# Assessment of Physiochemical Properties of Pond Water in Bemetara Town of Chhattisgarh State

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***Abstract :*** Quality of water is an important criterion for evaluating the suitability of water for drinking, domestic work and irrigation purpose whereas the quality of surface / ponds as well as ground water depends on various chemical constituents and their concentration. Ponds water sample were collected from nine prominent ponds in Bemetara town of Chhattisgarh State and analyzed for various physico-chemical characteristics like temperature, colour, Turbidity, pH, Electrical conductivity, Total alkalinity, Chloride, Total Hardness, Calcium ion, Magnesium ion, Total dissolved solid, Fluoride, Sulphate, Nitrate, Dissolved oxygen, BOD considering all three season (summer, rainy and winter) and observe values were compared with standard values recommended by Bureau of Indian Standards (BIS). Out of these nine ponds Pikari talab, Mohbhatha Talab and Kobia Chhoti Talab are most polluted. All these nine water bodies are not suitable for domestic and drinking purposes; proper management and monitoring is necessary to its use for human society.

***IndexTerms*** **- Water quality, Surface water, Pond water, Physico-chemical analysis, Bemetara.**

## 1. Introduction

Water is the vital and precious gift to the nature for living things and without water life would not have been possible on earth. Water as a combination of hydrogen and oxygen atoms, with a chemical formula - $H_2O$ and known to be the most abundant compound (70%) on earth surface. It is significant due to its unique chemical and physical properties[16-18]. Majority of water available on the earth is saline in the nature only 3 % of exists as fresh water including rivers, lakes, tanks, ponds and ditches. Fresh water has become a scare commodity due to over exploitation and pollution[8-9].

Pond is a reservoir of standing water, either natural or man-made that is usually smaller than a lake and larger than ditches, which hold water for few months of the year or throughout the year. Pond water has prime importance for human society besides its habitats that have been used since time immemorial as a traditional source of water supply in India. However, the water of the ponds, lakes and river are polluted mainly due to discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides from farmlands[7,10,21,24]. Water pollution concerns within the rural and municipal areas are therefore not limited to potable water criteria but include the effects on general health of humans, livestock, agriculture and aquatic life[1].

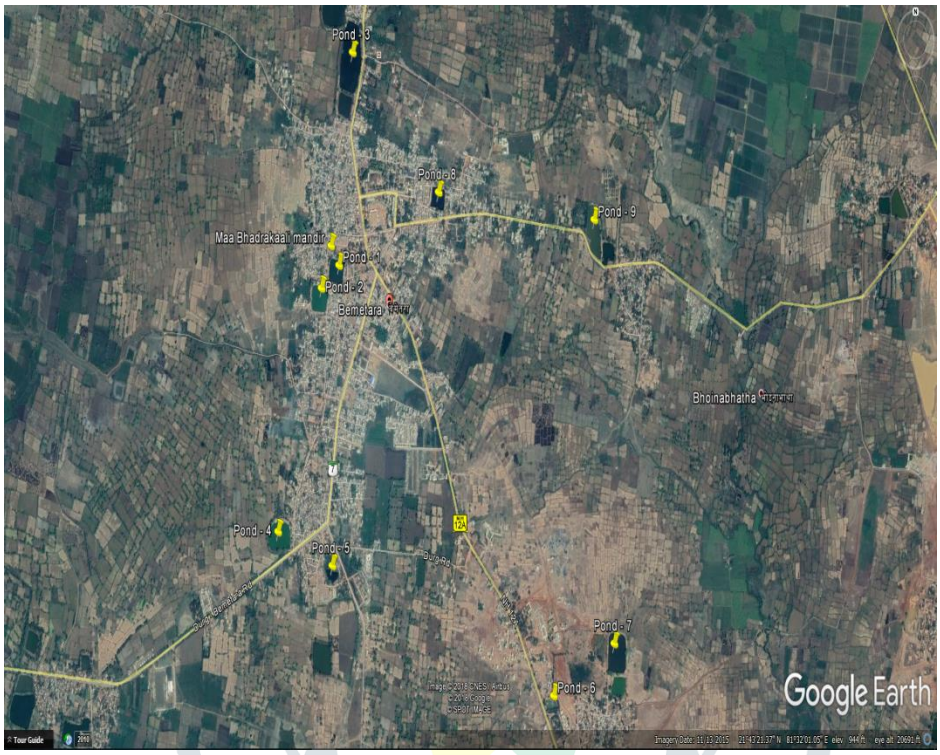
The seasonal variations in different physico-chemical parameters of water from ponds and other reservoirs were studied and analyzed the water quality by various workers, as reported from different regions of India and abroad; such as in India - from rural area of Nasik district of Maharashtra[22], Sagar city of Madhya Pradesh[19], Rajnandgaon town of Chhattisgarh[14], Jhansi City, Uttar Pradesh[5], Varanasi and Bhadohi, Uttarpradesh[23], Village Lohara, at Yavatmal in Maharashtra[6], a rural area of Barak Valley, Assam[7], Bhitarkanika National Park area of Orissa[15], Bharawas pond in district Rewari, Haryana[20].

Pollution of surface and ground water is creating great problem due to rapid increasing urbanization, industrialization and modern agricultural practices. Bemetara district (Latitude: 21.69º N, Longitude: 81.56º E) is a newly created district in the state of Chhattisgarh, India, in 2012, comprises 5 tehsil covering 2855 $km^2$ area, whereas main city is situated at Raipur – Jabalpur National highway NH-12A. Bemetara has a tropical wet and dry climate, temperatures remain moderate throughout the year, except from March to June, which can be extremely hot. The temperature in April–May sometimes rises above 48 °C (118 °F).These summer months also have dry and hot winds. In summers, the temperature can also go up to 50 °C. The city receives about 1,300 millimeters (51 in) of rain, mostly in the monsoon season from late June to early October. Winters last from November to January and are mild, although lows can fall to 5 °C (41 °F). Considering twelve parameters of physic-chemical properties, the water quality of selected nine major ponds of Bemetara town have assessed during present investigation.

## MATERIAL AND METHODS:

### Sample Collection -

For estimation of different physico-chemical parameter of pond water, samples were collected regularly in three different season Summer, Rainy and Winter respectively throughout the year from all the marked sampling sites of selected ponds denoting as P-1 (Pande talab), P-2 (Pikari talab), P-3 (Nayapara Talab), P-4 (BhadraKali Talab), P-5 (Mohbhatha Talab), P-6 (Singhauri Talab), P-7 (Kobia Badi Talab), P-8 (Kobia Chhoti Talab) and P-9 (Purani Talab). The samples were collected in pre-cleaned and sterilized polyethylene bottles and collected with a column water samples from at least five spots in each experimental pond between 8.00 to 10.00 am at a depth of 30 cm below the water surface. The two physico-chemical parameter of pond water that is temperature and pH was immediately measured at the site of sample collection by using mercury filled glass thermometer and digital pH meter and pH Strip respectively.




**Sampling Location**

### Chemical analysis of samples –

physico-chemical analysis was carried out applying the standard methods[2-3,13]. Standard guidelines in this concern were followed during collection, preservation and estimation & examination of various parameters.

### Conductivity and Turbidity –

Conductivity of pond water was measured in mmho.cm$^{-1}$ by conductivity meter in the laboratory[11-12]. The conductivity meter used was digital direct reading conductivity meter 304 (systronics). The turbidity of pond water was determined in Nephelomeric turbidity units (NTU) in the laboratory. The turbidity meter used was Digital Nephelo Turbidity meter model-132 (Systronics).

### Total dissolved solids (TDS) –

For the estimation of total dissolved solids firstly take an oven dried weighed (W in mg) porcelain dish place in the desiccators. 100 ml pond water sample pour in the porcelain dish and evaporate it to dryness by using oven maintaining a temperature of 105±2°C for 2 hours and cool it in the desiccators and then record the weight of porcelain dish plus residue ($W_1$ in mg). Calculate the value of total dissolved solids in the following manner:-

Total dissolved solids (TDS) in mg/liter = $[(W_1 - W) \times 1000] /$ Vol. of Sample (in ml)

Where, $W_1$ = Weight of porcelain dish plus residue; W = Weight of porcelain

**Dissolved Oxygen (DO) –**

DO was determined by Azide modification of Winkler method[4]. 300 ml sample was collected in BOD bottle. 2ml. Each of manganese sulphate and alkali-iodide-azide reagents was added. Bottle was shaken for about 15 minutes, allowing the precipitate to settle down. Then 2ml. conc. $H_2SO_4$ was added to dissolve the precipitate. 100 ml of this solution was titrated against 0.025 N sodium thiosulphate solutions in presence of starch indicator. DO $mg.l^{-1}$ = $[A \times N \times 1000 \times 8] / V_1$-V

Where, A = ml titrant used; B = Normality of titrant

$V_1$ = ml of sample, V = ml of $MnSO_4$ + alkali-iodide azide

**Biochemical Oxygen Demand (BOD) –**

Azide modification of Winkler method was used to measure the initial DO and DO after 5 days incubation of the sample at 20 degree C in BOD incubator. The BOD value was calculated with the help of following formula –

BOD $mg.l^{-1}$ DO (initial) - DO (5 days x dilution factor); Where, DO (initial) = dissolved Oxygen of the sample for the first BOD Bottle, which is not incubated.

DO (5 days) = Dissolved Oxygen of the sample after 5 days, incubation in dark.

**Chemical Oxygen Demand (COD) -**

2 ml of sample was diluted to 50 ml with distilled water and simultaneously running distilled water blank. 0.2 gm $HgSO_4$ was added to this then 5 ml 0.25 N Potassium dichromate. Solutions and 15 ml conc $H_2SO_4$ the solution was refluxed for 2 hour s. Excess of Potassium dichromate was titrated against 0.1 N ferrous ammonium sulphate using ferroin indicator.

COD mg/L = [ (a-b) ×N ×1000 ×8] / ml of sample

Where, a = ml titrant, used for blank, b = ml titrant, used for sample; N = Normality of titrant.

**Total hardness as $CaCO_3$ –**

EDTA complex metric titration method using Erichrome black T indicator was used for the estimation of total hardness in pond water.100 ml sample was taken in a conical flask. 5 ml buffer solution was added to raise the pH between 10 + 0.1. This solution was titrated against standard EDTA of 0.01 M, using Erichrome black T indicator .The total hardness was calculated using the following formula-

Total hardness as mg/l $CaCO_3$ = [ml EDTA used ×1000] / ml of sample

**Calcium and Magnesium hardness –**

Calcium and Magnesium have been estimated by EDTA (Ethylene Diamine Tetra Acetic acid) titrametic method. Cataions present in the exchange complex of the sample has been removed by leaching the sample with Ammonium Acetate solution. The EDTA has got a stronger affinity towards $Ca^{++}$ and $Mg^{++}$ and, therefore by addition of EDTA the former complex is broken down and a new complex of blue color is formed. 50 ml of sample was taken in a conical flask, and was added 1ml of buffer solution (16.9 gm $NH_4Cl$ in 143 ml of conc. $NH_4OH$ were dissolved and 1.179 gm of disodium EDTA and 0.780 gm of $MgSO_4$.7H2O. In 50 ml of distilled water , both the solutions were mixed and diluted to 250 ml with distilled water), 100 mg of Erichrome black T indicator (0.40 gm of Erichrome black T mixed with 100 gm NaCl), the solution turned wine red . This solution was titrated against EDTA solution (3.723 gm of disodium salt of EDTA in distilled water was dissolved to prepare 1 liter of solution). At the end point, color changed from wine red to blue;

**Calculation -** Calcium/Magnesium mg/L = [A×400.8×V] / V×1.645×10,000×S Where, A =Volume of EDTA, used for Calcium (ml); B =Volume of EDTA, used for $Ca^{++}$ Mg (ml)

S = Weight of sample, taken (50gm); v = Volume of sample titrated (ml)

**Chloride –**

Mohr's method was applied for the determination of the chloride, present in the sample water. 100 ml of the sample was titrated with silver nitrate using potassium chromate as an indicator. The chloride content was calculated using the following formula-

Cl mg/L = [(A-B) ×N ×35.45 ×1000] / ml of sample

Where, A = ml titrant, used for sample; B = ml titrant, used for blank; N = Normality of titrant

**Fluoride –**

Estimation for Fluoride the SPADNS method was followed with pond water sample. The reaction is immediate and given stable colour. Fluoride ion changes the colour of Zirconium-SPANDS complex and the colour change was proportional to the concentration of Fluoride ion. 50ml of pond water sample was taken in a Nessler tube. Add 2-3 drops of sodium arsenite solution and mix well. 100ml of the acid-zirconyl-SPADNS reagent were added to the sample and contents thoroughly mixed. Then measure the absorbance of the solution with the help of spectrophotometer.

**Iron –**

Iron in water may be present in dissolved, colloidal or suspended form. Generally the ferric form is predominant in pond water. In present work Phenanthroline method was followed for the detection of Iron. In this method take 50ml of pond water sample in conical flask and add 2ml of concentrated HCl and 1ml of hydroxylamine-hydrochloride solution. After added few glass beads in the sample, boil it for 20 to 25 minutes, for the complete dissolution of Iron existing in the sample. Allow the sample to cool down to room temperature, after that add 10ml of ammonium acetate solution, followed by addition of 2ml phenanthroline solution and then dilute the sample to 100ml. After proper mixing Orange-red color develop. Simultaneously prepare a 50ml blank solution of Iron free water with followed exactly same procedure. Measure the absorbance value of sample by spectrophotometer using 1cm light path and 510 nm wave-length by setting zero absorbance at the color intensity of blank solution.

**Nitrate ($NO_3$) –**

50 ml sample and simultaneously with distilled water taken as blank 1 ml sulphanilamide solution was added. Then, after 2 minutes, 1 ml napthyl ethylene diamine dihydrochloride solution was added. Intensity of pink color was measure at 543 nm with the help of digital spectrophotometer (Systronics model 106), Amount of $NO_2$-N was determined with the help of standard curve.

**Sulphate –**

Sulfate ions usually occur in natural waters. Many sulfate compounds are readily soluble in water. Sulphate ions ($SO_4^{--}$) is precipitated in an acetic acid medium with Barium Chloride ($BaCl_2$) so as to form Barium Sulphate ($BaSO_4$) crystals of uniform size and measure by a nephelometer. Take 100ml of pond water sample in Erlenmeyer flask and add 20ml buffer solution, mix well. Keep the flask constantly stirred with the help of stirrer. Add 1 spatula $BaCl_2$ crystals with stirring. Continue stirring for 1 minute after addition of $BaCl_2$. Measure the $BaSO_4$ turbidity after stirring period has been ended by nephelometer.

**Alkalinity –**

The alkalinity of a water sample is a measure of its capacity to neutralize acids. Alkalinity of sample can be estimated by titration with standard sulfuric acid (0.02N). Take 50ml of sample in conical flask and add 2-3 drops of phenolphthalein indicator. If pink colour develop titrate with 0.02 N $H_2SO_4$ till it disappears or pH is 8.3 note the volume of $H_2SO_4$ required. Then add 2-3 drop methyl orange to the same flask, and continue titration till pH down to 4.5 or yellow colour change to orange and not the volume of $H_2SO_4$ add. Calculate Total (T), phenolphthalein (P) and methyl orange alkalinity as follows-

P – Alkalinity, mg/liter as $CaCO_3$ = A × 1000/ml sample

T – Alkalinity, mg/liter as $CaCO_3$ = B × 1000/ml sample

In case $H_2SO_4$ is not 0.02 N applied the following formula:

Alkalinity, mg/liter as $CaCO_3$ = [A/B × N × 50000] /_ml of sampl.

Where A= ml of $H_2SO_4$ required to bring the pH to 8.3;

B = ml of $H_2SO_4$ required to bring the pH to 4.5; N = Normality of $H_2SO_4$ used.

**RESULT AND DISCUSSION:**

Seasonal variation in the value of different Physico-chemical parameters of 09 Pond water samples, as observed during present investigation has been computed in Table – 1; value of three samples of all three sites collected in triplicate, from different points during summer, rainy and winter season; whereas the entire value as mention in the Table - 2 (Mean ±SD) and shown in Fig. 1-3. The range value of each parameters considering the sites wise have been compare with standard value as recommended by BSI. The pH values were found slightly alkaline at all sites of pond water that ranges from 7.1 to 8.2. Total alkalinity was observed minimum at site- P-7, while maximum at sites P-2 & P-5. Variation in the value of DO was found from 3.57 mg/l to 6.57 mg/l that is more than standard value. The B. O. D. of the samples was found ranges from 45.43 mg/l to 76.70 mg/l, whereas the maximum value was observed at sites- P-5, P-2 and P-8. BOD is a good index of pollution and therefore helps in deciding the suitability of water for consumption. The BOD level in P-5, P-2 & P-8 were found maximum in all seasons it may be due to

human / animal activities in the pond e.g. washing, defection etc. and indicating polluted pond water. The maximum value of COD was observed at sites P-8 & P-2 while minimum at sites – P-9, varied from 64.07 mg/l to 86.70 mg/l. Total hardness of pond water was found maximum at site P-2 and variation from 168.0 mg/l to 483.0 mg/l was observed. The variation in the value of Nitrate, Phosphate and Sulfate was also observed, which are under permissible value, as recommended by BSI, however nitrate can be considered as more than should be for society. Nitrate represents the final stage of mineralization of nitrogenous organic matter such as dead green plants and animals. As such higher value of nitrate in the water may be indicative of sewage pollution. Similarly value of Chloride and Iron were also found with variable range whereas Chloride is lesser than standard value while Iron was found negligible. Iron is biologically on important element which is essential to all organisms. In present study Iron concentrate in all these samples found to be negligible.

**Table – 1: Seasonal variation in Physico-chemical properties of pond water in Bemetara Town.**

| STUDY SITE | Season | Physico-chemical Parameter | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temperature $^0$C | pH | Conductivity mmho.cm-1 | Turbidity NTU | TDS mg/l | DO mg/l | BOD mg/l | COD mg/l | Hardness mg/l | Ca ion mg/l | Mg ion mg/l | Chloride mg/l | Fluoride mg/l | Iron ppm | Nitrate mg/l | Sulphate mg/l | Alkalinity mg/l |
| P-1 | Summer | 27.8 | 7.6 | 615 | 12.8 | 436 | 5.8 | 54.6 | 72.3 | 170 | 53.4 | 15.8 | 54.8 | 0.3 | 0.5 | 18.5 | 46.7 | 213 |
| | Rainy | 23.8 | 7.1 | 538 | 6.5 | 498 | 6.2 | 57.8 | 78.7 | 188 | 54.7 | 13.7 | 48.7 | 0.1 | 0.2 | 12.6 | 23.2 | 154 |
| | Winter | 19.2 | 7.3 | 475 | 9.6 | 377 | 6.8 | 51.3 | 68.7 | 158 | 48.6 | 17.6 | 43.5 | 0 | 0.1 | 14.7 | 28.7 | 187 |
| P-2 | Summer | 28.2 | 8.2 | 1142 | 35.8 | 878 | 2.9 | 72.2 | 88.9 | 496 | 136.5 | 43.8 | 82.6 | 0.6 | 0 | 5.9 | 21.9 | 345 |
| | Rainy | 23.4 | 7.5 | 1018 | 19.5 | 985 | 3.5 | 78.6 | 94.2 | 521 | 138.5 | 41.3 | 76.3 | 0.4 | 0 | 3.7 | 9.8 | 274 |
| | Winter | 19.8 | 7.7 | 925 | 28.7 | 654 | 4.3 | 69.3 | 73.5 | 432 | 112.6 | 45.7 | 72.2 | 0.3 | 0 | 4.6 | 14.7 | 312 |
| P-3 | Summer | 27.4 | 7.4 | 765 | 11.6 | 421 | 4.9 | 48.9 | 68.7 | 218 | 65.8 | 10.9 | 122.8 | 0.1 | 0.2 | 34.2 | 34.7 | 264 |
| | Rainy | 22.6 | 6.9 | 612 | 5.9 | 487 | 5.3 | 57.5 | 76.3 | 227 | 67.9 | 9.8 | 112.6 | 0.1 | 0 | 23.5 | 16.5 | 131 |
| | Winter | 18.8 | 7.2 | 584 | 9.3 | 354 | 5.9 | 51.4 | 63.5 | 191 | 56.8 | 17.6 | 105.1 | 0 | 0.1 | 26.3 | 24.3 | 178 |
| P-4 | Summer | 27.4 | 7.5 | 594 | 10.9 | 421 | 5.7 | 49.7 | 67.4 | 173 | 51.2 | 13.4 | 52.4 | 0.2 | 0.4 | 17.4 | 44.2 | 207 |
| | Rainy | 24.2 | 7.1 | 472 | 5.5 | 464 | 6.3 | 55.5 | 79.8 | 182 | 53.9 | 11.7 | 49.1 | 0.1 | 0.2 | 13.4 | 21.6 | 147 |
| | Winter | 19.6 | 7.3 | 388 | 9.4 | 345 | 6.6 | 47.3 | 66.3 | 149 | 48.8 | 15.3 | 45.5 | 0.1 | 0 | 15.6 | 27.2 | 167 |
| P-5 | Summer | 28.7 | 8.1 | 1224 | 31.1 | 843 | 3.1 | 76.1 | 87.1 | 484 | 126.6 | 46.2 | 80.1 | 0.8 | 0 | 5.5 | 25.7 | 331 |
| | Rainy | 23.4 | 7.4 | 1018 | 23.4 | 934 | 4.2 | 82.3 | 92.8 | 508 | 128.8 | 43.8 | 78.4 | 0.5 | 0 | 3.4 | 13.6 | 251 |
| | Winter | 19.6 | 7.7 | 945 | 26.1 | 682 | 4.9 | 71.7 | 71.2 | 413 | 102.3 | 47.9 | 72.8 | 0.2 | 0 | 4.9 | 17.4 | 322 |
| P-6 | Summer | 29.1 | 7.5 | 605 | 8.4 | 401 | 3.8 | 44.6 | 71.9 | 225 | 59.6 | 13.6 | 46.6 | 0.3 | 0.2 | 31.2 | 29.5 | 246 |
| | Rainy | 23.6 | 7.1 | 513 | 3.9 | 467 | 4.5 | 53.3 | 79.6 | 234 | 62.7 | 11.8 | 48.5 | 0.3 | 0 | 23.5 | 14.4 | 124 |
| | Winter | 18.8 | 7.3 | 467 | 7.2 | 334 | 4.9 | 48.5 | 66.8 | 198 | 51.9 | 19.4 | 56.3 | 0.1 | 0.1 | 27.2 | 19.4 | 145 |
| P-7 | Summer | 27.8 | 7.6 | 964 | 9.8 | 407 | 5.3 | 46.9 | 70.4 | 180 | 56.3 | 17.3 | 52.4 | 0.2 | 0.4 | 20.4 | 40.7 | 187 |
| | Rainy | 23.2 | 6.9 | 852 | 6.5 | 474 | 6.9 | 52.7 | 82.9 | 189 | 57.3 | 16.2 | 41.1 | 0.1 | 0.2 | 17.3 | 16.6 | 126 |
| | Winter | 19.4 | 7.3 | 695 | 10.2 | 365 | 7.5 | 44.1 | 69.7 | 156 | 52.4 | 18.9 | 38.7 | 0.2 | 0 | 19.4 | 24.8 | 147 |
| P-8 | Summer | 27.6 | 7.9 | 1098 | 29.3 | 823 | 4.6 | 73.9 | 90.4 | 491 | 138.3 | 49.7 | 88.7 | 0.4 | 0 | 4.5 | 21.9 | 312 |
| | Rainy | 22.8 | 7.2 | 953 | 19.2 | 914 | 5.2 | 79.6 | 95.6 | 515 | 134.9 | 46.9 | 83.6 | 0.6 | 0 | 2.8 | 14.9 | 231 |
| | Winter | 18.4 | 7.5 | 906 | 23.1 | 662 | 6.9 | 68.4 | 74.1 | 420 | 109.7 | 51.1 | 78.3 | 0.3 | 0 | 3.7 | 16.2 | 302 |
| P-9 | Summer | 27.8 | 7.7 | 540 | 7.3 | 387 | 3.9 | 38.2 | 61.8 | 212 | 63.8 | 11.9 | 53.1 | 0.1 | 0.2 | 25.5 | 24.9 | 242 |
| | Rainy | 23.2 | 7.1 | 458 | 3.9 | 421 | 5.1 | 51.9 | 72.6 | 224 | 61.1 | 10.4 | 46.9 | 0.1 | 0.1 | 18.4 | 19.5 | 123 |
| | Winter | 19.5 | 7.4 | 386 | 5.1 | 313 | 4.9 | 47.4 | 57.8 | 186 | 51.3 | 18.2 | 55.7 | 0 | 0.1 | 23.7 | 21.8 | 186 |

**Table – 2: Physico-chemical properties of Pond water (Mean ±SD)**

| Physico-chemical Parameters | STUDY SITES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | P-1 | P-2 | P-3 | P-4 | P-5 | P-6 | P-7 | P-8 | P-9 |
| Temperature $^0$C | 23.6 ±1.3 | 23.80 ±1.2 | 22.93 ±1.6 | 23.73 ±0.9 | 23.9 ±1.1 | 23.83±0.8 | 23.46 ±1.2 | 22.93 ±1.4 | 23.5 ±1.3 |
| pH | 7.33 ±0.1 | 7.8 ±0.6 | 7.16 ±0.3 | 7.3 ±0.7 | 7.73 ±0.2 | 7.3 ±0.4 | 7.26 ±0.6 | 7.53 ±0.3 | 7.4 ±0.1 |
| Conductivity mmho.cm-1 | 542.66 ±4.1 | 1028.33 ±4.3 | 653.66 ±3.8 | 484.66 ±3.5 | 1062.33 ±5.6 | 528.33 ±3.1 | 837.0 ±3.6 | 985.66 ±4.8 | 461.33 ±2.9 |
| Turbidity NTU | 9.63 ±0.4 | 28.0 ±1.2 | 8.93 ±0.5 | 8.6 ±0.1 | 26.87 ±1.5 | 6.5 ±0.2 | 8.83 ±0.3 | 23.87 ±1.2 | 5.43 ±0.1 |
| TDS mg/l | 437.00 ±4.3 | 839.00 ±6.2 | 420.66 ±3.8 | 410.00 ±3.3 | 819.66 ±5.8 | 400.66 ±3.7 | 415.33 ±3.5 | 799.66 ±4.9 | 373.66 ±3.1 |
| DO mg/l | 6.27 ±0.2 | 3.57 ±0.1 | 5.37 ±0.2 | 6.20 ±0.5 | 4.07 ±0.3 | 4.40 ±0.4 | 6.57 ±0.7 | 5.57 ±0.3 | 4.63 ±0.2 |
| BOD mg/l | 54.57 ±2.3 | 73.36 ±2.6 | 52.6 ±1.9 | 50.83 ±1.6 | 76.7 ±2.8 | 48.8 ±1.7 | 47.9 ±1.9 | 73.96 ±2.8 | 45.83 ±1.4 |
| COD mg/l | 73.23 ±2.7 | 85.53 ±3.4 | 69.5 ±2.1 | 71.16 ±3.2 | 83.7 ±4.1 | 72.76 ±3.5 | 74.33 ±3.9 | 86.7 ±4.1 | 64.06 ±2.8 |
| Hardness mg/l | 172.00 ±4.1 | 483.00 ±5.2 | 212.00 ±3.8 | 168.00 ±2.9 | 468.33 ±4.2 | 219.00 ±3.6 | 175.00 ±2.8 | 475.33 ±5.2 | 207.33 ±3.6 |
| Ca ion mg/l | 52.23 ±2.3 | 129.2 ±3.4 | 63.5 ±2.7 | 51.3 ±1.9 | 119.23 ±2.6 | 58.06 ±1.8 | 55.33 ±3.1 | 127.63 ±3.8 | 58.73 ±2.3 |
| Mg ion mg/l | 15.7 ±1.6 | 43.6 ±2.4 | 12.76 ±1.8 | 13.46 ±1.4 | 45.96 ±2.3 | 14.93 ±1.1 | 17.46 ±1.9 | 49.23 ±2.7 | 13.5 ±2.1 |
| Chloride mg/l | 49.00 ±2.3 | 77.03 ±2.1 | 113.5 ±4.9 | 49.00 ±2.0 | 77.1 ±2.7 | 50.46 ±4.1 | 44.06 ±3.8 | 83.53 ±2.1 | 51.9 ±2.7 |
| Fluoride mg/l | 0.13 ± 0.01 | 0.43 ±0.03 | 0.06 ±0.01 | 0.13 ±0.01 | 0.5 ±0.02 | 0.23 ±0.01 | 0.16 ±0.01 | 0.43 ±0.02 | 0.06 ±0.01 |
| Iron ppm | 0.26 ±0.02 | 0.00 | 0.1 ±0.01 | 0.2 ±0.02 | 0.00 | 0.1 ±0.01 | 0.2 ±0.01 | 0.00 | 0.13 ±0.03 |
| Nitrate mg/l | 15.26 ±1.5 | 4.73 ±1.3 | 28.00 ±2.4 | 15.46 ±1.4 | 4.6 ±1.1 | 27.3 ±2.3 | 19.03 ±1.9 | 3.66 ±1.0 | 22.53 ±2.6 |
| Sulphate mg/l | 32.86 ±2.8 | 15.46 ±1.8 | 25.16 ±2.3 | 31.00 ±2.6 | 18.9 ±1.6 | 21.1 ±1.9 | 27.36 ±2.8 | 17.66 ±2.8 | 22.06 ±2.0 |
| Alkalinity mg/l | 184.66 ±4.2 | 310.33 ±5.6 | 191.00 ±4.3 | 173.66 ±4.9 | 301.33 ±5.3 | 171.66 ±3.3 | 153.33 ±2.9 | 281.66 ±4.4 | 183.66 ±3.6 |

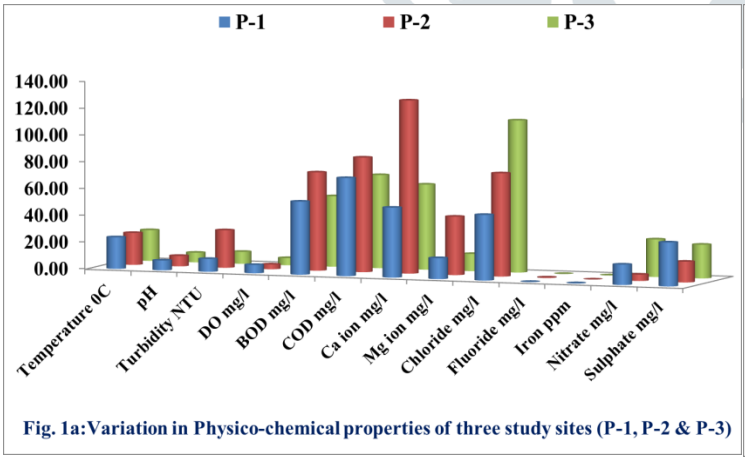



Fig. 1a:Variation in Physico-chemical properties of three study sites (P-1, P-2 & P-3)

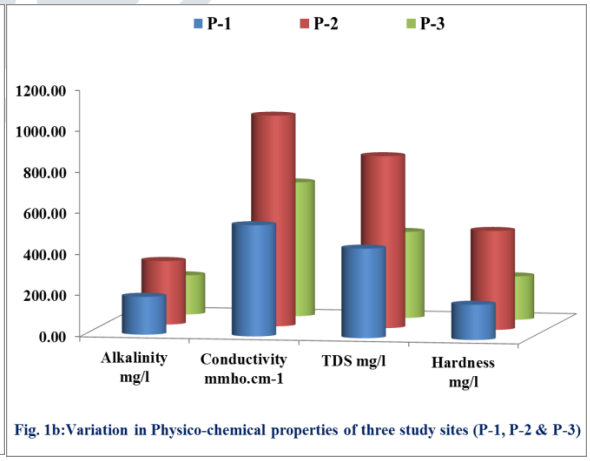



Fig. 1b:Variation in Physico-chemical properties of three study sites (P-1, P-2 & P-3)

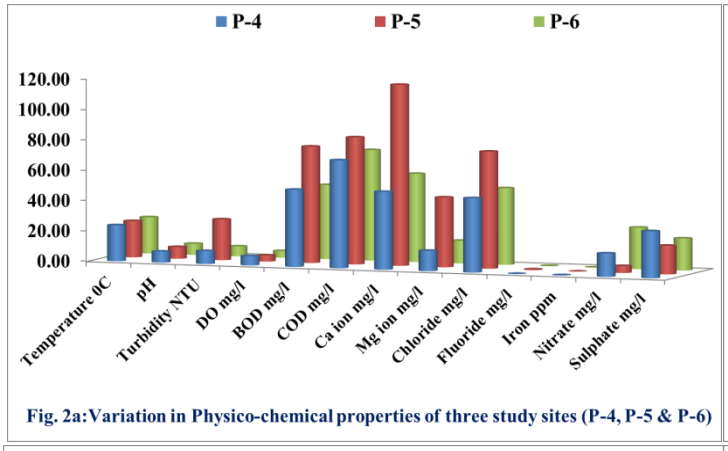



Fig. 2a:Variation in Physico-chemical properties of three study sites (P-4, P-5 & P-6)

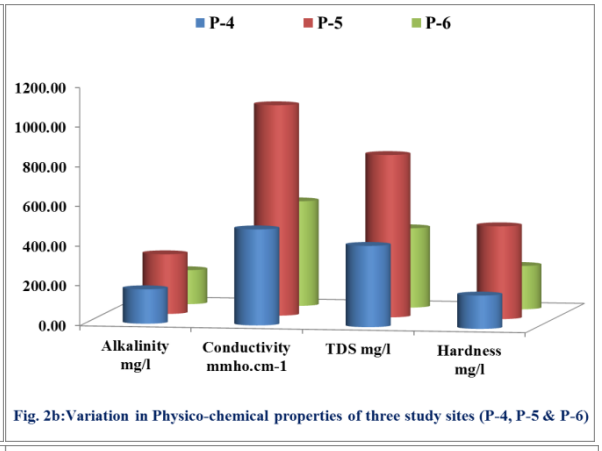



Fig. 2b:Variation in Physico-chemical properties of three study sites (P-4, P-5 & P-6)

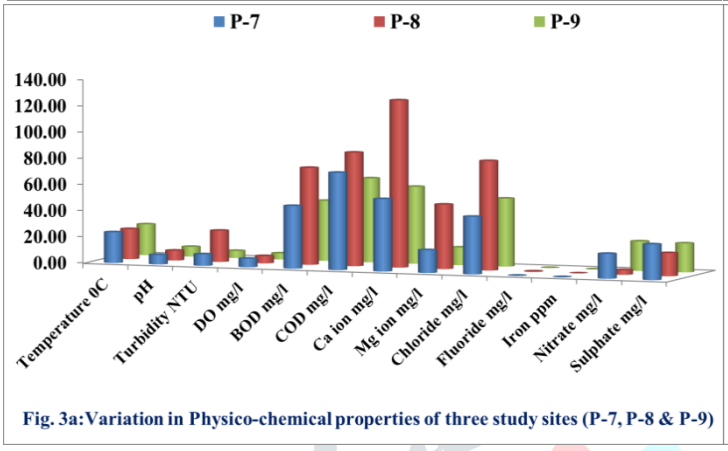



Fig. 3a:Variation in Physico-chemical properties of three study sites (P-7, P-8 & P-9)

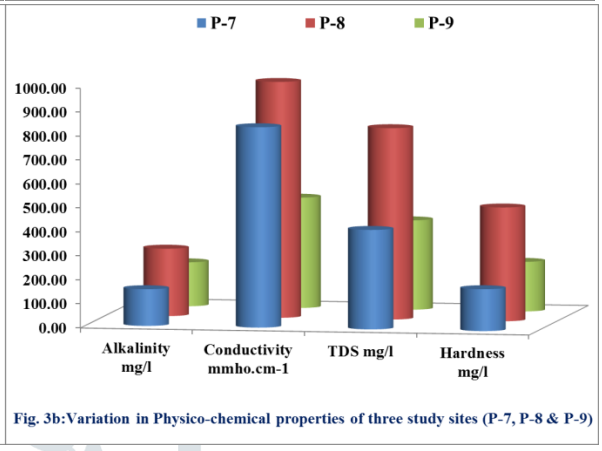



Fig. 3b:Variation in Physico-chemical properties of three study sites (P-7, P-8 & P-9)

Alkalinity of water is a measure of its capacity to neutralize strong acid and is due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium ions. The observed values of alkalinity ranged between 153.33 to 310.33 mg/l in these pond water. The cations analyzed in the present study include calcium, magnesium, sodium and potassium. For the present study the concentration of calcium has varied from 51.30 to 129.20 mg/l whereas the concentration of magnesium varies from 12.77 to 49.23 mg/l in the study area. Water is in the range of soft and moderately soft category which is due to the low concentration of calcium and magnesium ions present in the water. Dissolved oxygen (DO) is an important parameter of water quality which reflects physical and biological processes taking place in water. High level of DO causes speed up corrosion in water pipes. The value of DO for the water samples may be due to wave action, pollution load, organic matter and photosynthetic activity. Biochemical oxygen demand (BOD) is a measure of organic material contamination in water. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials. Chemical oxygen demand (COD) is a measure of organic material contamination in water. COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. High COD may cause oxygen depletion on account of decomposition by microbes to a level, detrimental to aquatic life.

**Conclusion**

In spite of variation, the observed value of Physico-chemical parameters, findings show generally under the range of Standard / recommended value accept four parameters that are COD, BOD, Alkalinity and Nitrate. The values of these parameters in the most of the samples have found more than permissible limit while Iron was found negligible. Through the present investigation, we have conferred the Physico-chemical properties of pond water used for domestic and irrigation purposes as well as drinking water for cattle and fish farming. Ultimately findings reveal the fact that the pond water of this area, especially in few patches of semi urban area is not absolute suitable for public health, especially P-2 (Pikari talab), P-5 (Mohbhatha Talab) and P-8 (Kobia Chhoti Talab) are more polluted, risky for human society as well as for wild & domestic animals. This study is alarming the management system of this urbanl area. In order to meet the quality of surface water it is recommended for continuous monitoring with proper action is essential to ensure the avaibility of suitable drinking pond water, ultimate source of ground water.

**Acknowledgment:**

An author is thankful to Principal, Govt. Nagarjun Postgraduate Science College, Bilaspur (C. G.) for providing laboratory facilities to conduct the chemical analysis during present investigation.

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