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Physico-Chemical Analysis of Pond Water of Surguja District, Chhattishgarh, India

Swati Shrivastava, V. K. Kanungo

ABSTRACT

Pond water samples were collected from 10 villages of Surguja district Chhattisgarh (India). These water samples from 10 sampling points of Surguja district were analyzed for their physicochemical characteristics. Laboratory tests were performed for the analysis of samples for Temperature, pH, Electrical conductivity, TDS, Alkalinity, Free CO₂, Chloride, DO, BOD, COD, Total hardness, Ca hardness, Calcium, Magnesium. Were analyzed for a periods of two year from 1st August 2009 to 31st May 2010. By observing the result it can be concluded that the parameters which were taken to study the water quality are below the pollution level for ground water which satisfies the requirement for the use of various purposes like domestic, agricultural, industrial etc. But in case of surface water, the water quality of small community pond are above the permissible limit., it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. The usefulness of these parameters in predicting pond water quality characteristics were discussed.

Keywords: Surguja Pond; Physico-Chemical Parameters.

1. Introduction

The water is one of the most important compounds of the ecosystem. Living things exist on the earth because of this is only planet that has the existence of water. It is necessary for the survival of all living things be it plant or animal life. It is the most abundant commodities in nature but also the most misused one. Although earth is a blue planet and 80% of earth's surface (80% of the total 50,000 million hectares in area) is covered by water, the hard fact of life is that about 97% of it's locked in oceans, sea which is too saline to drink and for direct use for agricultural or industrial purposes. 2.4% is trapped in polar icecaps and glaciers, from which icebergs break off and slowly melt at sea. < 1% (i.e. 33, 400 m³) water is present in ponds, lakes, rivers, dams etc. which is used by man for

Industrial, domestic and agricultural purposes¹. India receives about 1400-1800 mm of rainfall annually. About 96% of this water is used for agriculture, 3% for domestic use and 1% for industrial activity. An analysis revealed that 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. This results in the degradation of water quality of these water resources due to use of contaminated drinking water, human population suffers from water borne diseases. Also due to increased human population, use of fertilizers in the agriculture and man-made activities, the natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to depletion of aquatic biota Mahananda^[1] The present study involves the analysis of water quality in terms of physico-chemical parameters of pond water near 10 village of Surguja, District Chhattisgarh State Pagriya^[2].

2. Materials and Methods

(a) Study Area: Surguja district of Chhattisgarh. Surguja district which lies in the northern part of Chhattisgarh state is biodiversity rich area, dominated by tribal communities. Borders of Uttar Pradesh, Jharkhand, Orissa, and Madhya Pradesh states are adjoining to the district. The district has over extension between southeastern parts of Vindhya-chal-Baghelkhand region of peninsular India.

Surguja lies between 23°37'25" to 24°6'17" north latitude and 81°34'40" to 84°4'40" east longitude.

(b) Geography of Surguja: Geography of Surguja District is characterized by several rivers, vast forest lands, pleasant climate and adequate rainfall. Main rivers of this district of Chhattisgarh are Kanhar, Moran, Rihand River and Mahan. The natural features of the area have three main physiographic divisions - mountains (high lands), plateaus and hills (uplands) and central plain. As per its physiographic, the highlands are remarkable landforms. Average height of area varies from 600 meters and more. The uplands include plateaus and hills. The terrain of northwest region of the district is hilly in nature. The topography of central region of Surguja District assumes the form of low basin through which Rihand River and its tributaries flow. This low level basin is in the form of inverted triangle.

(c) Sample collection: For the collection and preservation of the pond water 10 ponds located in the 10 village of the study were chosen. Pond water was collected by using a glass bottle of one-liter capacity. The bottle was sterilized and then rinsed with pond water, before collection. Collections were made at one month interval in between 10:00 AM to 2:00 PM throughout the study period during the year 2009 to 2010. The collected pond water sample was transported to laboratory was used for analysis of physicochemical parameters.

(d) Physico-Chemical Analysis: The collected samples were analyzed for different physico-chemical parameters such Temperature, pH, Electrical conductivity, TDS, Alkalinity, Free CO₂, Chloride, DO, BOD, COD, Total hardness, Ca hardness, Calcium, Magnesium, as per the standard methods APHA [3], and the results were compared with the Indian Standards (ICMR) for potable water. The parameters present in the water sample can be calculated by using various methods. The pH of all the water samples was determined using a pH meter (Model no LI 127, Elico) Electrical conductivity was measured using a conductivity meter. The chloride, calcium, magnesium and total hardness were estimated by the standard methods of water.

3. Results and Discussion

The variation in physico-chemical characteristics of the pond water, and pond water of ten Villages and 10 ponds have been summarized in the tables 1, 2, and the interpretation of data has been made with the help of statistical tools.

1. Temperature

The temperature of 10 village's pond water ranged from a minimum of Endutikra village pond water 17.54 °C to a maximum Ajirma village 26.91 °C. (Table 1, 2, Fig-1) shows the variation in temperature of pond water.

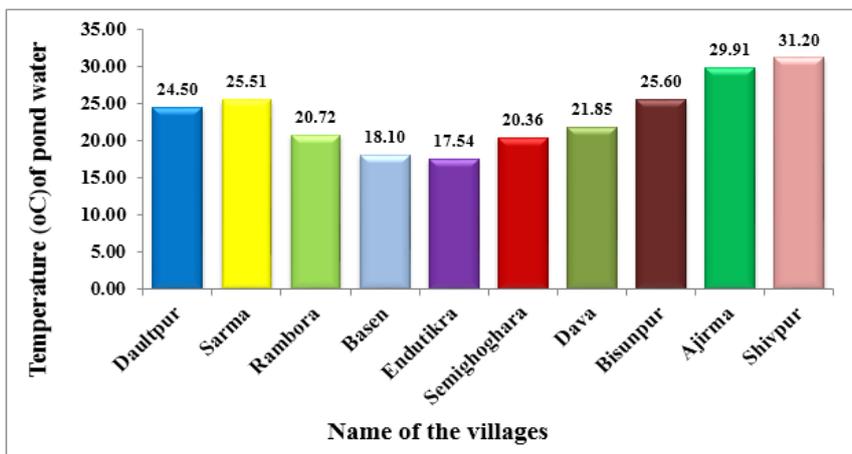


Fig 1: Temperature (°C) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

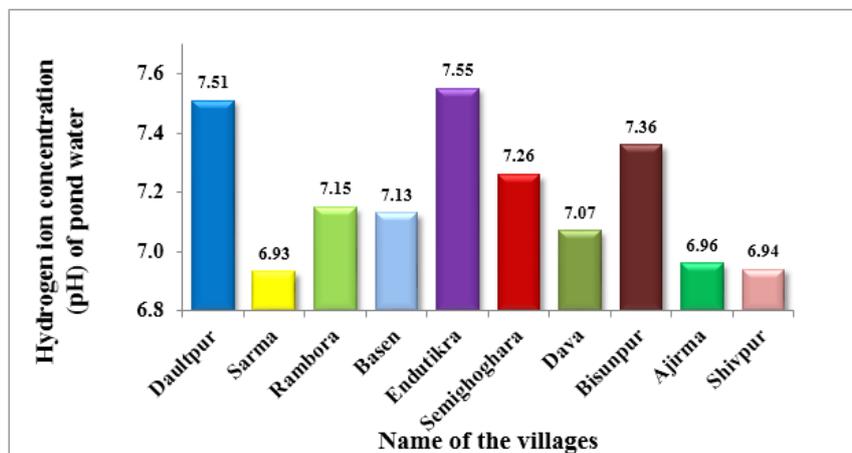


Fig 2: Hydrogen ion concentration (pH) of pond water recorded in 10 villages of Surguja district during the year 2009- 2010.

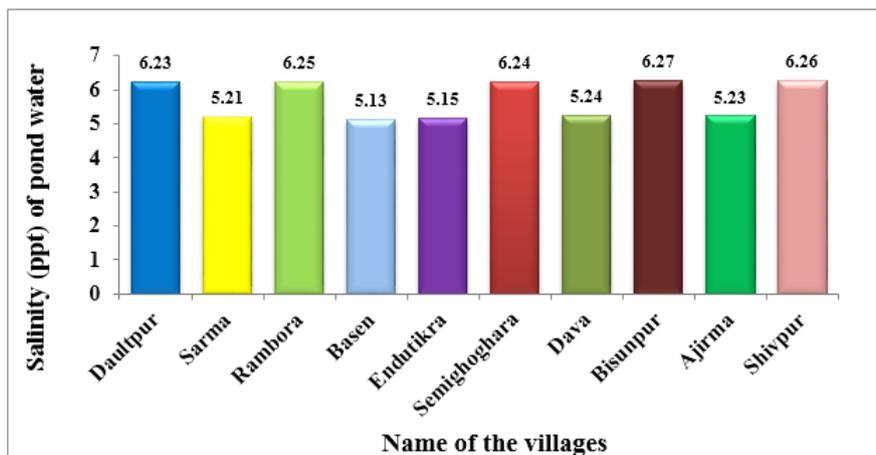


Fig 3: Salinity (ppt) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

2. Hydrogen ion concentration (pH)

The pH of 10 villages pond water ranged from a minimum of Sarma village pond water 6.93 to a maximum Endutikra village 7.55 (Table 1, 2, Fig-2) shows the variation in pH of pond water.

3. Salinity

The salinity of 10 village’s pond water ranged from a minimum of Basen village pond water 5.13 ppt to a maximum Bisunpur village 6.27 ppt. (Table 1, 2, Fig-2) shows the variation in salinity of pond

water.

4. Electrical conductivity

The temperature of 10 village’s pond water ranged from a minimum of Bisunpur village pond water 115.11 μ mhos/cm to a maximum Semighoghar village pond water 212.13 μ mhos/cm. (Table 1, 2, Fig-3) shows the variation in temperature of pond water.

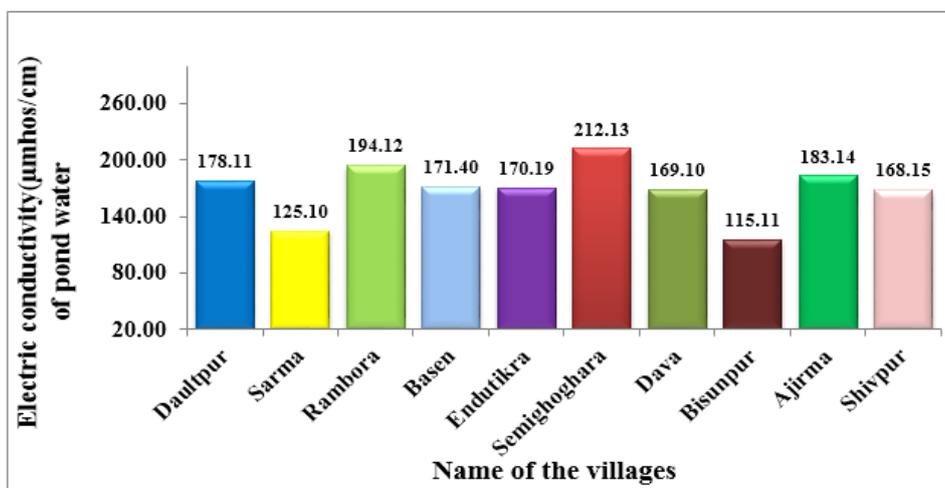


Fig 4: Electric conductivity (μ mhos/cm) of pond water recorded in 10 villages of Surguja district during the year 2009- 2010.

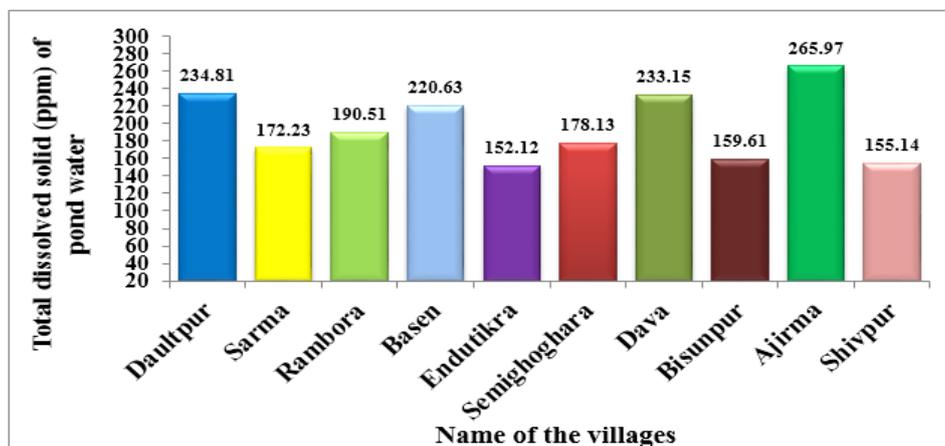


Fig 5: Total dissolved solid (ppm) of pond water of pond water recorded in 10 villages of Surguja district during the year 2009- 2010

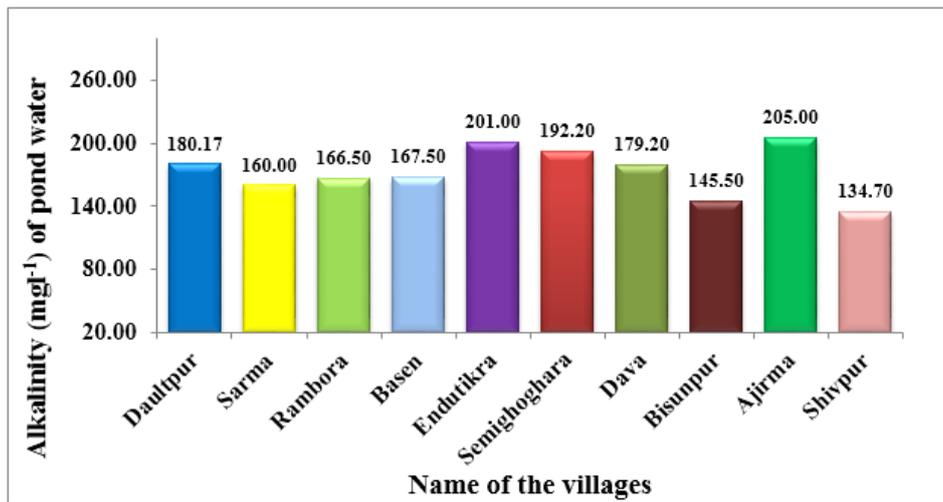


Fig 6: Alkalinity (Mg⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

5. Total dissolved solids (T. D. S.)

The total dissolved solids of 10 village’s pond water ranged from a minimum of Endutikra village pond water 152.12 ppm to maximum Ajirma village pond water 265.97 ppm. (Table 1, 2, Fig-4) shows the variation in temperature of pond water.

6. Alkalinity

The alkalinity of 10 village’s pond water ranged from a minimum of Shivpur village pond water 134.70 (Mg/L) to a maximum Ajirma village pond water 205.00 (Mg/L). (Table 19, 20, Fig-4, 5) shows the variation in temperature of pond water.

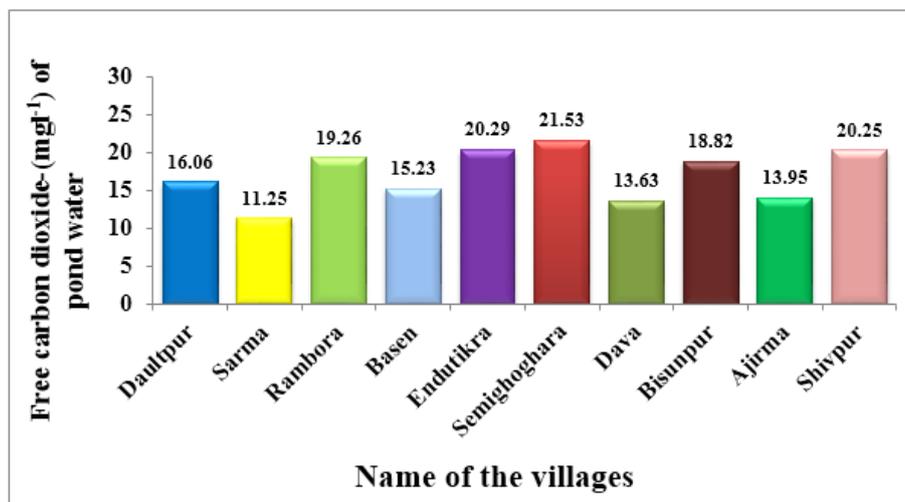


Fig 7: Free carbon dioxide (Mg⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

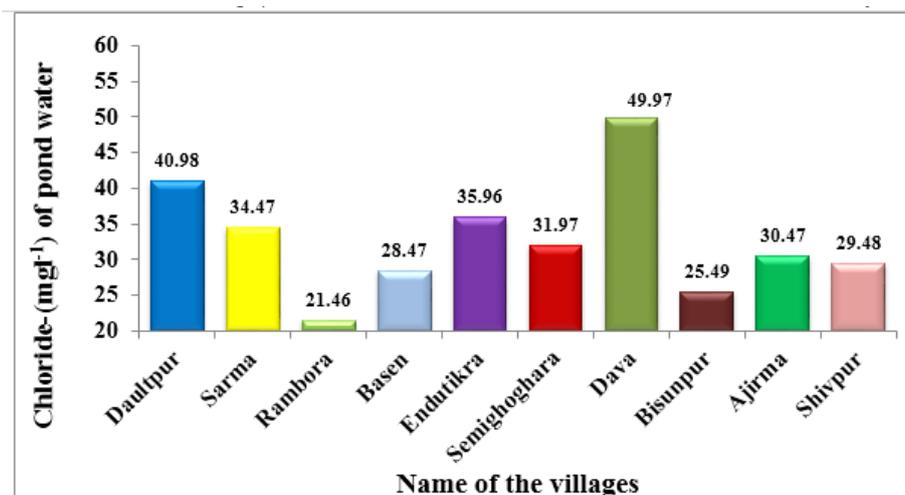


Fig 8: Chloride (Mg⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

7. Free carbon dioxide (Free CO₂)

The Free carbon dioxide of 10 village's pond water ranged from a minimum of Sarma village pond water 11.25 (Mg/L) to a maximum Semighoghar village pond water 21.53 (Mg/L). (Table-1, 2, Fig-6) shows the variation in temperature of pond water.

8. Chloride

The chloride of 10 village's pond water ranged from a minimum of Rambora village pond water 21.46 (Mg/L) to a maximum Dava

village pond water 49.97 (Mg/L). (Table 1, 2, Fig-7) shows the variation in temperature of pond water.

9. Dissolved oxygen (DO)

The dissolved oxygen of 10 village's pond water ranged from a minimum of Dava village pond water 2.43 (Mg/L) to a maximum Bisunpur village pond water 4.45 (Mg/L). (Table 1, 2, Fig-8) shows the variation in temperature of pond water.

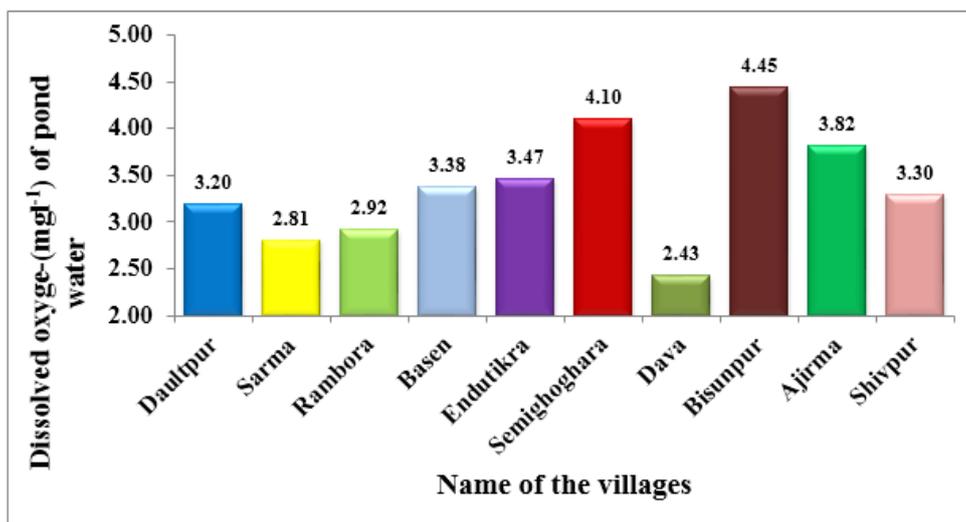


Fig 9: Dissolved oxygen (Mgl⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

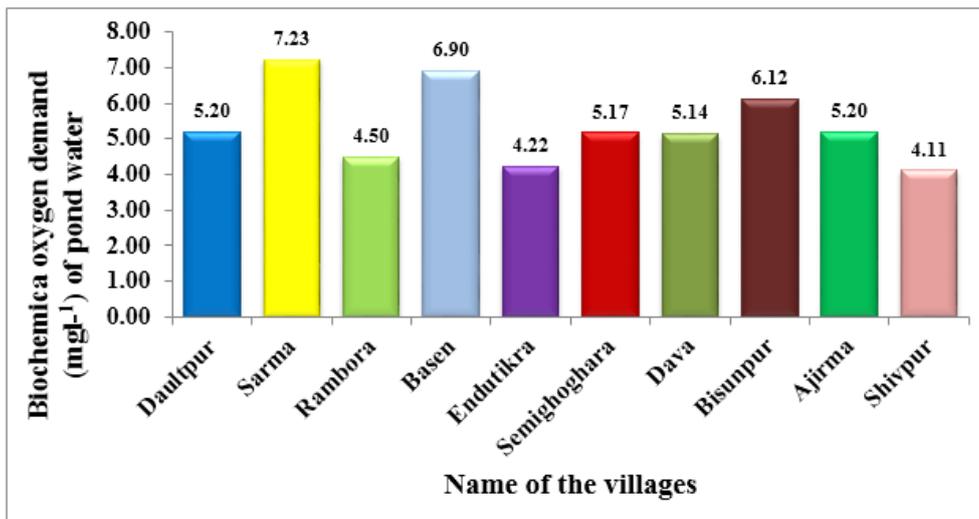


Fig 10: Biochemical oxygen demand (Mgl⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

10. Biological oxygen demand (BOD)

The biological oxygen demand of 10 village's pond water ranged from a minimum of Shivpur village pond water 4.11 (Mg/L) to a maximum Sarma village pond water 7.23 (Mg/L). (Table 1, 2, Fig-9) shows the variation in biological oxygen demand of pond water.

11. Chemical oxygen demand (COD)

The chemical oxygen demand of 10 village's pond water ranged from a minimum of Daultpur village pond water 9.15 (Mg/L) to a maximum Semighoghar village 18.00 (Mg/L). (Table 1, 2, Fig-10)

shows the variation in chemical oxygen demand of pond water.

12. Total hardness, Calcium hardness, Calcium and Magnesium

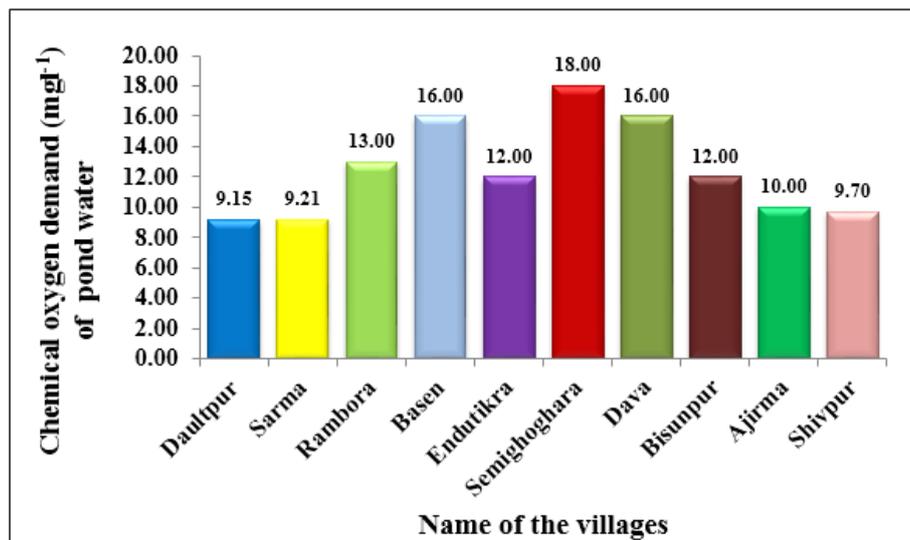
All the four parameters exhibited similar patterns. Lower range of values for above parameters were noted in decreasing order of TH>CaH>Ca>Mg. The Total hardness of 10 village's pond water ranged from a minimum of Endutikra village pond water 138.12 (Mg/L) to a maximum Ajirma village pond water 219.37 (Mg/L)

Table 1: Physicochemical characteristics of pond water in villages of district Surguja during the year 2009

S. N.	Physicochemical parameters	Name of the villages				
		Daultpur August-09	Sarma September-09	Rambora October-09	Basen November-09	Endutikra December-09
1.	Temperature (°C)	024.50	025.51	020.72	018.10	017.54
2.	Hydrogen ion concentration (pH)	007.51	006.93	007.15	007.13	007.55
3.	Salinity (ppt)	006.23	005.20	006.25	005.13	005.15
4.	Electric conductivity (μ mhos/cm)	178.11	125.10	194.12	171.40	170.19
5.	Total dissolved solid (ppm)	234.81	172.23	190.51	220.63	152.12
6.	Alkalinity - mg l^{-1}	180.17	160.00	166.50	167.50	201.00
7.	Free carbon dioxide - mg l^{-1}	016.06	011.25	019.26	015.23	020.29
8.	Chloride - mg l^{-1}	040.98	034.47	021.46	028.47	035.96
9.	Dissolved oxygen- mg l^{-1}	003.20	002.81	002.92	003.38	003.47
10.	Biochemical oxygen demand (BOD) - mg l^{-1}	005.20	007.23	004.50	006.90	004.22
11.	Chemical oxygen demand (COD) - mg l^{-1}	009.15	009.21	013.00	016.00	012.00
12.	Total hardness - mg l^{-1}	186.20	203.24	168.28	213.21	138.12
13.	Calcium hardness - mg l^{-1}	153.30	134.51	157.31	138.36	117.49
14.	Calcium - mg l^{-1}	061.62	053.92	063.12	049.81	046.91
15.	Magnesium - mg l^{-1}	017.31	015.43	012.40	016.11	014.72

Table-2: Physicochemical characteristics of pond water in villages of district Surguja during the year 2010.

S.N.	Physicochemical parameters	Name of the villages				
		Semighoghara January-10	Dava February-10	Bisunpur March-10	Ajirma April-10	Shivpur May-10
1.	Temperature (°C)	020.36	021.85	025.60	029.91	031.20
2.	Hydrogen ion concentration (pH)	007.26	007.07	007.36	006.96	006.94
3.	Salinity (ppt)	006.24	005.24	006.27	005.23	006.26
4.	Electric conductivity (μ mhos/cm)	212.13	169.10	115.11	183.14	168.15
5.	Total dissolved solid (ppm)	178.13	233.15	159.61	265.97	155.14
6.	Alkalinity - mg l^{-1}	192.20	179.20	145.50	205.00	134.70
7.	Free carbon dioxide - mg l^{-1}	021.53	013.63	018.82	013.95	020.25
8.	Chloride - mg l^{-1}	031.97	049.97	025.49	030.47	029.48
9.	Dissolved oxygen- mg l^{-1}	004.10	002.43	004.45	003.82	003.30
10.	Biochemical oxygen demand (BOD) - mg l^{-1}	005.17	005.14	006.12	005.20	004.11
11.	Chemical oxygen demand (COD) - mg l^{-1}	018.00	016.00	012.00	010.00	009.70
12.	Total hardness - mg l^{-1}	211.11	148.15	216.23	219.37	197.26
13.	Calcium hardness - mg l^{-1}	154.59	115.61	156.87	134.64	138.95
14.	Calcium - mg l^{-1}	038.92	046.21	058.31	053.92	035.42
15.	Magnesium- mg l^{-1}	010.50	019.34	020.91	013.25	010.16

**Fig 11:** Chemical oxygen demand (Mgl-1) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

and Calcium hardness of 10 villages pond water ranged from a minimum of Dava village pond water 115.61 (Mg/L) to a maximum Rambora village pond water 157.31 (Mg/L). The calcium of 10 village's pond water ranged from a minimum of Shivpur village pond water 35.42 (Mg/L) to a maximum Rambora

village pond water 63.12 (Mg/L) and Magnesium of 10 villages pond water ranged from a minimum of Shivpur village pond water 10.16 (Mg/L) to a maximum Bisunpur village pond water 20.91 (Mg/L). (Table-19, 20, Fig-51, 52, 53, 54) shows the variation in Total hardness, Calcium hardness, Calcium and Magnesium of

pond water.

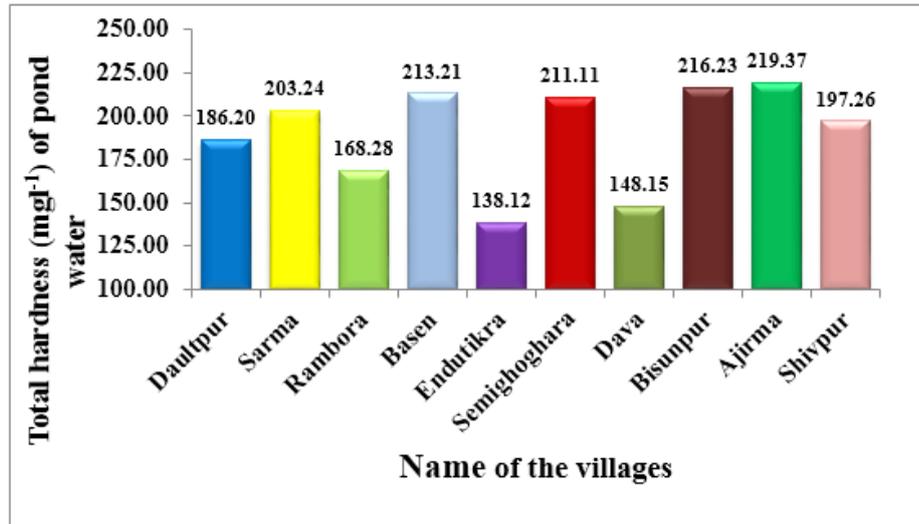


Fig 12: Total hardness (Mgl⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

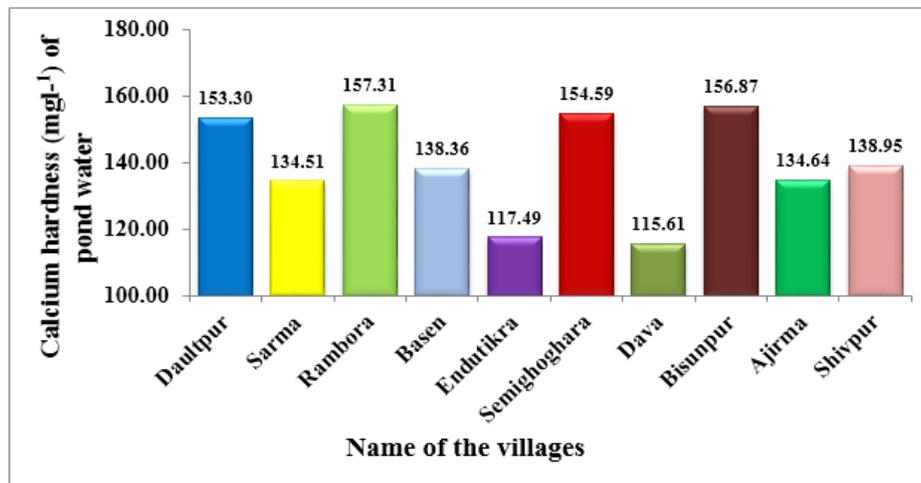


Fig 13: Calcium hardness (Mgl⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

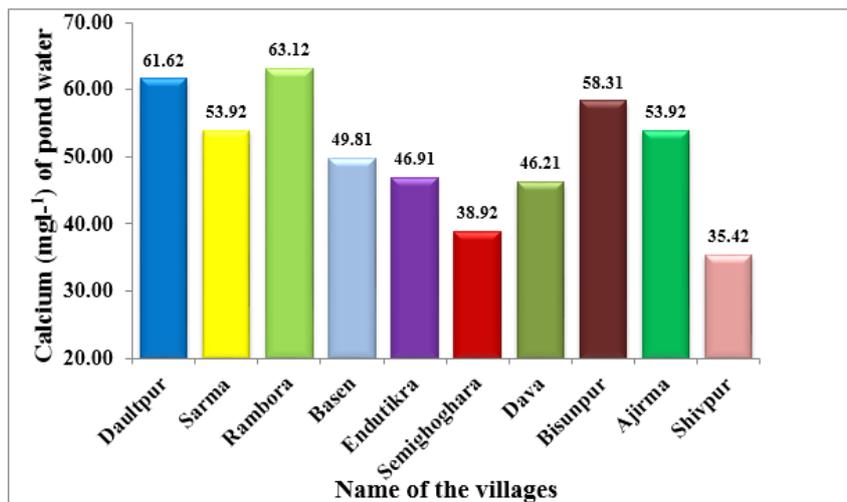


Fig 14: Calcium (Mgl⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

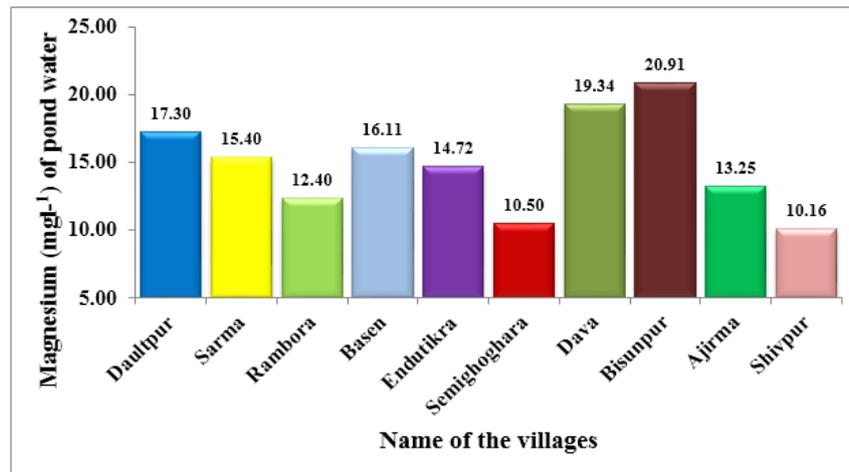


Fig 15: Magnesium (Mg l⁻¹) of pond water recorded in 10 villages of Surguja district during the year 2009-2010.

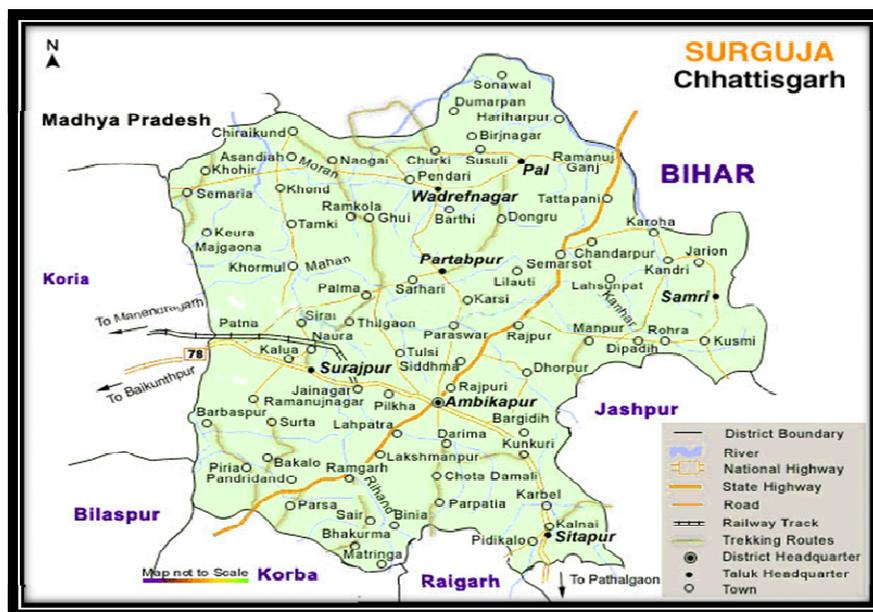


Fig 16: Location map of district Surguja in Chhattisgarh.

4. Conclusion

The study assessed the evolution of water quality in pond water of Surguja district a study of various site of pond water. was carried out by taking certain important parameters like Temperature, pH, Electrical conductivity, TDS, Alkalinity, Free Co₂, Chloride, DO, BOD, COD, Total hardness, Ca hardness, Calcium, Magnesium, (pond water). In this present investigation it was found that the maximum and minimum parameters were not at the level of pollution, although in the village Ajirma alkalinity, total hardness were slightly high in comparison with the other village. This may be due to the large community size and vicinity to the railway station resulting more human activity. Ajirma water level is not up to the pollution level but the increasing trend are need to be of concern if this trend fallow, soon the level will increase and this pound will become unsafe for human use. The similar workers investigated by like Ganeshalingam¹ [4], Kar [5], Manjare [6], Patel [7], Rajappa [8], Sahni [9], Smitha [10].

5. Acknowledgements

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