Article

Study of physico-chemical parameters of different pond water of Bilaspur District, Chhattishgarh, India

A K Dixit[1], **S K Pandey**[1], **R Mehta**[2], **NiyazAhmad**[1], **Gunjan**[1], **JyotiPandey**[1]

[1]Department of Botany, Guru Ghasidas Vishwavidyalaya, Bilaspur Chhattisgarh, India

[2]Department of Rural technology, Guru Ghasidas Vishwavidyalaya, Bilaspur Chhattisgarh, India

E-mail: dixitak@live.com

Abstract

This research article deals with the study of quality of pond water. Pond water samples were collected from 27 villages of Bilaspur district, Chhattisgarh (India)in triplicate. Samples were analyzed for physico-chemical parameters including pH, electrical conductivity (EC), total dissolved solids (TDS), temperature, salinity and dissolved oxygen (DO). pH ranged from 6.50 – 9.69, Electrical Conductivity ranged from 118.7 – 206.6 µmhos/cm, TDS ranged from 165.5 – 254.8 ppm, Temperature ranged from 20.9 – 33.8°C, Salinity ranged from 5.1 – 6.9 ppt, Dissolved oxygen ranged from 2.41 – 4.8 mg/l. Correlation coefficient (r) was found significant at p<0.05 level for the tasted parameters. The result of the proposed study will establish some facts about the use of water for various purposes like domestic and agriculture.

1 Introduction

Water is the most necessary component for the living being. Life on the earth is never possible without water. Water is one of the most vital element of the human environments. It is being used for many purposes e.g., industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of hydro-power plants. Water is the main source of energy and governs the evolution on the earth. 71% of earth surface is covered by water (CIA, 2008), 96.5% of the world's water is sea water which is salty that is not to be directly useful for irrigation, drinking, domestic and industrial purposes.1.7% in groundwater, 1.7% in glaciers and the ice caps. Less than 1% water is present in ponds, lakes, rivers, dams, etc., which is used by man for Industrial, domestic and agricultural purposes. According to an estimate about 70% of all the available water in our country is polluted due to the discharge of effluents from the industries, domestic waste, land and

agricultural drainage (Shrivastava and Kanungo, 2013). Chemicals are a major source of water contamination that introduced during water movement through geological materials (Kataria et al., 2011). Fertilizers and pesticides are major contributors to water pollution. Weathering of rocks, leaching of soils and mining processing, etc., these are contaminate natural water (Manjare et al., 2010).

In the ecosystem water is considered to be the most important component for the life but day by day the quality of water become degraded. There are several factors which are responsible for deterioration of water bodies such as increased human population, industrialization, use of excess fertilizers in the agriculture and other man-made activities etc. There are several diseases have been identified among the human beings, which are caused by using contaminated water. Water born disease infections occur during washing, bathing and consumption of contaminated water during food preparations. Therefore it is necessary that the quality of water should be checked at regular time of interval because the financial losses due to water born diseases have negative impact on the nation. Nowadays this is the major problem of developing countries throughout the world. The main aim of the present study was to give an idea about the pollution level of pond water in terms of physico-chemical characteristics. There is no information is available in relation to physico-chemical characteristics of pond water at Bilaspur. Few researchers (Kiran, 2010; Raut et al., 2011; Naik et al., 2012; Bahekar and There, 2013; Mahajan and Tank, 2013) in different regions of India have been studied the physico-chemical parameters of the various water bodies.
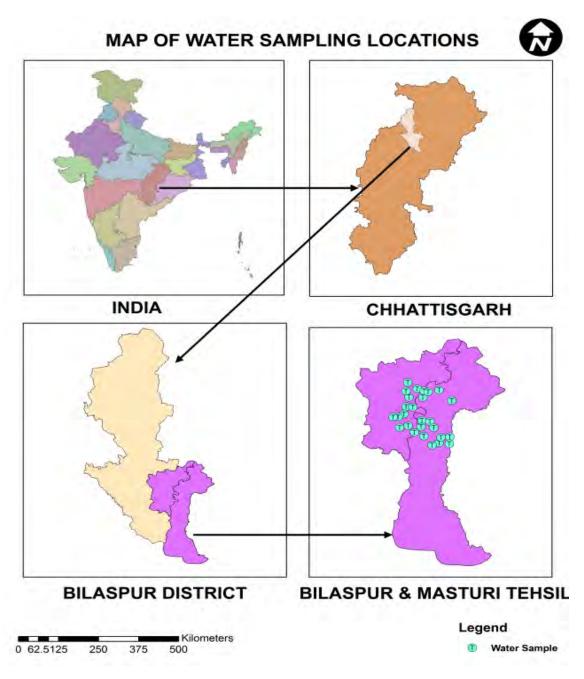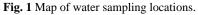
2 Materials and Methods

2.1 Study area

This investigation was carried out to evaluate the status of the pond water in Bilaspur district. Bilaspur district is situated between 21^0 47' to 23^0 8' North Latitude ad 81^0 14'to 83^0 15'. East Longitude (Fig. 1). These ponds water is used for agriculture, fisheries and partially domestic activities. The present study was conducted to analyze physico-chemical properties of water in the period of one year from Dec 2013 to Dec 2014.

2.2 Sample collection

Water Samples from the pond of twenty seven selected villages of Bilaspur district were collected during Dec 2013 to Dec 2014. Water samples from the pond were collected in bottles. All the precautions were taken during the sampling. The collected water samples were analyzed for different physico-chemical parameters such as for pH, electrical conductivity, total dissolved solid, temperature, salinity and dissolved oxygen by following the standard protocols (Table 1). All the above analyses were performed in triplicate.

Fig. 1 Map of water sampling locations.

Table 1.Methods followed for analysis of water samples.

S.No	Water quality Parameters	Method of Analysis
1	pH	pH meter
2	Electrical conductivity	Conductivity meter
3	Total dissolved solid	Water and Soil analysis kit Model no 161
4	Temperature	Thermometer
5	Salinity	Refractometer
6	Dissolved oxygen	Wrinkler's method

3 Results and Discussion

The variation in physicochemical parameters of pond water of twenty seven villages presented in Table 2 and correlation coefficients among physico-chemical characteristics were shown in Table 3.

3.1 pH

The pH (Potentia Hydrogeni) of a solution refers to its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. pH is measured in scales of 0 to 14. A pH value of 7 is neutral; a pH less than 7 is acidic and greater than 7 represents base saturation or alkalinity. From the above experimentation, it was observed that among the 27 villages, water analysis was carried out; pH ranged from 6.50 – 9.69, Maximum pH was recorded in Mohara village, whereas minimum was observed in Kacchar village. Shrivastava and Kanungo (2013), and Shyamala et al. (2008) reported the range of pH 6.93 to 7.55 and 7.5 to 8.4 respectively. Choudhary et al. (2014) reported a range of pH in between 7.0 and 8.3.According to Umavathi et al. (2007), pH ranged between 5.0 to 8.5 is best for planktonic growth.

3.2 Electrical conductivity

Electrical conductivity (EC) is the ability of an aqueous solution to conduct the electric current. Electrical Conductivity is a useful tool to evaluate the purity of water (Acharya et al., 2008).Water becomes a conductor of electrical current when substances are dissolved in it and the conductivity is proportional to the amount of dissolved substance. The source of EC may be an abundance of dissolved salts due to poor irrigation management, minerals from rain water runoff, or other discharges. Electrical Conductivity ranged from 118.7 – 206.6 μmhos/cm. Maximum electrical conductivity was recorded in the pond water of Pondi village whereas minimum was in pond water of Pipra village. Kataria et al. (2011), and Shrivastava and Kanungo (2013) also reported a range of EC in between 296 to723μmhos/cm and 115.11 to 212.13 μmhos/cm respectively.

3.3 Total dissolved solid

Total dissolved solids (TDS) denote mainly the various kinds of minerals present in water. There is no gas and colloids in TDS. TDS ranged from 165.5 – 254.8 ppm. Maximum TDS was observed in Beltukari village, whereas minimum was recorded in Nipaniya village. Rao et al. (2003), Kirubavathy et al. (2005), Garg et al. (2006) also reported the same result. Shrivastava and Kanungo (2013) reported the range of TDS in between 152.12 - 265.97 ppm.

3.4 Temperature

Temperature is the measurement of hotness of any material. It affects the physical and chemical properties of water and also affects the aquatic vegetation, organisms and their biological activities. During this study temperature ranged from 20.9 to 33.8°C. Maximum temperature was observed in pond water of Gataura village, whereas minimum was observed in pond water of Mohra village. Thripathaiah et al. (2012) and Shyamalaet al.,(2008) also reported the range of temperature in between 24.75 to 28.5°C and 26.3 to 27.2°Crespectively.

3.5 Salinity

Salinity is the saltiness or dissolved salt content of a body of water. From the above experimentation it has been observed that salinity ranged from 5.1 – 6.9 ppt. Maximum salinity was recorded in pond water of Raliya village, whereas minimum was recorded in pond water of Selar village. Shrivastava and Kanungo (2013) reported the range of salinity in between 5.13-6.27 ppt.

3.6 Dissolved oxygen

For all the forms of aquatic life dissolved oxygen (DO) is essential component to break down man-made pollutants. The presence of dissolved oxygen is essential to maintain the higher forms of biological life and to keep proper balance of various pollutions thus making the water bodies healthy. The chemical and biochemical

process undergoing in water body are largely dependent upon the presence of oxygen. Estimation of dissolved oxygen is a key test in water pollution and waste treatment process control. In this present investigation dissolved oxygen ranged from 4.72 – 6.13 mg/l. Maximum DO was recorded in pond water of Selar Village, whereas minimum was recorded in pond water of Raliya village. Shrivastava and Kanungo (2013) reported a rage of DO 2.43 - 4.45 mg/l in their study. Thirupathaiah et al. (2012) reported a range of DO in between 5.18-9.72mg/l. Benerjee (1967), and Torzwall (1957) had reported that if the concentration of DO is about 5mg/l, throughout the year, the reservoir will be productive for fish culture.

Table 2 Physico-chemical analysis of pond water.

SN	Name of village	pH	Electrical Conductivity (µmhos/cm)	TDS (ppt)	Temperature (°C)	Salinity (ppt)	D.O. (ppm)
1.	Selar	8.14	167.9	193.1	20.9	5.1	6.1
2.	Hardidih	8.28	145.8	236.5	21.2	5.3	6.07
3.	Mohra	9.69	157.5	196.3	21.0	5.8	6.12
4.	Chilhati	8.10	195.6	251.3	23.9	5.5	5.85
5.	Mopka	7.89	210.5	174.8	24.0	6.3	5.76
6.	Ucchbhatti	7.90	145.8	214.8	27.7	6.0	5.66
7.	Jhalmala	7.86	195.4	161.1	27.5	6.6	5.77
8.	Nipaniya	7.95	148.7	165.5	27.1	5.2	5.81
9.	Nawagaon	7.94	170.4	246.9	29.3	6.7	5.5
10.	Pondi	7.34	208.2	224.3	29.0	6.6	5.4
11.	Phandi	7.25	123.4	212.5	31.2	6.3	4.77
12.	Pipra	7.5	118.7	219.2	32.5	5.5	4.8
13.	Khaira	7.51	198.6	187.3	32.7	6.2	4.83
14.	Daganiya	7.58	183.1	178.5	32.9	5.8	4.79
15.	Farhada	8.62	143.7	254.5	30.3	5.5	5.02
16.	Devri	8.22	172.8	198.7	30.4	5.4	4.84
17.	Gataura	8.13	152.9	221.3	30.4	6.5	4.78
18.	Bhelai	8.02	143.4	218.1	31.1	6.3	4.73
19.	Parsada	7.88	179.4	178.8	31.0	5.9	4.74
20.	Raliya	7.90	170.8	174.6	31.1	5.4	4.72
21.	Hardadih	8.18	197.7	218.6	31.4	5.7	4.73
22.	Parsahi	7.36	148.1	245.3	32.1	6.2	4.75
23.	Bijaur	7.38	181.7	187.5	32.2	5.5	4.9
24.	Bahtarai	7.22	189.5	205.8	32.4	5.2	4.73
25.	Rank	7.26	142.3	183.4	32.1	5.4	4.75
26.	Kacchar	6.50	137.6	224.8	32.3	6.2	4.76
27.	Beltukri	7.35	198.5	254.8	32.4	5.4	4.75
Average		7.81	167.70	208.45	29.26	5.83	5.16
Range		6.50 – 9.69	118.7 – 206.6	165.5 – 254.8	20.9 – 32.9	5.1 – 6.7	4.72 – 6.12

Table 3 Correlation Coefficient (r) between different physicochemical parameters of pond water.

	pH	EC	TDS	Temperature	Salinity	DO
pH	1					
EC	0.0038	1				
TDS	-0.01049	-0.18936	1			
Temperature	-0.63099	-0.07	0.039084	1		
Salinity	-0.143	0.097996	0.076906	0.142968	1	
DO	0.528872	0.11747	-0.07376	-0.93656	-0.0508	1

3.7 Statistical analysis

There are so many statistical tools to study the interrelationship between different variables. Among them correlation and regression are also the important tools for the study of the interrelationship between two variables. In the present paper correlation was used for reducing the range of uncertainty. Correlation coefficient (r) was calculated by using the equation (Patil and Patil, 2010). Correlation coefficient (r) was calculated by taking the values of two parameters at a time shown in Table 2.

From the Table 3 it has been observed that the water pH found to show positive correlations with EC and DO it means variation of pH with EC and DO is in forward direction i.e. if one is increases other will also be increased. pH has negative correlation with TDS, temperature and salinity i.e. if one is increases other will decrease. EC has positive correlation with salinity and DO whereas negative correlation with TDS and temperature. TDS shows positive correlation with temperature and salinity whereas negative correlation with DO. There is the strong negative correlation in between DO and temperature. Temperature show positive correlation with salinity. There is the negative correlation between salinity and DO.

4 Conclusion

From the above experimentations it has been concluded that the pH value observed in different pond water samples generally ranged from 6.5 to 8.5 which in compliance of the water quality criteria given by CPCB, New Delhi for all the categories (i.e., A to E). However, water samples of Mohra village, Parasahi village, BhimaTalab showed comparatively higher values (above 9) indicating that the water from these ponds are not suitable for drinking, bathing, propagation of wildlife and fisheries, and irrigation purposes. Based on the DO values measured at different ponds, it seems that most of them fell in the B or C category of water quality criteria indicating that water is safe for organized bathing and even drinking after conventional treatment.

Acknowledgement

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