from 32.00 to 42.00 ppm, of Calcium from 12.8 to 16.8 PPM, of potassium from 1.8 to 4.8 PPM, of sodium from 18.5 to 32.5 PPM, of phosphate from 0.21 to 0.34 PPM and of nitrate from 2.05 to 5.2 PPM.

Key Words : Abiotic parameters, Water, Shivganga pond, Deoghar, Jharkhand.

INTRODUCTION

Physicochemical features are the abiotic parameters of Aquatic systems. These are important parameters to assess the quality of water reservoirs. Temperature, turbidity, suspended solids, dissolved solids, pH, dissolved oxygen, free carbon dioxide, carbonate, bicarbonate, silicate, chloride, calcium, calcium hardness, magnesium, potassium, sodium, phosphate and nitrate are some of the important abiotic parameters to judge the quality of water. Natural sweet water constitutes the freshwater which is commonly used by the human beings for drinking, cooking, bathing, washing, etc. Water is the

most important ingredient of our life and all life present on this earth. 80% of our life is water. Water is the basis of life. Water is the most precious natural gift to the mankind which is naturally available in ponds, lakes, rivers, springs, and underground water. Only 0.3 % of the total fresh water present on the earth is available in ponds. Pond is the most common and important source of freshwater widely used by public in rural as well as urban areas. Inland water with land bounded areas having lesser depth, artificially or naturally made in small basins is, the pond. Scientifically pond is a freshwater, lentic, aquatic ecosystem on which diverse array of life depends. The whole year has been categorized into

three Seasons namely winter, summer and monsoon. Winter season comprises November, December, January and February months. Shiv Ganga pond of BaidnathDham Deoghar, Jharkhand, India is a large perennial pond which is commonly used by thousands of local inhabitants and pilgrims daily for bathing and washing .Its water is also used for cooking, drinking, washing of utensils, fishing, swimming and immersion of idols and images of God and Goddesses throughout the year. As per media reports more than 50 lacs of pilgrims take Holy dips only in Shravan month (July to August) before offering worship in the famous temple “DwadashJyotirlingRavaneshwarBaidyanath” of Lord Shiva. The Shiv Ganga pond water was stinking, blooming and turned to greenish-giving the appearance of polluted nature, which may cause diseases. Keeping this view in mind abiotic parameters of Shiv Ganga pond was assessed in winter months to assess the quality of its water

METHODOLOGY

Physicochemical parameters of Shiv Ganga pond, Deoghar assessed in winter months from November to February. Sample from subsurface water of the pond work properly collected in polythene bottles at morning hours, water temperature, dissolved oxygen, free carbon dioxide, carbonate and Bicarbonate were analyzed at the research site just after the collection of the samples. Other parameters were assessed in laboratory. Standard methods as prescribed in reputed manuals and journals of APHA (1979), Welch (1948), NEERI (1979), Adoni (1975) etc. were followed for the analysis of different abiotic factors as follows:

TEMPERATURE :

Aerial and water temperature were recorded in centigrade with the help of centigrade mercury thermometer.

TURBIDITY :

Nephelo-Turbidity meter (Systronic type 131) was used for the analysis of turbidity. It was measured in Nephelo-Turbidity unit (NTU).

SUSPENDED SOLIDS; DISSOLVED SOLIDS :

The method prescribed by Wood (1975) was applied for the estimation of dissolved solids and suspended solids.

HYDROGEN-ION CONCENTRATION (pH):

Water quality analyzer (Elico type PE 32) was employed for the analysis of pH. Buffer solutions of pH 9.2 and 4.00 were used for its standardization.

DISSOLVED OXYGEN(DO₂):

Modified Winkler's method was followed to analyze dissolved oxygen which was given by Welch (1948).

FREE CARBON DIOXIDE(FCO₂):

Method prescribed by Welch (1948) was used for determination of free carbon dioxide.

CARBONATE (CO₃) AND BICARBONATE (HCO₃):

Carbonate and Bicarbonate alkalinity were analyzed by the method prescribed by Welch (1948).

SILICATE (SI):

It was measured by the method prescribed by Jhingaram *et al.*, (1949).

CHLORIDE (CL):

Argentometric method (APHA, 1975) was followed to estimate the amount of chloride.

CALCIUM HARDNESS, CALCIUM, MAGNESIUM, POTASSIUM AND SODIUM:

Calcium hardness, calcium, magnesium, potassium and sodium were determined by the method of APHP (1975).

PHOSPHATE (PO₄):

It was analyzed by adopting the method of Wilde *et al.*, (1972).

NITRATE (NO₃)

Method described in APHA (1975) and NEERI (1975) was applied to assess the nitrogen in the form of nitrate.

RESULTS AND DISCUSSION

Air temperature:

It ranged in between 16.00°C to 24.00°C, which is

moderate (Table 1). Lowest temperature was recorded in February and highest in November during winter season.

Water temperature:

Noticeable fluctuation in water temperature was observed. It varied from 18.5°C to 25.00°C (Table 1). Highest water temperature was recorded in the

month of November and lowest in January during winter

Similar observations were reported by Mishra and Yadav (1978) and Saha (1984). Direct impact of ambient temperature was observed on water temperature. Solar radiation, water level, duration of day hour and clarity of atmosphere probably has direct influence on water temperature.

Table 1.

Parameters	November	December	January	February
Air temp (°C)	24.00	18.00	18.00	16.00
Water temp(°C)	25.00	19.00	18.5	19.00
pH	6.2	5.8	6.22	6.5
DO ₂ (ppm)	2.32	1.04	0.4	1.12
FCO ₂ (ppm)	24.00	58.00	64.000	48.00
CO ₂ (ppm)	Nil	Nil	Nil	Nil
HCO ₃ (ppm)	82.00	208.00	128.2	160.00
Turbidity (N.T.U)	40.00	40.00	80.00	20.00
Suspended solids (ppm)	110.00	70.00	310.00	180.00
Dissolved solids (ppm)	200.00	200.00	300.00	300.00
Silicate (ppm)	16.08	17.00	14.12	12.69
Chloride (ppm)	23.82	25.01	26.83	25.84
Calcium hardness (ppm)	36.00	32.00	6.00	2.00
Calcium (ppm)	14.4	12.8	14.4	16.8
Magnesium (ppm)	1.46	0.68	1.46	0.48
Potassium (ppm)	2.3	1.8	2.71	4.83
Sodium (ppm)	18.5	18.5	9.5	2.5
Phosphate (ppm)	0.27	0.23	0.21	0.34
Nitrate (ppm)	5.2	2.05	2.7	2.5

Turbidity:

Muddy Opaque water is known as turbid, which happens due to suspended particles in water. It ranged in between 20.00 Nephelo-Turbidity unit (N.T.U) to 80.00 N.T.U during winter in Shiv Ganga pond. Lowest turbidity was recorded in February and highest in January (table 1). Lower turbidity in winter was also recorded by Dhindsa and Bhargava (1982). Turbidity maybe attributed to temperature, light, water current, wind velocity, suspended solids, dissolved solids and plankton density.

Hydrogen ion concentration (pH):

Table 1, indicates the fluctuation in pH. It ranged from 5.8 to 6.5 during winter in Shiv Ganga pond. Its highest value was found in February and lowest in December. It is assumed that pH is regulated by CO₂ and HCO₃. It remained in acidic range which supports the view of Singh (1980).

Dissolved oxygen (DO₂):

DO₂ fluctuated in between 0.4 ppm to 2.32 ppm (table 1) during winter months. Its lowest value was observed in the month of January while highest in November. Its lower amount might be due to the standing state of water, least water current, greater

decomposition and increase respiration by heterotrophic organisms, which is in conformity with the results of Saha and Chaudhary (1985). Higher DO_2 maybe attributed to Greater aeration by rippling turbulence, water current and wind velocity with supports the report of Mohanty and Padhi (1984) and Saha and Pandit (1984). Higher rate of photosynthesis by greater phytoplankton's population, releasing greater amount of oxygen might also be the reason of higher DO_2 in water.

Free carbon dioxide (FCO₂)

Carbon assimilated and Incorporated in the food matters of the aquatic flora essentially comes from dissolved free carbon dioxide in water. Carbon is one of the most important and integral component of the food matters of Aquatic autotrophs. Table 1 displays the fluctuation of FCO₂ in the water of Shiv Ganga pond. In winter months it ranged from 24.00 ppm to 64.00 ppm. Its lowest value was found in November and highest in January. Its direct diffusion from air and decomposition of organic matter are the sources of CO₂ in natural water. Release of CO₂ after respiration by aquatic plants and animals also contribute to increase CO₂ in water. High temperature might be the reason for its higher concentration, (Bilgrami *et al.*, 1985). Lower amount of FCO₂ in pond may be attributed to its greater utilization in photosynthesis by autotrophs which support the results of Chakraborty *et al.* (1959).

Carbonate (CO₃):

Alkalinity is contributed by hydroxide, carbonates and bicarbonates. pH of water is regulated by alkalinity and thereby regulates the biotic composition and its quality. Carbonate remained completely absent during the winter months in Shiva Ganga pond (table 1).

Bicarbonate (HCO₃):

It fluctuated in between 82.00 ppm 208.00 ppm (table 1). Its highest value was found in December and lowest in November. Its lower value might be due to Greater dilution by rains. Its higher value might be attributed to depletion in water volume and greater

washing activities, which supports the reports of Saha and Choudhary (1985).

Suspended solids (S.S):

Particles of organic matters and silt, particles remain physically mixed with water making the water turbid and opaque, are the suspended particles. Distribution of organic particles and silt particles may be odd or even. Total sum of suspended solids and dissolved solids constitute the total solid in water. Suspended solids ranged in between 70.00 ppm to 310.00 ppm in winter months. Its lowest value was found in the month of December and highest in January (table 1). Its higher value may be attributed to addition of Greater amounts of silt particles in rains and depletion in water volume along with greater human activities in water.

Dissolved solids (D.S):

It fluctuated in between 200.00 ppm to 300.00 ppm during winter months in Shiv Ganga pond. Its highest value was found in January and February while lowest in November and December (table 1). Greater decomposition of organic matter in pond water might be the reason for its greater amount.

Silicate (Si):

It is an important abiotic factor of Aquatic system which imparts as structural constituent of Bacillariophycean algae (Diatoms). It varies from 12.69 ppm to 17.00 ppm (table 1) during the winter months. Low temperature and sedimentation of suspended particles may be accounted for low amounts which supports the reports of Saha (1983). Its utilization in the formation of frustules by diatoms might also be the reason for its lower concentration as also reported by Singh (1985).

Chloride (Cl):

It plays a significant role in photolysis of water and phosphorylation in aquatic autotrophs. It is considered as pollution indicator when present in high concentration. Table 1 reveals the chloride concentration in different months of winter season in Shiva Ganga pond. It fluctuated in between 23.8 to 26.8 ppm during winter months. Dumping of

sewage, organic matters of animal's origin, immersion of mud made painted idols and images, Industrial effluents as well as bathing activities might be the probable cause of Greater chloride concentration in Shiv Ganga pond water.

Calcium hardness (CaH):

Table 1 exhibits the monthly variation during winter in the amount of calcium hardness which range between 32.00 ppm 42.00 ppm. It showed narrow range of variation. Its lowest value was obtained in December and highest in February. Nutrients, and current human activities in impart on the amount of calcium hardness (George, 1966).

Calcium (Ca):

Calcium is a micronutrient which remains commonly present in freshwater. Table 1 shows the monthly variation in the amount of calcium during winter in Shiv Ganga pond. It fluctuated in between 12.8 ppm to 16.8 ppm. Higher concentration of calcium was due to greater alkalinity and hardness of water. It is considered as a good parameter to judge the quality of water. As per Ohle (1934) water bodies having less than 10 ppm of calcium are considered as poor while with 10.00 ppm to 15.00 ppm as medium and with more than 25.00 ppm as rich in respect of nutrients. Based on this concentration Shiv Ganga pond water was medium in nutrition during winter which indicates its slight eutrophic nature.

Potassium (K):

It is an important parameter of Aquatic ecosystems. It acts as enzyme activators. It contributes significantly in the metabolic activities of Aquatic autotrophs. It fluctuated in between 1.8 ppm to 14.8 ppm during winter months in Shiv Ganga pond (Table 1).

Sodium (Na):

Sodium is essential for growth of Cyanophean algae. It imparts softness to water and determine the quality of water. It ranged in between 18.5 ppm to 32.5 ppm (table 1). Its lowest value was observed in November and December while highest in February.

Phosphate (PO4):

It is an important plant nutrient and it may act as limiting factor (Dngan, 1972). It is a major source of water pollution depicting eutrophication, if present in excess amount. It fluctuated in between 0.21 ppm to 0.34 ppm during winter months in Shivganga. Its lowest value may be attributed to low bacterial decomposition capacity and its rapid utilization by aquatic autotrophs. Decomposition of organic matter might be the reason for its higher concentration. It contributes to the increased rate of primary productivity.

Nitrate (NO3):

It is the most important type of plant nutrient. Bacteria contributes significantly in the formation of nitrate by decomposing complex organic matter (Zafar, 1964). Table 1 shows the monthly variation in amount of nitrate during winter months in Shiva Ganga pond water. It ranged in between 2.05 ppm to 5.2 ppm. Its highest amount was found in November and lowest in December. It's higher value may be attributed to Greater decomposition of organic matter, its lower concentration may be probably due to sedimentation and biogenic uptake by macrophytes. Brown and Austin (1973) reported the same.

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