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

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Abstract : This research was conducted to assess the condition of the freshwater Sonchiraiya Water Pond, located in Yusufpur Dighi Khurd, Hajipur, Vaishali, Bihar. The primary focus was to investigate the effects of sewage pollution originating from adjacent drainage systems. A comprehensive analysis was performed on various physical and chemical parameters of the water, which included water temperature, transparency, turbidity, total dissolved solids, pH levels, dissolved oxygen content, free carbon dioxide, total hardness, chlorides, alkalinity, phosphates, and nitrates. This evaluation spanned a full year, from January 1, 2024, to December 31, 2024. The results indicated that all measured parameters remained within acceptable limits, suggesting that the pond is not polluted and is suitable for domestic purposes, agricultural irrigation, and aquaculture activities.

Keywords : **Freshwater Pond; Physico-Chemical Parameters, Monthly variation, Sewage, Pollution.**

I. INTRODUCTION

Water is an essential and irreplaceable component of the ecosystem, playing a fundamental role in supporting life and maintaining ecological balance. It serves as a habitat for a diverse array of organisms, influencing climate patterns and is critical for numerous biological processes. The quality of water, which is crucial for the health of both aquatic and terrestrial ecosystems, is influenced by a range of physical, chemical, and biological characteristics. These attributes not only determine the suitability of water for various life forms but also impact the overall health of the environment, highlighting the importance of protecting and preserving this vital resource.

The physical characteristics of water quality include several critical factors, such as temperature, turbidity, color, and the presence of sediment. Each of these elements plays a significant role in determining the suitability of aquatic habitats for various forms of life. For instance, temperature can affect metabolic rates in aquatic organisms, while turbidity, which refers to the cloudiness of water caused by suspended particles, can hinder the penetration of sunlight, thereby impacting the process of photosynthesis in aquatic plants. Additionally, the color of the water can indicate the presence of certain substances or organisms, which may further influence the ecosystem. The presence of sediment can also affect water quality by altering habitats and potentially smothering organisms that reside on the bottom. Collectively, these physical attributes not only determine the health and viability of aquatic ecosystems but also influence the overall aesthetic appeal and recreational potential of water bodies, making them vital considerations for environmental management and conservation efforts.

Chemical characteristics include a diverse range of substances, such as pH levels, dissolved oxygen, essential nutrients (including nitrogen and phosphorus), heavy metals, and pollutants like pesticides and pharmaceuticals. These chemical factors are vital for assessing the water's capacity to sustain life, as they can significantly influence the well-being of aquatic organisms and the suitability of water for human consumption. For example, elevated nutrient levels can trigger eutrophication, which may cause harmful algal blooms that reduce oxygen levels in the water, leading to the formation of dead zones where aquatic life cannot thrive.

A complex relationship exists among these physical and chemical parameters. Alterations in one water quality aspect can lead to a series of effects on others. For instance, a rise in temperature may influence dissolved oxygen concentrations, subsequently affecting the survival of fish and other aquatic life. Grasping these interconnections is essential for successful water quality management and conservation initiatives.

Recognizing the critical factors that affect water quality is crucial for evaluating the condition of aquatic ecosystems and safeguarding the sustainability of water resources. By concentrating on essential indicators, researchers and environmental managers can formulate specific strategies for monitoring and enhancing water quality. This may include the introduction of pollution control initiatives, the restoration of natural habitats, and the encouragement of sustainable land use practices. Ultimately, preserving high water quality is essential not only for the health of ecosystems but also for human well-being, economic activities, and the overall welfare of communities dependent on these water resources.

The growth of the human population, coupled with industrial activities, the use of fertilizers in agriculture, and various human-induced actions, has resulted in considerable pollution of natural water resources. This contamination negatively impacts water quality and contributes to the decline of aquatic biodiversity. Therefore, it is crucial to consistently monitor drinking water quality, as the ingestion of polluted water can lead to numerous waterborne diseases affecting human health. Gaining a thorough understanding of biological processes is complex, as the chemical makeup of water offers vital insights into the metabolism of ecosystems and clarifies the overarching hydro-biological interactions. The physico-chemical characteristics of water and their effects on all life processes highlight the importance of incorporating these elements into environmental evaluations.

This study examines the water quality by analyzing the physicochemical parameters of a freshwater pond located at Yusufpur Dighikhurd in Hajipur, Vaishali,. The water from this pond is mainly used for domestic needs, agricultural practices, and fisheries. In India, various researchers have previously investigated the physicochemical and biological properties of both stagnant and flowing water bodies.

II. Material & Methods

Water samples were methodically collected from four distinct locations within the pond during the morning hours, specifically between 9:00 AM and 11:00 AM, utilizing polythene bottles on a monthly basis. After collection, these samples were promptly transported to the laboratory for the assessment of various physicochemical parameters. During the sampling procedure, measurements of water temperature, transparency, and pH were conducted using a thermometer and a portable digital pH meter. Transparency was evaluated with the aid of a Secchi disc. In the laboratory, additional parameters including dissolved oxygen (DO), total dissolved solids (TDS), free carbon dioxide (CO2), hardness, chlorides, alkalinity, phosphate, and nitrate were analyzed using standard methodologies as outlined by the American Public Health Association (APHA), the American Water Works Association (AWWA), Trivedy and Goel, and Kodarkar.

III. Results and Discussion

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

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

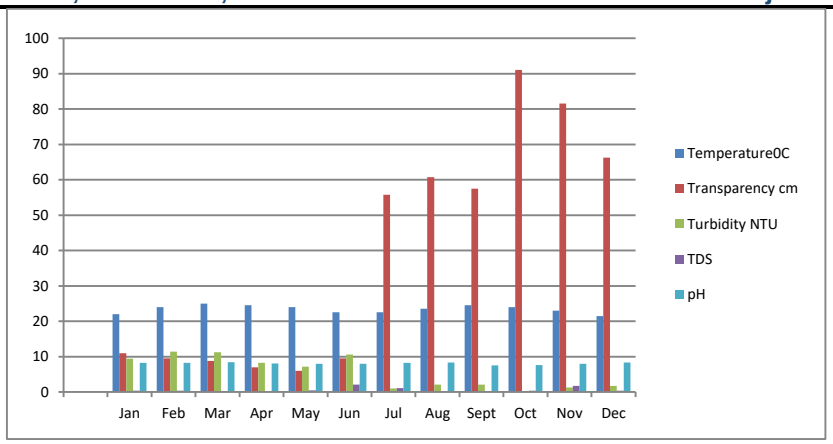
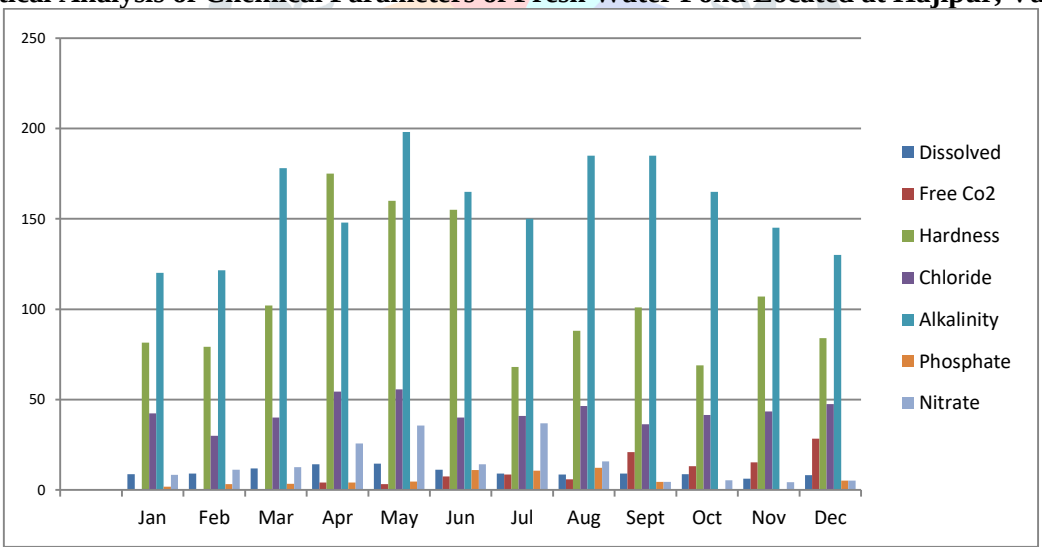


Table 2: Chemical parameters of Fresh Water Pond Located at Hajipur, Vaishali

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

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



Water Temperature – In the present study, water temperatures were recorded within a range of 21.5°C to 26.5°C. The peak temperature of 26.5°C occurred in June, aligning with the summer season, while the minimum temperature of 21.5°C was observed in December, which corresponds to winter. This pattern suggests higher temperatures during the summer months and lower temperatures in winter. Similar observations were made by Jayabhaye et al. and Salve and Hiware , who indicated that the rise in water temperatures during summer can be linked to decreased water levels, higher ambient temperatures, and clear skies. Water temperature plays a vital role in influencing the chemical, biochemical, and biological characteristics of aquatic ecosystems.

Water transparency- The transparency of water ranges from 6.0 cm to 91.0 cm. The peak transparency level of 91.0 cm was recorded in October, a winter month, while the minimum level of 6.0 cm was noted in May, which falls within the summer season. Khan and Chowdhury observed that higher transparency levels are generally found in both winter and summer, which can be attributed to reduced rainfall, limited runoff, and the absence of floodwaters, as well

as the gradual settling of suspended particles. Likewise, Kadam et al. reported similar observations from the Masoli reservoir located in the Parbhani district of Maharashtra.

Turbidity- The turbidity of the water varies between 0.3 NTU and 11.40 NTU. The peak turbidity level of 11.40 NTU was noted in February, coinciding with the summer season. This rise in turbidity could be linked to human activities, decreased water levels, and the accumulation of suspended particles. In contrast, the minimum turbidity measurement of 0.3 NTU was recorded in October.

Total dissolved solids- The total dissolved solids concentration ranges from 0.1 g/l to 2.1 g/l, with the peak level of 2.1 g/l recorded in June. This rise is linked to substantial rainfall, whereas the minimum concentration of 0.1 g/l was observed in April.

pH- The pH levels were determined to be alkaline, varying between 7.5 and 8.4. The peak pH value of 8.4 was recorded in March (summer), whereas the minimum value of 7.5 was noted in September. Various factors, including air temperature, can have a significant impact on water pH. Most biochemical and chemical processes are influenced by pH levels. A decline in photosynthetic activity results in a lower uptake of carbon dioxide and bicarbonates, which ultimately leads to an increase in pH. Furthermore, low oxygen levels were observed to correspond with higher temperatures during the summer months.

Dissolved Oxygen- Dissolved oxygen (DO) levels vary between 6.20 mg/l and 14.5 mg/l. The highest concentration of 14.5 mg/l was recorded in May, a summer month, while the lowest level of 6.20 mg/l was observed in November, a winter month. The higher DO levels during the summer can be linked to increased temperatures and longer daylight hours, which influence the concentration of soluble gases, including oxygen and carbon dioxide. The extended sunlight and intense light during summer likely boost the photosynthetic processes of phytoplankton, which absorb carbon dioxide and produce oxygen. This process may account for the elevated oxygen levels seen in summer, whereas winter months tend to show a decrease in these levels, as noted in reference.

Free Carbon dioxide- The levels of free CO_2 fluctuate between 0.0 mg/l and 28.4 mg/l. The highest recorded concentration of 28.4 mg/l occurred in December, coinciding with the winter season, whereas the minimum concentration of 0.0 mg/l was recorded from January to March. This fluctuation could be affected by the water body's alkalinity and hardness. The increased CO_2 levels in December may be linked to a higher rate of decomposition that takes place during the warmer months.

Hardness – Hardness levels vary between 68 mg/l and 175 mg/l, with the highest measurement of 175 mg/l recorded in April, a summer month, and the lowest at 68 mg/l in July. Hujare noted that total hardness is generally higher in summer than during the monsoon and winter seasons. This increase in hardness during the summer can be attributed to a decrease in water volume and a rise in evaporation rates. Similar results were found in the present study.

Chlorides- The levels of chlorides range from 30.06 mg/l to 55.60 mg/l. The maximum concentration of 55.60 mg/l was observed in May, coinciding with the summer season, whereas the minimum concentration of 30.06 mg/l was recorded in February. This research suggests that the highest chloride concentrations occur during the summer months. Similar results were reported by Swarnalatha and Narsing Rao.

Alkalinity – Total alkalinity ranges from 120.5 mg/l to 198 mg/l. The maximum recorded level of 198 mg/l was noted in May, a summer month, whereas the minimum level of 120.2 mg/l was recorded in January, during winter. The increase in alkalinity observed in April, another summer month, is likely due to higher bicarbonate concentrations in the water. Hujare also observed that alkalinity peaks in the summer and reaches its lowest point in winter, a trend associated with increased photosynthetic activity.

Phosphate – Phosphate concentrations in the studied area exhibit a significant range, varying from 0.11 mg/l to 12.35 mg/l. The peak concentration of 12.35 mg/l was documented in August, which aligns with the onset of the monsoon season. In contrast, the lowest concentration of phosphate, measured at 0.11 mg/l, was recorded in October, signaling the beginning of winter. The elevated phosphate levels observed in August can be attributed to several factors,

including increased rainfall, surface water runoff, and agricultural runoff. Additionally, activities such as laundry may also play a role in elevating the levels of inorganic phosphates in the water.

Nitrates – The concentration of nitrates varies significantly, with values ranging from a low of 4.35 mg/l to a high of 36.9 mg/l. Notably, the highest concentration of 36.9 mg/l was recorded in July, a period that aligns with the onset of the monsoon season. In contrast, the lowest concentration of 4.35 mg/l was observed in November, which corresponds to the winter season. This fluctuation in nitrate levels suggests a potential correlation between seasonal changes and nitrate concentration in the environment.

IV. CONCLUSION

In this study, we conducted a comprehensive analysis of water samples collected from a freshwater pond located in Yusufpur Dighikhurd, Hajipur, Vaishali. The findings indicated that several water quality parameters exceeded the acceptable limits set by the World Health Organization (WHO) standards. This situation led to a concerning assessment of water quality, particularly affecting three nearby villages. As a result, it is imperative to prioritize the ongoing monitoring of water quality in this region. Furthermore, the implementation of local technologies should be actively pursued to ensure that the water is treated adequately, making it safe for both domestic and drinking purposes.

REFERENCES

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

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

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

[4] 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.

[5] 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.

[6] 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.

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

[9] Masood Ahmed and Krishnamurthy R.(1990): Hydrobiological studies of Wohar reservoir Aurangabad(Maharashtra state) India. J. Environ. Biol. 11(3), 335-343.

[10] 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.

[11] 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.

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