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Nitesh Kumar Mehta

C.M.Sc. College, Darbhanga,

LNMU, Darbhanga, Bihar, India

Dr. Arti Kumari

C.M.Sc. College, Darbhanga,

LNMU, Darbhanga, Bihar, India

Study of water quality using of physico-chemical parameters of two perennial fish ponds of Darbhanga

Nitesh Kumar Mehta and Dr. Arti Kumari

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Abstract

Darbhanga is known as city of ponds. The current investigation was undertaken the study of the physico-chemical conditions of two perennial fish ponds- Harahi Talab and Maharani Pokhar of Darbhanga city. Present study revealed that physico-chemical parameters were comparatively higher of Harahi Talab to other pond, Maharani Pokhar. The water samples were analyzed for water temperature, transparency, TDS, pH, free CO₂, chloride, carbonate, bicarbonate, magnesium, dissolved oxygen (DO) and biological oxygen demand (BOD). Higher value of physico-chemical parameters BOD, is considered to be sewage water pollution indicator for eutrophication and it also lower down the fish production.

Keywords: Physico-chemical parameters, Harahi Talab, BOD, water pollution, sewage, Darbhanga city pond.

Introduction

Darbhanga is known as city of ponds. The district has huge freshwater resources in form of thousands of Government and private ponds. The pond water is generally used for domestic and fisheries activity. However, Darbhanga is categorized as one of the fastest urbanizing cities of north Bihar. To fulfill of water supply to its exploding population the pressure on ground water and pond has been increasing constantly. Ground water pollution can occur where anthropogenic activity waste water is discharged into sewage drain, ponds and rivers (Farnaz & Rahmatullah, 2013) [5]. Among five elements water is the most vital resource for the existence of all life and ecosystems in Earth. Certain standards in terms of its physical, chemical and biological parameters determine its suitability for intended purposes. Water is considered polluted when these parameters shift from the acceptable range of quality standards (APHA, 2000) [1].

Aquaculture offers a significant role in nutritional security and is the fastest-growing sector, accounting nearly 50% of the world fish production (FAO, 2018) [4]. Fisheries sector plays a key role in food security and employment generation as significant proportion of population depends upon it for livelihood sustenance. It also generates precious revenue for the state (Kumar & Singh, 2013) [9].

The objective of this work has to analyze various physico-chemical parameters of the water of two ponds Harahi Talab and Maharani Pokhar at Darbhanga city, Bihar.

Materials and Methods

The water samples were collected from four different stations of both Harahi Talab, near Darbhanga Jn. and Maharani Pokhar, Darbhanga in the period for one year from June, 2021 to May, 2022, sample were collected monthly around 9 to 11 am., in polythene bottle regularly for once in every month and samples brought into laboratory for the estimation of various physico-chemical parameters like water temperature, transparency, pH, were recorded at the time of collection, by using thermometer pocket digital pH meter, transparency was measured with the help of Secchi Disc while other parameters such as TDS, DO, BOD, free CO₂, chloride, carbonate, bicarbonate and magnesium were estimated in the laboratory by using standard methods as APHA (2000) [1], Trivedy and Goel (1986) [23], Kodarkar (1992) [8].

Corresponding Author:

Nitesh Kumar Mehta

C.M.Sc. College, Darbhanga,

LNMU, Darbhanga, Bihar, India

Results

The monthly variation of certain physico-chemical parameters of both ponds Harahi Talab and Maharani Pokhar, Darbhanga

were observed in during period of June, 2021 to May, 2022, is presented in tables as follow:-

Table 1: Physical parameters of Harahi Talab, Darbhanga.

Month	Water Temperature °C	Transparency cm	TDS gm/liter	pH
Jun	34.2	60.1	2.4	7.2
Jul	33.2	58	1.11	7.3
Aug	33.4	45.6	0.2	7.5
Sept	29.5	46	0.3	7.6
Oct	30.0	45	0.9	8.0
Nov	29.0	45.2	1.8	8.1
Dec	19.1	52	0.6	8.2
Jan	20.0	43.2	0.37	8.5
Feb	21.5	46.9	0.39	8.8
Mar	27.5	45	0.4	7.9
Apr	28.2	61	0.3	7.7
May	34.5	77.5	0.6	7.0

Table 2: Chemical parameters of Harahi Talab, Darbhanga.

Month	Carbonate	Bicarbonate	Dissolved Oxygen	Free CO ₂	BOD	Chloride	Magnesium
Jun	0.0	394	5.50	10.45	155.80	34.00	9.27
Jul	0.001	206	10.10	18.10	25.50	28.25	10.42
Aug	0.0	195	7.70	19.10	27.30	39.00	6.78
Sept	0.0	175	7.00	16.55	39.45	45.50	4.10
Oct	0.001	145	7.60	12.01	61.15	33.08	11.02
Nov	2.4	150	8.00	14.50	21.25	25.00	11.05
Dec	2.9	115	8.62	5.00	22.40	30.00	12.00
Jan	3.01	115	9.0	0.02	34.50	28.10	8.25
Feb	2.3	112	8.50	0.85	42.05	33.45	8.52
Mar	0.0	105	9.70	4.00	49.50	40.10	14.08
Apr	0.001	255	6.20	5.28	72.05	43.40	16.45
May	0.001	165	6.50	9.40	154.00	36.49	12.40

Table 3: Physical parameters of Maharani Pokhar, Darbhanga.

Month	Water Temperature °C	Transparency cm	TDS' gm/liter	pH
Jun	31.0	77.1	1.8	8.3
Jul	32.4	76	1.10	7.7
Aug	31.4	52	0.2	8.1
Sept	28	53	0.3	8.0
Oct	28.1	55	0.4	7.8
Nov	27.8	53	0.8	8.1
Dec	20.0	55.1	0.6	8.2
Jan	21.0	51.1	1.37	8.4
Feb	22.5	58.1	1.39	8.1
Mar	26	73	0.6	7.6
Apr	28.0	73.5	0.4	8
May	34.1	82.4	1.2	8.1

Table 4: Chemical parameters of Maharani Pokhar, Darbhanga.

Month	Carbonate	Bicarbonate	Dissolved Oxygen	Free CO ₂	BOD	Chloride	Magnesium
Jun	0.00	234	5.8	13.41	125.8	38.00	12.20
Jul	0.05	195	6.18	12.10	20.5	34.25	13.40
Aug	0.00	135	8.1	11.10	29.3	43.00	9.70
Sept	0.00	147	7.5	12.57	32.4	50.41	7.10
Oct	0.05	139	8.1	7.02	43.1	37.08	14.04
Nov	4.00	110	8.4	3.50	25.20	30.25	15.06
Dec	3.0	115	9.0	1.00	25.40	34.00	10.94
Jan	3.21	124	9.0	0.10	39.50	32.10	17.32
Feb	4.10	105	8.50	0.15	41.04	36.45	11.54
Mar	4.01	154	10.45	7.10	25.50	44.10	17.05
Apr	0.05	155	6.7	7.15	74.05	46.40	19.48
May	0.05	225	7.1	20.40	124.0	40.49	15.40

Discussion

The physico-chemical parameters analysis of water of the two fish ponds, Harahi Talab and Maharani Pokhar has been made during different season of a year of observation. The detail of observed data may be discussed in relation to the previous works done by the different workers.

Temperature: Water temperature of Harahi Talab was recorded maximum in month of May (summer) 34.5 °C and in December (winter) 19.1 °C while in Maharani Pokhar maximum in month of May (summer) 34.1 °C and in December (winter) 20 °C. Temperature is amongst one of the important factors that has direct effect over the existence of living organisms and as well as physico-chemical quality of water for the fish production. Temperature of the pond water showed typical seasonal fluctuation as it was recorded maximum in summer and minimum in winter. Yearly mean of the temperature was observed higher in pond water during the summer but lower in winter. Vyas and Kumar (1968) [26]; Kumar & Singh (2013) [9] and Ranjan, (2017) [16] have found similar results.

Transparency: Water transparency of Harahi Talab pond was recorded maximum in month of May (summer) 77.5 cm and in October (winter) 45 cm while in Maharani Pokhar maximum in month of May (summer) 82.4 cm and in January (winter) 51.1 cm. higher transparency occur during winter and summer due to absence of rain, runoff and flood water as well as gradual setting of suspended particles. Higher transparency in winter was also reported by Bhatt *et al.* (1985) [2]. However, Towhead *et al.* (1988) observed maximum transparency during the winter. Minimum transparency was observed during the rains, has also been observed by several investigators including Kumar & Singh (2013) [9] and Ranjan, (2017) [16] have found similar results.

pH: Water pH of Harahi Talab was recorded minimum in month of May (summer) 7.0 and in October (winter) 8.8 while in Maharani Pokhar minimum in month of June (summer) 7.7 cm and in January (winter) 8.4 . Most commonly it varies between 7 and 9. In commonest water, pH is slightly alkaline due to the presence of bicarbonates and carbonates of alkaline earth. Seulpthorpe (1976) [17] has suggested that pH and carbon dioxide are even more critical factors in the survival of aquatic plant and fishes than the oxygen supply. Alternations in pH in natural waters are usually accompanied by changes in other physico-chemical factors also. It is therefore very essential to monitor the level of pH in a given water body regularly in view of its implication. Its level fluctuated in within a narrow range in conformity with the findings of various workers (Hosmani and Bharati, 1980; Mesfin and Belay, 1989 and Surabhi, 1994 Kumar & Singh 2013; Farnaz & Rahmatullah, 2013 and Ranjan, 2017) [6, 10, 9, 21, 5, 16].

TDS of Harahi Talab water was recorded maximum in month of June (rainy season) 2.4 gm/L and in April (before summer) 0.3 gm/L while in Maharani Pokhar maximum in month of July (rainy season) 82.4 cm and in April (before summer) 0.4 gm/L. It is due to heavy rainfall. Similar records were observed to reported by Verma and Munshi (1987) [24]; Towheed *et al.* (1988) [22] Kumar & Singh (2013) [9] and Ranjan, (2017) [16].

DO: The amount of oxygen in water depends on the surface area exposed, temperature and salinity. Water, where organic

matter is very high, has very little oxygen dissolved in it and self-purification of water system depends on the presence of sufficient amount of oxygen dissolved in it. Dissolved Oxygen was found to be maximum during the winters in both ponds. This can be attributed to the prevailing lower temperature. Solubility of oxygen is dependent on temperature and it increases with decrease in water temperature (Clarke, 1965) [3]. Higher amount of dissolved oxygen during the winters have also been reported by Vyas and Kumar (1968) [26], Bhatt *et al.* (1985) [2] and Towheed *et al.* (1988) [22]. Minimum content of Dissolved Oxygen was observed during the rains and summers, a result also observed by Verma and Munshi (1987) [24] and Towheed *et al.* (1988) [22] Kumar & Singh (2013) [9] and Ranjan, (2017) [16].

BOD: Biological Oxygen Demand is an important parameter for assessing water quality. When oxygen is used up faster than it is replaced, the water quality begins to deteriorate. Water BOD of Harahi Talab was recorded maximum in month of May (summer) 165.5 ppm and minimum in November (winter) 40 ppm and rainy season while in Maharani Pokhar maximum in month of May (summer) 125.8 ppm and in July (rainy season) 20 ppm occur during rainy season due to runoff water. The similar result also observed by Verma and Munshi (1987) [24] and Towheed *et al.* (1988) [22] Kumar & Singh (2013) [9] and Ranjan, (2017) [16].

Carbonate & Bicarbonate: Seasonal mean was maximum in winter and minimum in summer in both ponds water. Carbonate alkalinity was low whereas bicarbonate alkalinity was recorded fairly high. The lower levels carbonate alkalinity and higher level of bicarbonate alkalinity can be attributed to the pH range which favours more CO₂ to be present as HCO₃ ion (Clarke, 1965) [3]. High value of bicarbonate alkalinity in polluted water have been reported by Singh (1985) [18] and Sahay *et al.* (1985). Based on alkalinity values, Moyle (1946) [12] classified water into three categories: low productive with less than 20 ppm alkalinity, low to medium with 20-40 ppm alkalinity and medium to high with 40-90ppm alkalinity. Philipose (1959) [13] categories Indian water as low productive having 40-50 alkalinity, moderately high with 50-100 ppm alkalinity and fairly high with 100-200 ppm alkalinity. On the basis of these classifications, the pond under study appear to be of good productive value. It has no adverse effect on health but highest desirable limit of 100 mg/l and maximum permissible limit of 500 mg/l have been set by WHO for drinking water.

CO₂: Water with concentration of free CO₂ less than 5ppm supports good fish production, where as its high concentration in water leads to asphyxiation and obtain death of fishes. As far as prediction of the trophic status of a water body on the basis of recording of annual mean values of free CO₂ is concerned, there are difference in opinions. Yadava *et al.* (1987) [27] and Hosmani (1988) [6] have observed decrease value of free CO₂ in eutrophic and polluted water bodies and on the other hand Hosmani and Bharti (1980) [7], Mesfin and Belay (1989) [10], Rana and Palria (1998) [15], Farnaz & Rahmatullah, 2013 [5] have ascertained lower free CO₂ content at unpolluted sites. Thus, CO₂ concentration appears to be no yard stick for predicting either the trophic level or magnitude of pollution of any water body.

Chloride: Water Chloride of Harahi Talab was recorded maximum in month of May (summer) 45.0 ppm and minimum in November (winter) 25 ppm while in Maharani Pokhar maximum in month of May (summer) 50 ppm and in January (winter) 32 ppm occur. None of the values exceeded desirable standard (200ppm) of WHO and Ministry of Works and Housing in the water of pond and river. High chloride content in the polluted water has been reported by Venue *et al.* (1984)^[25], Singh (1985)^[18], High chloride content in the polluted water has been reported Venue *et al.* (1984)^[25], Singh (1985)^[18] and Rana and Palria (1988)^[15]; Farnaz & Rahmatullah, 2013^[5] and Ranjan, (2017)^[16] have found similar results.

Magnesium: Mg is an important major nutrient needed by all organisms, since it activates many enzyme systems. It is an essential constituent of the chlorophyll and is also involved in phosphorus transfer process. It is particularly associated with clay. It plays an important role in synthesis of ATP and ADP and inorganic phosphates. It is also an activator for many of the enzymes involved in carbohydrate metabolism. In the present study, yearly mean of magnesium was found to be lower in the rainy season and higher in winter. The highest desirable limit of magnesium in drinking water prescribed by WHO and acceptable limit to Ministry of Works and Housing is 30ppm. Thus existing level of magnesium in pond and river water is within the maximum desirable limit of WHO and acceptable limit of Ministry of Works and Housing Prasad and Singh (1982)^[11] recorded higher values of magnesium of polluted station (35.36 ppm) in comparison with unpolluted station (17.13 ppm) of Gomati river at Lucknow. Singh *et al.* (1970) during their study of the algal flora of sewage recorded the range of magnesium between 15.4 and 85.0ppm. Singh (1992)^[19] recorded minimum magnesium level during monsoon months and the maximum in the month of February. Therefore, it may be concluded that the both ponds water under study is not polluted as far as magnesium is concerned.

Conclusion

Observed values of Harahi Talab water on Temperature, magnesium, carbonate, chloride, BOD and free CO₂ were found comparatively higher than that of Maharani Pokhar, whereas pH, Transparency, Dissolved Oxygen and bicarbonate of Harahi Talab water were found lower than the Maharani Pokhar. Higher value of physico-chemical parameters BOD, is considered to be sewage water pollution indicator for eutrophication and it also lower down the fish production.

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