



Assessment of Physicochemical Properties of a Fish Pond, Matokhar Dah, Sheikhpura (Bihar)

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Abstract: Assessment of physicochemical properties with fish culture of a fish pond Matokhar Dah in Sheikhpura district of Bihar have been carried out for a period of one year i.e. from October 2021 to September 2022. Water temperature, Depth, transparency, Total solids (TS), Total dissolved solids (TDS), Total suspended solids (TSS), pH, Free Carbon dioxide (CO₂), Dissolved oxygen (DO), Biological oxygen demand (BOD), Chemical oxygen demand (COD), Nitrate, Phosphate, Alkalinity, Chloride, Total Hardness, Calcium (Ca²⁺), Magnesium (Mg²⁺) had been determined. The results of water quality assessment revealed that Matokhar Dah pond was suitable for fish culture.

Keywords: Pond, Physicochemical properties, Matokhar Dah, Sheikhpura, Fish Culture.

1. INTRODUCTION:

Water is the most precious for all living organisms and there is no possibility of life on the earth without water. It is one of the essential components for survival as it is used for used for various activities such as drinking, irrigation purpose, fish production, industrial purpose, power generation, recreation activities and many others (Lokhande and Sathe 2001). Thus, judicious use of water is recommended to all of us.

The fresh water resources get contaminated by the entry of various waste products coming from domestic sewage, industrial waste, agricultural waste and run off (Reddy 2012, Reddy and Baghel 2012). Due to anthropogenic disturbances the surface water quality is degrading day by day. The water quality directly affects the fish productivity. Thus, to main the water quality of any pond requires understanding of various water quality parameters becomes inevitable.

In the present investigation, physicochemical properties a fish pond (Matokhar Dah) Sheikhpura Bihar was assessed to determine the water quality. Sheikhpura is a district in Bihar state of India. The studied area is surrounded by human population of Matokhar village. The site "Matokhar Dah pond" is famous for fish farming particularly major carps *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*. But no scientific studies of this pond have been done earlier. Thus, the assessment of physicochemical parameters would be beneficial to determine its water quality and its use for fish production since it generate source livelihood.

2.MATERIALS AND METHODS :

Study Area:

Matokhar Dah pond is the studied area present in Sheikhpura district of Bihar. It lies in 25° 07' 52'' North Latitude and 85° 47' 35'' East Longitude (Fig. 1).

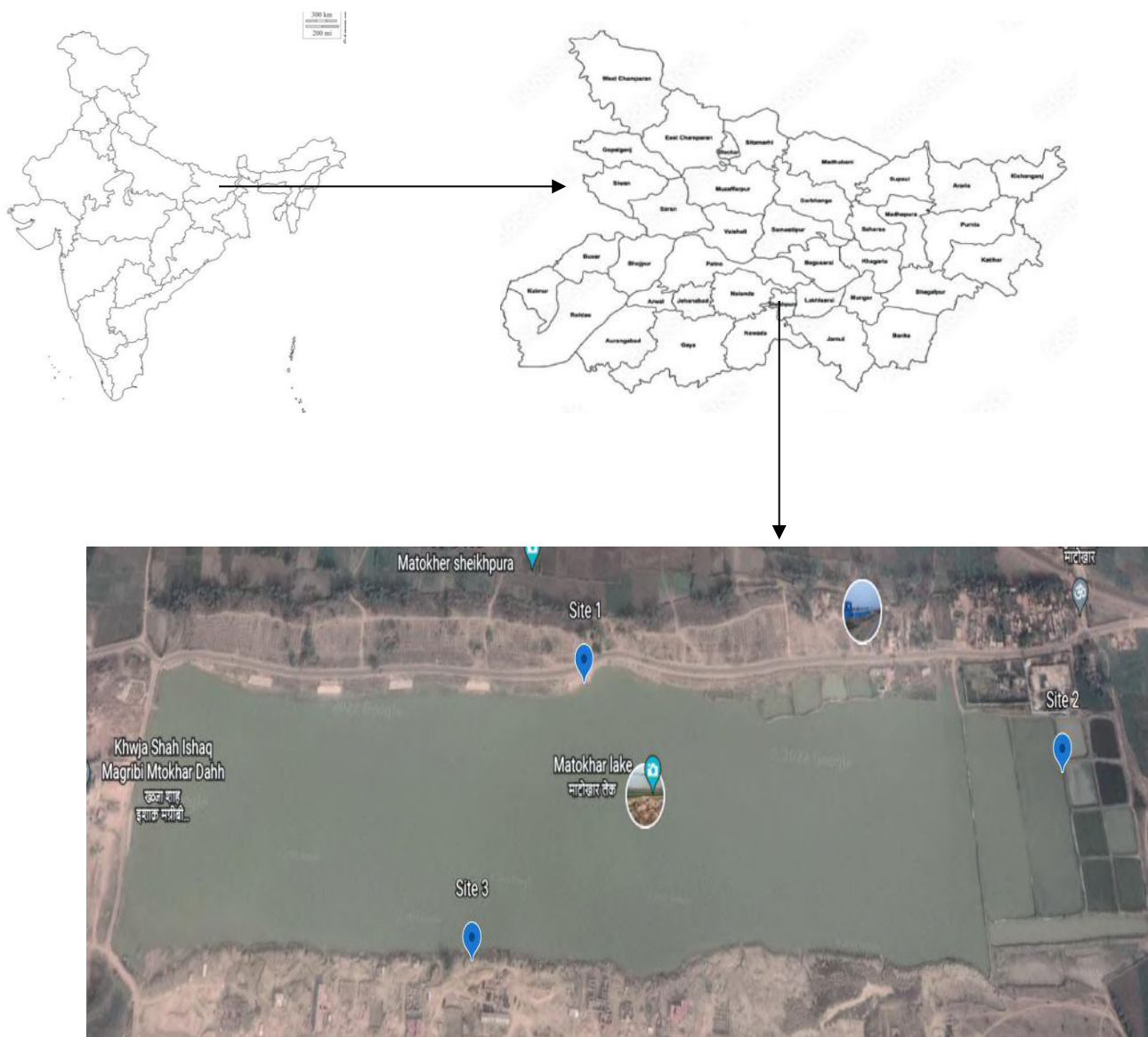


Fig: 1. Study area showing three sampling sites of Matokhar Dah Pond, Sheikhpura (Bihar)

The physicochemical properties of water of Matokhar Dah Pond were analysed at monthly interval during October 2021 to September 2022. The water sample were collected in 1 Litre plastic bottle and 300 ml BOD bottle (for BOD) during 8:30 am to 11:30 pm and then brought to the laboratory. The physicochemical properties were determined by methods given in APHA (2017) and Verma and Paul (2023). Some parameters that were determined on the site are pH, water depth, water temperature, transparency, dissolved oxygen, free carbon dioxide, total alkalinity and chloride and the rest parameters were determined in the laboratory. The methods of assessment of different water variables are given in Table 1.

S. No	Parameters	Methods / Tools
01	Water Temperature (°C)	Mercury Thermometer
02	Water Transparency (cm)	Secchi Disc
03	pH	pH Meter



04	Total solid (TS) (mg/L)	Gravimetric method
05	Total suspended Solid (mg/L)	Gravimetric method
06	TDS (mg/L)	Gravimetric method
07	Dissolved Oxygen (mg/L)	Winkler's Alkali Azide Method
08	Free CO ₂ (mg/L)	Titrimetric Method
09	Chloride(mg/L)	Titrimetric Method
10	Total Alkalinity (mg/L)	Titrimetric Method
11	BOD (mg/L)	3-day incubation method
12	Chemical Oxygen Demand (mg/L)	Closed reflux method
13	Total Hardness (mg/L)	Titrimetric Method
14	Calcium (mg/L)	Titrimetric Method
15	Magnesium (mg/L)	Titrimetric Method
16	Phosphate (mg/L)	Spectrophotometric Method
17	Nitrate (mg/L)	Spectrophotometric Method

Table 1 – List of The Physicochemical Parameters Along with Their Determination Methods

3. RESULT AND DISCUSSIONS

The results of physicochemical parameters of water sample Matokhar Dah Pond are given in Table 2. Range of various water variables was as follows:

Water Temperature:

water temperature is an important factor which directly influence some chemical reactions in aquatic ecosystem. An ideal temperature of 24°C to 30°C is considered good for fish culture in pond (Ganpati 1962 and Verma 1967). In the present study, it ranged between 15°C to 31.50°C. Minimum and maximum temperature was observed in the winter and summer season respectively since water temperature follows pattern of air temperature.

Water Transparency:

It gives an idea of clarity in the water since more transparency indicates clean water and less value of transparency indicates turbid water. Transparency of water was measured with the help of Secchi disc. The maximum transparency was recorded in February 2022, (52.07 cm) and minimum value was recorded in May 2022, (22.16 cm). Transparency also affects primary productivity of pond or any other water body. Low transparency was observed during summer season which may be due to suspended solids and organic matter present mainly due to human activities or surface runoff.

pH:

pH is an important limiting factor for fish culture. It indicates about the acid base balance of water. The suitable range of pH for the growth of fishes is between 6.7 to 9.5 (Santosh and Singh, 2007). Any variation to this value could be stressful to the fishes. In present study pH of Matokhar Dah Pond ranged between 8.2 to 9.80 which was a little high. Its maximum value was observed in winter. Increased pH in water in winter can be caused by several factors. The factor in the present investigation contributing to increased pH in winter ponds is the reduced biological activity.



Beneficial bacteria which help break down wastes and remain a stable pH, are less active in colder temperature. Similar result was observed by Sawant and Telave (2009).

Parameters	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
pH	9.1	9.6	9.5	9.8	9.2	8.9	8.8	8.5	8.2	9.0	8.7	8.9
Water temp (°C)	27	24.6	18	15	24	25	25.5	28	31.5	30	29.5	28.8
Transparency (Cm)	27.31	45.21	40.64	44.45	52.07	25.40	24.13	22.16	19.05	27.94	31.75	30.48
TS (mg/l)	400	300	400	400	300	300	300	300	500	600	600	400
TSS (mg/l)	200	100	200	100	100	150	100	100	250	300	300	200
TDS (mg/l)	200	200	200	300	200	150	200	200	250	300	300	200
D0 (mg/l)	6.24	6.45	9.2	10.47	9.66	7.24	7.24	8.86	5.83	5.62	6.44	6.44
CO ₂ (mg/l)	0.44	0.22	0.24	0.46	0.22	0.24	0.22	0.22	0.22	0.22	0.00	0.00
Chloride (mg/l)	33.5	33.5	26.8	26.8	33.5	33.5	33.5	37.52	39.76	50	42.6	42.6
TA (mg/l)	38	36	42	46	32	44	36	40	48	50	46	48
BOD (mg/l)	4.50	5.6	4.79	5.65	5.45	4.46	5.45	5.25	6.86	4.82	4.03	4.63
COD (mg/l)	46.2	46	42	44	40	46.8	44	42.6	48	46	44.5	46.2
TH (mg/l)	88	112	130	134	92	119	92	88	112	86	118	88
Calcium (mg/l)	16.03	21.64	28	28	19.23	20.23	19.23	20.4	22	26	22.4	19.23
Magnesium (mg/l)	16.2	15.4	15.6	22.2	18.2	13.72	10.72	15.26	22.42	20.23	18.42	16.74
Phosphate (mg/l)	0.33	0.31	0.24	0.20	0.40	0.30	0.22	0.32	0.31	0.23	0.21	0.32
Nitrate (mg/l)	1.0	1.0	1.2	1.3	1.8	1.4	0.9	1.5	1.3	0.7	0.9	0.8

Table 2: Physicochemical properties of water of Matokhar Dah Pond (Sheikhpura), Bihar during October 2021 to September 2022.

Total Solids (TS):

Total solid (TS) comprised of both total suspended solid and total dissolved (non-filterable). The presence of solids may indicate algal growth and hence an indicative of severely eutrophic conditions. It will also reduce light penetration in surface water and interfere with macrophytes. It may affect fish life as it can clog the gills of fishes. In the present study, Total Solids varies between the range of 300mg/l to 600mg/l. Maximum concentration of TS was observed during monsoon period i.e. July which could be due to surface runoff. The findings are in conformity with the findings of Priyadarshini & Aruchamy (2015).

Total Suspended Solids (TSS):

Total Suspended Solids (TSS) is non-settleable solid particles found in water. These are organic and inorganic matter suspended in water. In the present study, TSS value ranges from 100 to 300 mg/L. Maximum value of TSS was observed during monsoon period i.e. July which might be due to surface runoff. Similar trend of seasonal variation was observed by Yadav and Tiwari (2023).

Total Dissolved Solids (TDS):



The Total Dissolve Solid (TDS) tells about all inorganic and organic substances dissolved in water body. It can be minerals, salts, metals, cations, or anions (Hussain, 2019). Total dissolve solids are one of the important parameters to indicate water quality because its high levels can affect the taste, hardness, and overall health of the water ecosystem. It defines the use of water for various purposes like drinking, agriculture, and industrial processes. In this present study of Matokhar Dah Pond, Total Dissolve Solids (TDS) concentration varied from 150 mg/L to 300 mg/L. Its maximum value was observed during winter season (January) which might be due to low biological activity. Similar trend was observed by Birajdar et al. 2017.

Dissolved Oxygen (DO):

Dissolved oxygen (DO) of water was measured by Winkler titration method. It is also one of the important parameters which support the aquatic life. The main source of DO in water is the photosynthesis by phytoplankton and vegetation. In the present investigation, the concentration of DO was observed in the range of 5.62 mg/l to 10.70 mg/l. A minimum concentration of DO is 4mg/l is required for propagation of fish culture (Santosh and Singh, 2007). Maximum concentration of DO was observed during winter season which might be because of low water temperature that hold more oxygen. similar trend of result was observed by Abir (2014).

Free CO₂:

Free carbon dioxide (CO₂) in water is the byproduct of metabolism. Free CO₂, temperature and Sun light radiation are some important factors which are necessary for vegetative and phytoplankton growth (Bristow, 2011). In the studied area, the value of free CO₂ ranged between 0 mg/l to 0.46 mg/l with maximum value during winter which may be due to slow photosynthesis leading to accumulation of CO₂ in water. For any fish culture pond the concentration of free CO₂ should must be less than 5 mg/L (Santosh and Singh, 2007) and in this study the results obtained was quite low.

Chloride:

It is represented by negative ion (Cl⁻). Presence of excess chloride is an indicative of domestic sewage in any water body (Hong et al. 2023). In the present study of Matokhar Dah pond, the concentration of Chloride obtained was in the range of 26.8 to 42.60 mg/l. Its maximum value was observed during monsoon season which could be due to surface runoff.

Total Alkalinity:

Total Alkalinity provides the ability to neutralise acid in water. The major contributors of alkalinity in the water are carbonate, bicarbonate and the hydroxyl ions (Bozorg-Haddad, 2021). The values of total Alkalinity of the water samples in Matokhar Dah Pond were ranged between 32mg/l to 50mg/l. The ideal value for fish culture is 50mg/l to 300mg/l (Santosh and Singh, 2007). The results indicates that its concentration was found to be ideal for fish culture. Maximum value of TA was observed during winter which might be due to combined effect of low temperature and reduced dilution of pond water leading to more concentration of carbonates and bicarbonates. Mehta and Kumari (2022) obtained the same trend of maximum value.

BOD:

Biochemical oxygen demand (BOD) is one of the water variables which indicates water quality. It determines the concentration of oxygen required for degradation of organic matter (Jouanneau et al. 2014). The range of BOD in present study in Matokhar Dah Pond was found to be 4.03 mg/l to 6.86 mg/l with maximum value during summer season which might be due to high microbial activity. Similar seasonal pattern was observed by Mehta and Kumari (2022). The optimum BOD level for aquaculture should be less than 10mg/l (Santosh and Singh, 2007). High BOD could result in stress, suffocation and even death of living organisms but this condition was not observed in the present study.

COD:

The Chemical Oxygen Demand (COD) is a measure of the total amount of oxygen which is required to oxidize all the organic matter in sample to CO₂ and H₂O. It simply indicates oxidation of organic matter (Rekrak et al. 2020). Like BOD, COD is also an indicative of organic enrichment in pond water. The ideal value of COD should be less than 50 mg/l for fish culture (Santosh and Singh, 2007). The COD value in Matokhar Dah Pond ranged between 40mg/l to 48mg/l. Maximum COD was observed during summer season coinciding with high BOD which indicates high decomposition of organic matter due to favourable temperature during summer.

Total Hardnes (TH):

The hardness of water causes precipitation of insoluble Ca⁺ and Mg⁺ salts of higher fatty acids. It is mainly caused by calcium as well as magnesium bicarbonates, carbonates, chlorides and sulphates (Etim et al. 2014). Its concentration varies from pond to pond. In the present study, the concentration of Total hardness (TH) in the Pond ranged between 86 mg/l to 134 mg/l with maximum concentration during winter season. Calcium and magnesium contribute to hardness in water. The concentration of calcium was maximum during winter season which might be due



to low calcium uptake by faunal diversity because of low metabolic activity during winter season. Upadhyaya (2013) reported higher value of TH during the summer which contrast with the result of this present study. For fish culture, its ideal value should be in between 30-180 mg/L (Santosh and Singh, 2007) and the results found in this study are within limits.

Calcium:

Calcium (Ca^{2+}) is one of constituent of living organisms. It can be present naturally in earth crust or can be produced anthropogenic activities. Domestic sewage can also produce calcium in surface water (Kalavati et al. 2011). In Matokhar Dah Pond, content of Ca^{2+} ranged between 16.03 mg/l to 28 mg/l with maximum concentration during the winter which may be due to less uptake of calcium by living organisms in low temperature during winter.

Magnesium:

It imparts hardness to water but always remains lower than calcium concentration (Sajitha and Vijayamma, 2016). Magnesium (Mg^{2+}) is also an important content of ground water chemistry. In present investigation, concentration of Mg^{2+} in Matokhar Dah Pond was found to be 14.62 mg/l to 22.42mg/l with concentration maximum during the winter similar to calcium.

Phosphate:

Phosphate (PO_4^-) value obtained in this present study ranged between 0.2 mg/l to 0.4mg/l. Phosphate concentration is present in very small quantity in water but its presence is important for the production of algal growth and macrophytes. It is also important for metabolic activities in other life forms. Its higher concentration could lead to eutrophic state of water body (Ramachandra et al. 2006). In the present study, the concentration of phosphate ranged between 0.20 and 0.40 mg/L. Its maximum concentration was observed during February. Due to less vegetative growth in low temperature, the phosphate concentration remained unutilized and could have led to more concentration.

Nitrate:

Nitrate (NO_3^-) is the highly oxidized form of nitrogen compounds present in surface water. For fertility of pond water, the recommended ratio of phosphorus and nitrogen is 1:4. In water ideal range was 0.1mg/l to 4.5mg/l for fish culture (Santosh and Singh, 2007). In present study, nitrate value obtained in Matokhar Dah Pond ranged between 0.7mg/l to 1.8mg/l. The period of winter showed maximum concentration of nitrate which may be due to combined effect of reduced uptake of nitrates by vegetation along with fish feed and fish waste. Its concentration also lies within the limits of drinking water standards given by IS (10500-1989). Some sources of nitrates could be fertilizers, decayed vegetation and animal matter, domestic effluents and surface runoff.

4. Conclusion:

In the present investigation, different water variables tend to show seasonal variation also. Most of the parameters are found to lie within guidelines for water quality for fish culture. Thus, the Matokhar Dah pond was found suitable for fish culture. Slight high pH was observed in the water body. Some precautionary measures can be taken to control the pH of pond water. A regular monitoring of water would be helpful in high productivity of the pond which could further enhance the livelihood of the local people.

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