Analysis of Water Quality using Physico-chemical Parameters of Fresh Water Ponds of Hajipur, Vaishali District of Bihar

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***Abstract*— The present study was conducted to assess the fresh water ponds located at Bazar Samiti in Hajipur, Vaishali, Bihar and effects of sewage pollution from the drains of surrounding areas. In Physical and Chemical Parameters Such as Water Temperature, Transparency, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide, and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates. Were analyzed for a periods of one year from 1st January 2024 to 31st December 2024. All Parameters were within the Permissible limits. The results indicate that the tank is Non-polluted and can be used for Domestic, Irrigation and Pisciculture.**

***Index Terms*— Perennial tank; Physico-Chemical Parameters, Monthly variation.**

I. INTRODUCTION

Water is an essential and vital component of the ecosystem, playing a fundamental role in supporting life and maintaining ecological balance. It serves as a habitat for countless organisms, influences climate patterns, and is integral to various biological processes. The quality of water, which is critical for the health of both aquatic and terrestrial ecosystems, is defined by a range of physical, chemical, and biological characteristics.

Physical characteristics of water quality include parameters such as temperature, turbidity, color, and the presence of sediments. These factors can affect the habitat suitability for aquatic organisms, influence photosynthesis in aquatic plants, and impact the overall aesthetic and recreational value of water bodies.

Chemical characteristics encompass a wide array of substances, including pH levels, dissolved oxygen, nutrients (such as nitrogen and phosphorus), heavy metals, and contaminants like pesticides and pharmaceuticals. These chemical parameters are crucial for determining the water's ability to support life, as they can directly affect the health of aquatic organisms and the quality of water for human use. For instance, high levels of nutrients can lead to eutrophication, resulting in harmful algal blooms that deplete oxygen in the water and create dead zones where aquatic life cannot survive.

Biological characteristics refer to the presence and abundance of living organisms in the water, including bacteria, phytoplankton, zooplankton, and fish populations. The diversity and health of these biological communities can serve as indicators of water quality, as certain species are more sensitive to pollution and environmental changes than others. Monitoring these biological indicators can provide valuable insights into the overall health of the aquatic ecosystem.

There exists a complex correlation among these physical, chemical, and biological parameters. Changes in one aspect of water quality can have cascading effects on the others. For example, an increase in temperature can affect dissolved oxygen levels, which in turn can impact the survival of fish and other aquatic organisms. Understanding these interrelationships is crucial for effective water quality management and conservation efforts.

Identifying the significant parameters that influence water quality is essential for assessing the health of aquatic ecosystems and ensuring the sustainability of water resources. By focusing on key indicators, researchers and environmental managers can develop targeted strategies for monitoring and improving water quality. This can involve implementing pollution control measures, restoring natural habitats, and promoting sustainable land use practices. Ultimately, maintaining high water quality is vital not only for the health of ecosystems but also for human health, economic activities, and the overall well-being of communities that rely on these water resources.

The increase in human population, industrial activities, the application of fertilizers in agriculture, and various anthropogenic actions have led to significant pollution of natural aquatic resources. This pollution adversely affects water quality and contributes to the depletion of aquatic biodiversity. Consequently, it is essential to regularly monitor the quality of drinking water, as the consumption of contaminated water can result in a range of waterborne diseases affecting the human population. A comprehensive understanding of biological phenomena is challenging, as the chemical composition of water provides critical insights into the ecosystem's metabolism and elucidates the general hydro-biological relationships. The physico-chemical parameters of water and their influence on all life processes underscore the necessity of considering these factors in environmental assessments.

The current study focuses on the analysis of water quality concerning the physicochemical parameters of a freshwater pond located in Hajipur, Vaishali. This pond is situated in the Bazar Samiti area of Hajipur. The water from this pond is primarily utilized for domestic purposes, agricultural activities, and fisheries. In India, numerous researchers have previously conducted studies on the physicochemical and biological characteristics of both standing and flowing water resources[1-3].

II. MATERIAL AND METHODS

Water samples from the pond were systematically collected from four distinct stations during the morning hours, specifically between 9:00 AM and 11:00 AM, using polythene bottles on a monthly basis. Upon collection, the samples were promptly transported to the laboratory for the assessment of various physicochemical parameters. At the time of sample collection, measurements for water temperature, transparency, and pH were recorded using a thermometer and a pocket digital pH meter. Transparency was determined with a Secchi disc. Other parameters, including dissolved oxygen (DO), total dissolved solids (TDS), free carbon dioxide (CO_2), hardness, chlorides, alkalinity, phosphate, and nitrate, were analyzed in the laboratory utilizing standard methods as outlined by APHA, AWWA[4], Trivedy and Goel[2], and Kodarkar[3].

III. RESULTS AND DISCUSSION

The Monthly Variation in Physico-chemical Parameters is presented in Table.

Table 1: Physical parameters of Fresh Water Pond Hajipur, Vaishali

Month	Temperature ^{0}C	Transparency cm	Turbidity NTU	TDS gm/lit	pH
Jan	22	11	9.45	0.35	8.2
Feb	24	9.5	11.40	0.37	8.2
Mar	25.5	8.75	11.2	0.3	8.4
Apr	25.5	7	8.2	0.1	8.1
May	26	6.0	7.2	0.5	8.0
Jun	26.5	9.5	10.6	2.1	8.0
Jul	24.5	55.75	1.0	1.12	8.2
Aug	24.5	60.75	2.1	0.2	8.3
Sept	24.5	57.5	2.1	0.3	7.5
Oct	24	91.0	0.3	0.4	7.6
Nov	23	81.5	1.3	1.7	8.0
Dec	21.5	66.25	1.7	0.4	8.3

Biostatistical Analysis of Physical Parameters of Fresh Water Pond Located at Hajipur, Vaishali

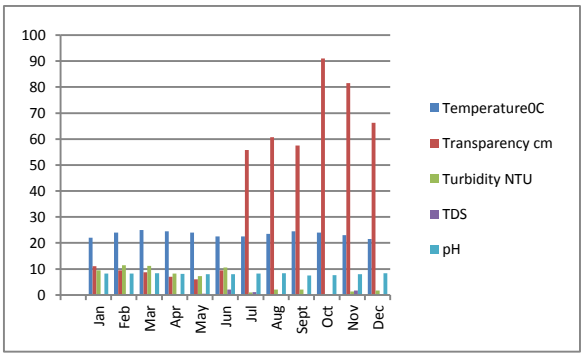
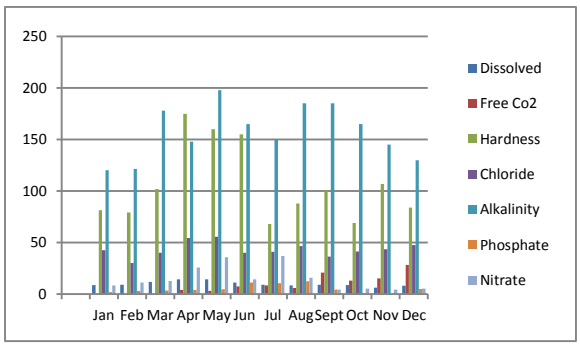


Table 2: Chemical parameters of Fresh Water Pond Located at Hajipur, Vaishali

Months	Dissolved oxygen	Free Co_2	Hardness	Chloride	Alkalinity	Phosphate	Nitrate
Jan	8.80	-	81.5	42.46	120.2	1.87	8.41
Feb	9.02	-	79.2	30.06	121.5	3.25	11.25
Mar	11.95	-	102	40.0	178	3.35	12.7
Apr	14.2	4.2	175	54.35	148	4.10	25.8
May	14.5	3.2	160	55.60	198	4.7	35.7
Jun	11.19	7.4	155	40.15	165	11.10	14.2
Jul	9.01	8.5	68	41.02	150	10.65	36.9
Aug	8.55	5.9	88	46.50	185	12.35	15.85
Sept	9.05	21	101	36.30	185	4.45	4.55
Oct	8.72	13.1	69	41.4	165	0.11	5.30
Nov	6.20	15.2	107	43.5	145	0.18	4.35

Dec	8.15	28.4	84	47.5	130	5.11	5.20

Biostatistical Analysis of Chemical Parameters of Fresh Water Pond Located at Hajipur, Vaishali



Water Temperature – In the current investigation, water temperature ranges were observed between 21.5°C and 26.5°C. The highest temperature of 26.5°C was recorded in June, during the summer months, while the lowest temperature of 21.5°C was noted in December, corresponding to winter. This indicates a trend of elevated temperatures in summer and comparatively lower temperatures in winter. Similar findings were reported by Jayabhaye et al. [5] and Salve and Hiware [6], who noted that elevated water temperatures during summer can be attributed to reduced water levels, increased ambient temperatures, and clear atmospheric conditions. Water temperature is a crucial factor that significantly affects the chemical, biochemical, and biological properties of aquatic environments.

Water transparency- The transparency of water varies between 6.0 cm and 91.0 cm. The highest level of transparency, recorded at 91.0 cm, was observed in October, which is a winter month, while the lowest level, at 6.0 cm, occurred in May during the summer season. Khan and Chowdhury[7] noted that increased transparency is typically seen in both winter and summer, attributed to the lack of rainfall, runoff, and floodwaters, along with the gradual settling of suspended particles. Similarly, Kadam et al.[8] reported comparable findings from the Masoli reservoir in the Parbhani district of Maharashtra.

Turbidity- The turbidity levels of the water range from 0.3 NTU to 11.40 NTU. The highest recorded turbidity, at 11.40 NTU, occurred in February, which is during the summer season. This increase may be attributed to human activities, a reduction in water levels, and the presence of suspended particulate matter. Conversely, the lowest turbidity value of 0.3 NTU was observed in October.

Total dissolved solids- The concentration of total dissolved solids varies between 0.1 g/l and 2.1 g/l, with the highest measurement of 2.1 g/l observed in June. This increase is attributed to significant rainfall, while the lowest concentration of 0.1 g/l was noted in April.

pH- The pH levels were found to be alkaline, ranging from 7.5 to 8.4. The highest pH value of 8.4 was observed in March (summer), while the lowest value of 7.5 occurred in September. Factors such as air temperature can significantly affect the pH of water. The majority of biochemical and chemical reactions are dependent on pH levels. A decrease in photosynthetic activity leads to reduced assimilation of carbon dioxide and bicarbonates, which ultimately contributes to an increase in pH. Additionally, low oxygen levels were noted to coincide with elevated temperatures during the summer months.

Dissolved Oxygen- The dissolved oxygen (DO) levels range from 6.20 mg/l to 14.5 mg/l. The peak value of 14.5 mg/l was observed in May, which is a summer month, while the lowest value of 6.20 mg/l was noted in November, a winter month. The elevated DO levels in summer can be attributed to higher temperatures and extended periods of sunlight, which affect the concentration of soluble gases such as oxygen and carbon dioxide. The prolonged daylight and strong sunlight during the summer months likely enhance the photosynthetic activity of phytoplankton, which consume carbon dioxide and release oxygen. This phenomenon may explain the increased oxygen levels recorded in summer, whereas the levels are somewhat reduced during the winter, as indicated by [10].

Free Carbon dioxide- The concentration of free CO_2 varies between 0.0 mg/l and 28.4 mg/l. The peak concentration of 28.4 mg/l was observed in December, during the winter season, while the lowest concentration of 0.0 mg/l was noted from January to March. This variation may be influenced by the alkalinity and hardness of the water body. The elevated CO_2 levels in December may be associated with the increased rate of decomposition occurring in the warmer months.

Hardness – The hardness levels range from 68 mg/l to 175 mg/l, with the peak value of 175 mg/l observed in April, which is a summer month, while the lowest value of 68 mg/l was noted in July.

Hujare [11] indicated that total hardness tends to be greater in summer compared to the monsoon and winter seasons. The elevated hardness levels during summer can be explained by a reduction in water volume and an increase in the evaporation rate. Comparable findings were observed in the current study.

Chlorides- The concentration of chlorides varies between 30.06 mg/l and 55.60 mg/l. The highest concentration, recorded at 55.60 mg/l, occurred in May, which is during the summer season, while the lowest concentration of 30.06 mg/l was observed in February. This study indicates that the peak chloride levels are attained in the summer months. Comparable findings were noted by Swarnalatha and Narsing Rao [12].

Alkalinity – Total alkalinity varies between 120.5 mg/l and 198 mg/l. The highest recorded value of 198 mg/l occurred in May, during the summer months, while the lowest value of 120.2 mg/l was observed in January, which is winter. The peak alkalinity in April, also a summer month, can be attributed to an increase in bicarbonate levels in the water. Hujare [11] similarly noted that alkalinity is at its highest in summer and lowest in winter, a phenomenon linked to elevated rates of photosynthesis.

Phosphate – The concentration of phosphate varies between 0.11 mg/l and 12.35 mg/l. The peak concentration of 12.35 mg/l was observed in August, during the monsoon season, while the lowest concentration was noted in October, which corresponds to winter. The elevated phosphate levels in August can primarily be attributed to rainfall, surface water runoff, and agricultural runoff; activities related to laundry may have also played a role in increasing the inorganic phosphate levels. Comparable findings were documented by Arvindkumar [13].

Nitrates – The concentration of nitrate varies between 4.35 mg/l and 36.9 mg/l. The highest concentration, recorded at 36.9 mg/l, occurred in July during the monsoon season, while the lowest concentration of 4.35 mg/l was noted in November, which is part of the winter season.

IV. CONCLUSION

In this study, we conducted an analysis of water samples collected from a freshwater pond located in Hajipur, Vaishali. The findings indicated that several parameters exceeded the acceptable limits set by WHO standards, and the water quality index for three villages was found to be poor. Therefore, it is imperative to prioritize water quality monitoring, and the implementation of indigenous technologies should be pursued to ensure that the water is suitable for domestic and drinking purposes following appropriate treatment.

REFERENCES

[1] Pandey, A. K., Siddiqi S. Z. and Rama Rao (1993): Physico-chemical and biological characteristics of Husain sagar, an industrially polluted lake, Hyderabad. Proc. Acad. Environ. Biol. 2(2), 161-167.

[2] Trivedy, R. K. and Goel P. K. (1986): Chemical and biological methods for water pollution studies, Environmental Publication, Karad, Maharashtra.

[3] Kodarkar M. S. (1992): Methodology for water analysis, physico-chemical, Biological and Microbiological Indian Association of Aquatic Biologists Hyderbad; Pub.2: pp. 50.

[4] APHA (1985): Standard Methods For Examination of Water and Wastewater, 20th Edition, American Public Health Association, Washington D. C.

[5] Jayabhaye, U. M.; Pentewar M. S. And Hiware C. J. (2006): A Study on Physico-Chemical Parameters of a Minor Reservoir, Sawana, Hingoli District, Maharashtra.

[6] Salve, V. B. and Hiware C. J. (2008): Study on water quality of Wanparakalpa reservoir Nagpur, Near Parli Vaijnath, District Beed. Marathwada region, J. Aqua. Biol., 21(2): 113-117.

[7] Khan, M. A. G and Choudhary S. H. (1994): Physical and chemical limnology of lake Kaptai, Bangladesh. Trop. Eco. 35(1): 35-51.

[8] Kadam, M. S. Pampatwar D. V. and Mali R. P. (2007): Seasonal variations in different physico-chemical characteristics in Masoli reservoir of Parbhani district, Maharashtra, J. Aqua. Biol. 22(1): 110-112.

[9] Kamble, S. M.; Kamble A. H. and Narke S. Y.(2009): Study of physico-chemical parameters of Ruti dam, Tq. Ashti, dist. Beed, Maharashtra. J. Aqua. Biol. 24(2): 86-89.

[10] Masood Ahmed and Krishnamurthy R.(1990): Hydrobiological studies of Wohar reservoir

Aurangabad(Maharashtra state) India. J. Environ. Biol. 11(3), 335-343.

[11] Hujare, M. S. (2008): Seasonal variation of physico-chemical parameters in the perennial tank of Talsande, Maharashtra. Ecotoxicol. Environ. Monit. 18(3): 233-242.

[12] Swaranlatha, S. and A. Narsingrao. (1998): Ecological studies of Banjara lake with reference to water pollution. J. Envi. Biol. 19(2): 179-186.

[13] Arvindkumar, (1995): Some Immunological Aspects of the Fresh water Tropical Wetland of Santhal. Pargana (Bihar) India, J. Envi. Poll.2 (3): 137-141.