

ANALYSIS OF SELECTED PHYSICO-CHEMICAL PARAMETERS OF TWO PONDS OF MADHUBANI

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ABSTRACT

Present study was aimed to observe the monthly variations in selected physico-chemical parameters of surface water of two perennial ponds of Madhubani district of Bihar state. Selected parameters were determined for one year that is from January to December in 2018. The maximum value of water pH, temperature, turbidity, alkalinity, transparency, total dissolved solids, dissolved oxygen, free carbon dioxide, Biological Oxygen Demand, Chemical Oxygen Demand, Chloride contents Nitrates and Calcium and Total hardness of the pond situated near R.K. College, Madhubani were found as 8.5, 35^oc, 48.0, 158.74, 150.0cm, 1270 mg/l, 852 mg/l, 7.38 mg/l, 42.28, 58.74, 29.62 mg/l, 8.34 mg/l, 48.64 mg/l, 151.60 mg/l respectively, while the maximum values of same parameters of an abandoned pond were, 8.3, 36^oc, 46.0, 155.18, 142 cm, 1228 mg/l, 8.62 mg/l, 7.46 mg/l, 42.78, 59.58, 31.24 mg/l, 9.52 mg/l, 49.85 mg/l, and 146.62 mg/l. Present study indicates the existing health of these two perennial water bodies being used by the local people. Based on the above data suitable measures may be taken by the administrators to reduce the different loads of pollutant to maintain the purity of these perennial resource of water bodies.

KEYWORDS: Physico-chemical Parameters, Monthly Variations, Abandoned, Perennial, Water Bodies, Pollutants

Water was essential for the origin of life on this earth and it is an essential component for the survival of the life on this planet. Out of the total water present on this earth 96.5 percent is the sea water and is not directly used for any purpose. 1.7 percent is in the form of glacier, and 1.7 percent is ground water only 0.1% of water is available for all of the process of living beings (Durge *et al.*, 2018). Water in nature is always pure, but due to anthropogenic activities, its purity is being lost. Unrestrained increase in human population and rapid urbanization and industrialization in all over the world is placing great stress up on fresh water resources. (Bano *et al.*, 2016). Village ponds were the only source of perennial water among the villagers, but due to urbanization, these water bodies are being used as a sink for the dumping of domestic wastes, discharge of sewage and being used for washing clothes and animals only.

Due to such anthropogenic pressures, the water quality of such ponds is being distressed and polluted. The deterioration of water of such ponds has reached at alarming conditions. Not only this during rainy season's different agro-chemicals used by the farmers in their fields being deposited in these ponds along with runoff water. Local people who are using this pond water do not know about the health of such pond water. It is therefore, essential that there should be frequent test and analysis of such water bodies. The quality of water is characterized by different physico-chemical parameters. These parameters are not constant as they change in different seasons because of the input of rain water, which may carry different pollutants and nutrients along with it. It

also depends on the local human intervention (Parikh and Mankodi, 2012).

Physico-chemical analysis of different water bodies have been done by different workers. Results of these works are eye opener. Some of them may be cited here, Pejawar *et al.*, (2004), Charkhabi and Sakizadeh (2006), Smitha *et al.*, (2007), Kiran (2010), Mahananda *et al.*, (2010), Singh (2010), Biswas *et al.*, (2011), Kedar and Patil (2011), Srivastva and Srivastva (2011), Barai and Kumar (2012), Sahni and Sheela (2012), Verma *et al.*, (2012), Tirupathaiiah *et al.*, (2012), Bhatnagar and Devi (2013), Mishra *et al.*, (2013), Mohan *et al.*, (2013), Patel and Parikh (2013), Prasath *et al.*, (2013), Srivastva and Kanungo (2013), Tank and Chippa (2013), Yadav *et al.*, (2013), Mazumdar and Dutta (2014), Mishra *et al.*, (2014), Nag and Gupta (2014), Singh (2014), Dixit *et al.*, (2015), Paul *et al.*, (2015), Reddy *et al.*, (2015), Qureshimatva *et al.*, (2015), Swarnkar and Chaubay (2016), Uddin *et al.*, (2016), Balkrishnan *et al.*, (2017), Goswami *et al.*, (2017), Rahman *et al.*, (2017), and Durge *et al.*, (2018). Keeping these ideas in mind the present work was planned to study the physico-chemical parameters of two ponds of Madhubani district.

MATERIALS AND METHODS

Study Area

For the present work two ponds, situated in Madhubani were selected one pond near R.K. College, and other outside the town area which is virtually abandoned.

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The pond near R.K. College receives large amount of allochthonous matter, from the surroundings, where as the pond outside the town gets different agro-chemical from the surrounding agricultural lands during the rainy seasons. The geographical location of these ponds situated in Madhubani is at a longitude of 25⁰-59' to 26⁰-39' East and the latitude is 85⁰-43' to 86⁰-42' North. Here the rain fall varies between 900 mm and 1300 mm. Average rainfall is 1273.2 mm.

Sampling of pond water was done monthly for one year. The standard methods suggested by APHA (2005) were followed. Water samples were collected during the early hours (9:45-10:45 AM) from different parts of the ponds. They were mixed for the study of different parameters. Physical parameters such as pH, temperature and transparency were studied at site, where as turbidity and total dissolved solids and alkalinity was studied in laboratory. Similarly, dissolved oxygen, free carbon dioxide, Biological oxygen demand, chemical oxygen demand, concentrations of chloride, nitrate, calcium, total hardness were studied in the laboratory. pH

was measured with the help of pH meter and temperature with Celsius-thermometer graduated up to 110⁰C.

Transparency was measured with the help of Secchi disc. Turbidity was measured using Nephelometer (Systronics digital nephelo turbidity meter), Dissolved oxygen was calculated using standard Winkler's titration method. Free carbon dioxide was calculated by doing titration of sample water with 0.02 NaOH, using Phenolphthalein as indicator. Biochemical oxygen demand was calculated using 5 days incubation process. Chemical oxygen demand was calculated using condensation digestion and titration method. Alkalinity, chloride and total hardness were calculated by titration methods. All the experiments were done in triplicate and the mean of the data was used for discussion.

RESULTS AND DISCUSSION

Data obtained from the above experiments have been represented by table 1 and table 2 for the physical and chemical parameters.

Table 1: Monthly variations in selected physico-chemical parameters of pond water of R.K. College, Madhubani.

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
pH	8.5	8.2	7.8	7.9	8.3	7.7	8.0	7.8	7.4	7.6	7.4	7.5
Temp.	15.0	17.0	19.0	20.0	31.0	35.0	32.0	30.0	28.0	28.0	24.0	19.0
Turbidity NTU	36.0	38.0	35.0	40.0	48.0	46.0	44.0	42.0	39.0	38.0	35.0	37.0
Alkalinity	133.62	129.45	134.64	131.52	141.18	133.56	153.35	156.48	146.62	158.74	155.86	151.71
Transparency	150.0	130.0	140.0	120.0	58.0	50.0	56.0	68.0	90.0	96.0	105	118
TDS mg/l	1187.0	988	1070	1166	1078	1284	1270	1078	970	948	978	1035
DO mg/l	8.52	8.41	8.15	7.40	5.80	4.76	6.42	7.50	7.80	8.15	8.30	8.38
BOD	28.36	30.65	32.40	38.54	42.28	40.62	39.58	37.74	36.25	35.18	33.64	30.72
COD	38.85	42.28	44.36	48.54	52.66	58.74	54.24	53.78	50.55	48.38	48.18	44.86
Chloride mg/l	28.74	26.45	23.28	21.65	20.18	20.78	15.78	16.40	19.18	21.25	24.38	29.62
Nitrate	2.56	2.74	2.48	2.62	2.68	2.35	2.74	5.46	8.34	7.82	6.78	5.46
Ca⁺⁺	38.42	36.58	35.75	34.68	34.34	33.16	32.74	48.64	44.18	45.62	38.50	36.75
Total Hardness	78.54	72.38	86.46	108.62	138.46	151.60	142.44	136.18	131.72	122.38	114.74	82.36
Free CO₂	4.56	5.82	6.48	6.56	6.78	7.38	6.64	6.48	6.41	6.24	5.72	5.38

pH

It is a measure of hydrogen ion concentration of the water body. The acidity and alkalinity of water may be determined due to its concentration. From the table 1, it may be noted that pH of the pond near R.K. College, Madhubani ranged between 7.4 to 8.5. The pH of pond water was slightly alkaline. Highest range 8.5 was found in the month of January, which decreased in summer. Decrease in pH during rainy season may be due to increase in volume of water of the pond.

Similar, trends for pH was also found in the pond water situated out of the town in Madhubani. However, here maximum value was 8.3 while the minimum 7.4. pH is associated with the rate of photosynthesis of the aquatic plants. Increased pH value in winter and low in summer have been reported by Singh (2010), Sahni and Yadav (2012), Goswami *et al.*, (2017), Bhattacharyya (2018). Therefore, findings of the present work corroborate with the above findings. However,

Sahni and Yadav (2012) reported higher range of pH during summer.

Table 2: Monthly variations in selected physico-chemical parameters of pond of Madhubani abundant

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
pH	8.3	8.1	7.6	7.8	8.1	7.6	8.0	7.6	7.4	7.5	7.4	7.6
Temp.	14	16	18	21	32	36	34	32	31	27	26	17
Turbidity NTU	34.0	36.0	34.0	38.0	46.0	43.0	42.0	40.0	38.0	36.0	33.0	34.0
Alkalinity	131.78	127.64	132.58	130.28	138.34	131.26	149.62	151.24	143.56	155.18	152.36	147.68
Transparency	142.0	124.0	136.0	115.0	50.0	48.0	51.0	62.0	74.0	82.0	98.0	118.0
TDS mg/l	1125.0	961.0	1015.0	1018.0	1022.0	1228.0	1198.0	1010.0	915.0	889.0	915.0	998.0
DO mg/l	8.68	8.54	8.28	7.52	5.24	4.18	6.12	7.36	7.30	8.25	8.46	8.52
BOD	28.58	31.24	33.56	38.82	42.78	41.28	40.34	39.56	38.34	36.55	34.72	31.65
COD	39.64	43.54	45.74	49.38	53.85	59.58	56.18	55.34	51.46	50.45	49.34	46.85
Chloride mg/l	29.84	27.68	24.55	22.76	21.49	22.14	17.32	18.54	21.38	22.53	26.42	31.24
Nitrate	2.78	2.88	2.64	2.74	2.81	2.56	2.88	6.84	9.52	8.38	7.24	6.36
Ca ⁺⁺	39.52	38.74	37.55	36.84	37.18	34.25	33.88	49.85	47.56	48.16	39.72	37.68
Total Hardness	76.28	70.16	83.44	104.54	134.36	146.62	148.34	130.18	126.52	118.74	105.34	78.52
Free CO ₂	4.74	5.92	6.68	6.74	6.81	7.46	6.78	6.58	6.51	6.38	5.84	5.56

Water Temperature

Water temperature of pond water near R.K. College ranged between 15°C to 35°C, while in the other pond this ranged between 14°C to 36°C. Here the lowest temperature was found during winter while the highest during summer. Water temperature may accelerate or slow down the rate of the chemical reactions in the aquatic life forms. From the table it may be noted that from the month of February to June there was gradual increase in temperature, due to rise in atmospheric temperature. Due to rainy season the atmospheric temperature lowered and this was also true for the water temperature too. The higher temperature of the outside pond than the pond near R.K. College may be due to its open area as there were no shading devices. Pond near R.K. College is surrounded by the buildings and big trees, so shading of the pond water was noted. Present findings are in agreement with the findings of Singh (2010), Goswami *et al.*, (2017). Ramnathan and Amsath (2018) who also reported higher range of temperature during summer and lowest during winter.

Turbidity

From the table 1, it is clear that the value of turbidity ranged between 35.0 NTU to 48.0 NTU in the water of pond near R.K. College and 33.0 NTU to 46.0 NTU in the water of pond situated outside the town. In both the ponds higher range of turbidity was found in the month of May and lowest in the month of November. Further the turbidity range was higher in the pond water

near R.K. College, which may be correlated with the fact that this pond constantly gets domestic wastes as it is surrounded by the dense population where as the pond in outer location gets no such materials. Turbidity is the amount of suspended matter present in any water body. Higher the concentration of total suspended solids higher will be the turbidity. Turbidity found here is supported by the findings of other workers such as Srivastva and Srivastva (2011), Tidame and Shinde (2012), Ramanathan and Amsath (2018).

Transparency

Transparency of water body signifies the depth up to which the light can penetrate into the water. Transparency of the both the pond water was determined. Maximum transparency 150.0 cm was observed in calm water of the pond near R.K. College in the month of January. In the same month., the transparency of pond water situated outside the town was 142.0 cm. Similarly, the minimum transparency that was noted in the month of June in both the pond was 56 and 48 cm respectively. Reduced transparency during summer may be associated with the concentrations of inorganic substances. During rainy season they were diluted so gradually transparency increased. During winter these particles generally settle down, so maximum transparency was observed. Similar results have been observed by workers like Sahni and Yadav (2012), Rahman *et al.*, (2017), Sharma *et al.*, (2017), Durge *et al.*, (2018) etc. Therefore, these findings authenticate the present findings.

Alkalinity

The ability to resist changes in pH is alkalinity, which is due to presence of carbonates, bicarbonates, hydroxides, phosphates and other compounds in water (Bhatnagar & Pooja, 2013). In the present study as noted in table-1, alkalinity ranged between 133.62 to 156.48 and 131.78 to 151.24 respectively. Here higher range was obtained in summer and lowest in winter in both the ponds. The variation of total alkalinity was seasonal as it rose in summer and fell in winter. Maximum value of alkalinity in summer may be correlated with the fact that in summer, there is higher degradation of debris and organic waste. Increase in concentration of carbonate and bicarbonate thereby also increase the alkalinity of water. Biswas *et al.*, (2011) also observed similar result in a pond of Burdwan municipality, West Bengal. Above findings are also supported by the findings of Bhattacharyya (2018).

Total Dissolved Solids

Water is generally called as the universal solvent. Large numbers of minerals metals, organic matters, inorganic salts mainly calcium, magnesium, sodium, potassium, chloride etc. (size less than 2 microns) are dissolved in it. (Charkhabi and Sakizadeh, 2006). Sewage, waste water and other organic and inorganic substances the source of total dissolved solids. In the present study monthly variation in the contents of total dissolved solids were found in both the ponds.

As noted in table 1, maximum amount of total dissolved solid was found in the month of June that was 1284 mg/l in the pond near R.K. College, where as it was 1228 mg/l in outside pond. Similarly, minimum amount was 948 mg/l in the month of September in one pond while it was 889 mg/l the month of October in other pond. Present findings corroborate with the findings of Barai and Kumar (2012), Majumdar and Dutta (2014), Swarnkar and Chaubay (2016), Sharma *et al.*, (2017).

Dissolved Oxygen

It is the amount of free molecular oxygen dissolved in water. Main sources of dissolved oxygen in water bodies include air and phytoplanktons. In above two ponds monthly variations in dissolved oxygen were studied. As mentioned in table 2, it was noted that maximum value 8.52 mg/l was found in the month of January while the minimum value 4.76 mg/l was found in the month of June in the pond water near R.K. College while it varied between 8.64 mg/l in the month of January and 4.18 mg/l in June respectively. Water temperature is

a physical parameter that significantly regulates the dissolved oxygen in water. Here in cold water oxygen dissolved maximum than the warmer water. Present findings are in agreement with the findings of Sahni and Yadav (2012), Mohan *et al.*, (2013), Mazumdar and Dutta (2014), Quareshimatva *et al.*, (2015), Rahman *et al.*, (2017) and Durge *et al.*, (2018).

Free Carbon Dioxide

Monthly variations in carbon dioxide were also calculated. As mentioned in table 2, the amount of free carbon dioxide was maximum 7.38 mg/l in the month of June, while it was the minimum 4.56 mg/l in the month of January in pond water near the R.K. College, while it was 7.46 mg/l in the month of June and 4.74 in the month of January. The lower value may be due to maximum utilization in photosynthesis and higher values may be due to minimum utilization of free carbon dioxide by the process of photosynthesis.

Present findings are in agreement with the findings of Sahni and Yadav (2012), Prasath *et al.*, (2013), Dixit *et al.*, (2015), Bano *et al.*, (2016), Goswami *et al.*, (2017) and Durge *et al.*, (2018).

Biological Oxygen Demand

It is a measure of amount of oxygen needed by the microorganisms to decompose the organic matters present in a water body. Biochemical oxygen demand was measured on the monthly basis between January to December. From the table 2, it may be noted that the value ranged between 28.36 mg/l to 42.28 mg/l. Here the minimum value was noted in the month of January, while the maximum in the month of May in the pond water near R.K. College, Madhubani. In the outer pond this value ranged between 28.58 mg/l to 42.78 mg/l in the month of January to June respectively. Above findings corroborate with the findings of Singh (2010), Kedar and Patil (2011), Thimupathaiah *et al.*, (2012), Srivastva and Kanungo (2013), Reddy *et al.*, (2015), Sharma *et al.*, (2017) and Durge *et al.*, (2018).

Chemical Oxygen Demand

It measured the amount of oxygen needed to oxidize the inorganic chemicals present in the water body. COD was also studied on monthly basis in both the ponds from January to December.

From the table 2, it may be noted that the value ranged between 38.85 mg/l to 58.74 mg/l in the water of the pond near R.K. College, Madhubani, while the outer pond water it was noted 39.64 mg/l to 59.68 mg/l. Here in

both the ponds the minimum value was found in the month of January while the maximum in the month of May respectively. Similar results have been reported by Singh (2010), Kedar and Patil (2011), Thimupathaiiah *et al.*, (2012), Srivastva and Kanungo (2013), Reddy *et al.*, (2015), Sharma *et al.*, (2017) and Durge *et al.*, (2018). So the present findings are authenticated by the above workers.

Chloride Contents

Chloride ions are found in low concentrations in fresh water. This may be either due to natural or anthropogenic causes. Chloride ions in fresh water are basically added due to sewage contamination and addition of fertilizers residues such as potassium chloride etc. Chloride ions contents of both the above ponds were studied at monthly basis. From the table-2, it was clear that in pond near R.K. College revealed a monthly fluctuation which ranged between 15.78 mg/l to 29.62 mg/l.

Similarly, in the pond situated outside the town revealed monthly variations between 17.32 to 31.24. The minimum concentration in both the ponds was noted in the month of July while the maximum in the month of December respectively. The highest value in outside pond may be due to the runoff from the nearby agricultural lands. In the pond near R.K. College may be due to the release of sewage from the surrounding areas. Present findings corroborate with the findings of Singh (2010), Biswas *et al.*, (2011), Thirupathaiiah *et al.*, (2012), Yadav *et al.*, (2013), Singh (2014), Reddy *et al.*, (2015), Uddin *et al.*, (2016), and Rahman *et al.*, (2017). At low concentration chloride ions are harmless but at higher concentration it can harm the aquatic organisms.

Calcium

It is found in greater abundance in all natural water and its main source is the chemical fertilizers and decomposition of the matter containing calcium. From the table-2, it was clear that pond water near R.K. College revealed monthly fluctuation in calcium concentrations that was between 32.74 mg/l to 48.64 mg/l, in pond situated outside revealed variations between 33.88 mg/l to 49.85mg/l. Here the lower concentrations were noted in the month of July, while higher in August in both the pod. In outside pond runoff from agricultural field might have added calcium as the residue of chemical fertilizers. Similar patterns of variations have been reported by Sahni and Yadav (2012), and Thangamalathi and Anuradha (2018).

Total Hardness

This is caused by mainly due to the presence of calcium and magnesium. Although ions of iron, zinc, manganese etc. also contribute in the hardness but due to their lower concentrations their contribution is not much significant. From the table-2, it may be noted that, pond water near R.K. College had maximum hardness 151.60 mg/l in the month of June while minimum 72.38 was found in February. In the same month maximum hardness of outside pond water was 146.62 mg/l and minimum 70.16 mg/l respectively. During summer the volume water is reduced and naturally the chemical concentrations will be increased. While during winter the volume increases due to addition of water during rainy season and there is less evaporation. Present findings corroborate with the findings of Sahni and Yadav (2012), Tidame and Shinde (2012), Durge *et al.*, (2018), and Ramanahan and Amsath (2018). Therefore, these findings are authenticated with the findings of different workers.

CONCLUSION

Present study was conducted to find out the monthly variations in selected physico-chemical parameters of tow ponds of Madhubani town situated at different location. The pond near R.K. College is surrounded by dense populations and the sewage and other domestic solid wastes are being dumped in it. Due to this the quality of water is degrading day by day. The pond outside the town is surrounded by agricultural lands. During rainy season the pond gets water from these fields. Such water carried residue of different agrochemicals. They are being deposited every year and this is not good for the health of the water of the pond. The data obtained here may help in the management of these water bodies because, purity of water is essential for both the flora and fauna.

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