The Biobrio
ISSN : 2393-9508
e-ISSN: 2582-4902
An International Quarterly Journal of Life Sciences
Website: www.thebiobrio.in SJIF 2023:8.16

10 (3&4): 1017-1022, 2023

Assessment of physico-chemical parameters of wetland of Gopalganj in relation to agricultural productivity

Rajesh Kumar Sharma, A.K. Jha, Aleya Siddiquee & Md. Sarfaraz Ahmad
University Department of Botany, Jai Prakash University, Chapra, Bihar, India.

Received : 11th July, 2023 ; Accepted : 12th August, 2023

ABSTRACT

Bihar is home to several floodplains and small rivers. Due to recent fast population increase, agricultural effluents comprising fertilisers and pesticides as well as home and industrial waste have polluted water bodies. The temperature, pH, Electrical conductivity, Dissolved oxygen (DO), Total hardness, Alkalinity, COD, TDS, Nitrate, Sulphate, Nitrite and Phosphate were among the characteristics used to assess the quality of the sample. The temperature value after the physico-chemical test was determined to be 25°C. The measured pH value was 7.34 (site 1) 6.8 (site 2) and 6.9 (site 3). The sample's TDS (mg/L) value was 478 (site 1), 391 (site 2) and 408 (site 3) mg/L when it was tested. The sample's electrical conductivity was calculated, and the result was an EC (µS/cm) value of 807 (site 1), 787 (site 2) and 813 (site 3). A test for total hardness was run, and the result showed that the sample's total hardness value was 597 (site 1), 408 (site 2) and 503(site 3) mg/L. A measurement of the sample's chloride concentration yielded a result of 90(site 1), 87(site 2) and 74 (site 3) mg/L. The sample's alkalinity was measured using an alkalinity test, and the result was 287 (site 1), 263 (site 2) and 275 (site 3) mg/L. The amount of dissolved oxygen (DO) was calculated to be 4.2 mg/L. The sample underwent a COD test, and the result showed that the COD level was 110 (site 1), 97 (site 2) and 105 (site 3) mg/L. Nitrate ion concentration was tested, and the result was 0.53 (site 1), 0.63 (site 2) and 0.59 (site 3) mg/L. The amount of phosphate ion concentration was calculated to be 1.13 (site 1), 1.11 (site 2) and 1.07 (site 3) mg/L. The amount of Sulphate ion in the sample was calculated to be 1.54 (site 1), 1.33 (site 2) and 1.41 (site 3) mg/L. Nitrite ion concentration was tested, and the result was 0.78 (site 1), 0.64 (site 2) and 0.71 (site 3) mg/L.

Key Words - Wetland, Physico-chemical, Alkalinity, Agricultural production, COD.

***Corresponding author :** rajeshkumarsharma88@gmail.com

INTRODUCTION

Throughout the course of human history, marshes have been reclaimed for agricultural use in a number of different locations of the globe by means of ever-improving drainage and land-improvement processes. According to Hassan *et al*., (2005) natural wetland ecosystems that have been reclaimed in this way have, for the most part, lost their original features. This has resulted in a reduction in biodiversity as well as a loss in the provision of functions that are not related to agricultural productivity. It is a fact that large wetland areas have been lost owing to drainage and development for the world's freshwater wetlands, despite the fact that quantitative figures are only accessible for a select number of places. According to an Assessment in 2005, more than half of the peatlands, depressional wetlands, riparian zones, lake littoral zones, and floodplains that formerly existed in North America, Europe, and Australia have been converted to heavy agricultural use. This is the primary reason for the loss of these ecosystems.

Any wetland's capacity to sustain the development of autotrophic organisms like algae and macrophytes is a major determinant of its biological production (Kumari and Kumar, 2002). The ecology becomes out of balance when there is a shortage or surplus of certain nutrients. In both natural and artificial ecosystems, high rates of production take place when physico-chemical conditions are favourable. The ability to use natural wetland resources for any purpose depends on biological production (Bohra and Kumar, 2002).

According to Soja and Wiejaczka (2014), the physicochemical characteristics of water can affect the growth of biological life forms in water and consequently influence the quality of water. This category includes both chemical parameters such as Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Total Hardness (TH), Total Dissolved Solid (TDS) as well as physical variables such as temperature, electrical conductivity, *etc*.

Restoration calls for the replication of previous physical conditions, alterations to soil and water chemistry, and biological intervention (Zedler, 1996). In present study we will assess the physio-chemical analysis of Shatiya Wetland of Gopalganj in relation to agricultural productivity.

METHODS

Study area

Gopalganj is one of the districts of Bihar, India. In the district of Gopalganj, there are 14 Taluks, 1534 villages, and 5 towns. Gopalganj district contains 413044 houses and 2562012 people, of whom 1267666 are men and 1294346 are women, according to the Census of India 2011. Children under the age of six make up 449530 people, or 17.55% of the total population. Gopalganj district has a sex ratio of about 1021, which is higher than the average for Bihar state (918). Gopalganj district has a literacy rate of 53.98%, with 62.63% of men and 45.51% of women being literate. Gopalganj has a total area of 2033 square kilometres and a population density of 1260 inhabitants per square kilometre; out of the total population, 6.35% live in urban areas and 93.65% live in rural areas.

Sample collection

Samples of the water were taken from three locations (site 1, site 2 and site 3) from Shatiya wetland in Gopalganj. The samples were collected directly in polyethylene cans of 2L capacity at a depth of 30 cm below the water's surface between the hours of 7 and 9 in the morning. The temperature of water, measured in Celsius, and its clarity was recorded. At each location, measurements of several physico-chemical parameters, including dissolved oxygen, pH, free carbon dioxide, carbonate, and bicarbonate were taken. In the laboratory, measurements were taken of the other parameters, including biochemical oxygen demand (BOD), conductivity, calcium, magnesium, chloride, nitrate-nitrogen, phosphate-phosphorus, and chloride.

Physico-chemical analysis

Immediately after the sample, measurements were taken to determine the temperature, pH, electrical conductivity, and do. A number of different physicochemical parameters, such as DO, Total hardness, alkalinity, COD, TDS, Nitrate, Sulphate, Nitrite, and Phosphate, were measured in accordance with the standard procedures outlined in APHA (1998).

RESULTS

Numerous physicochemical characteristics of the samples that were obtained were investigated and examined. Using a digital water analyser kit, on-site measurements of several physical parameters, including pH and temperature, were made. A tool known as a conductivity metre can be used to test electrical conductivity. Using the evaporation method, the Total Dissolved Solids (TDS) were estimated. The Winkler method was used to calculate the Dissolved Oxygen (DO) mg/L. Titration was used to determine alkalinity. Many other parameters were used to identify the water quality. The values of investigated physicochemical parameters are shown in table 1.

Table 1. Physico-chemical characterization of Shatiya Wetland of Gopalganj

Sl.No.	Parameters	Recorded value		
		Site 1	Site 2	Site 3
1	Temperature (°C)	25	22	23
2	Ph	7.34	6.8	6.9
3	TDS (mg/L)	478	391	408
4	EC (µS/cm)	807	787	813
5	Total Hardness (mg/L)	597	408	503
6	Chloride (mg/L)	90	87	74
7	Alkalinity (mg/L)	287	263	275
8	DO (mg/L)	4.2	3.9	4.5
9	COD (mg/L)	110	97	105
10	Nitrate (mg/L)	0.53	0.63	0.59
11	Phosphate (mg/L)	1.13	1.11	1.07
12	Sulphate (mg/L)	1.54	1.33	1.41
13	Nitrite (mg/L)	0.78	0.64	0.71
14	Salinity (ppt)	0.4	0.4	0.31
15	Turbidity (NTU)	11	10	9
16	Organic matter content (%)	2.7	2.5	2.5

According to Ramachandra and Solankin's research (2007), temperature affects the behavioral features of organisms, as well as the solubility of gases, pH, and conductivity of water. It has an equivalent impact on the dissolved oxygen content in the water, the rate of photosynthesis in aquatic plants, and the metabolic rates of aquatic creatures. According to Jayaraman *et al*., (2007), the fluctuation in temperature may be linked to the varying times of collection as well as the impact of the seasons. The weather conditions, such as rainfall and solar radiation, are the primary climatic factors that have an effect on the majority of the physicochemical characteristics of water bodies, including temperature. In most cases, the weather conditions determine the temperature of the water. TDS of the sample was measured to be 478 mg/L The Total Dissociation Potential (TDS) of groundwater often represents the salinity behaviour of the water or the sum of the cations and anions in the water.

Table 2: Water Quality Parameters Standards

Parameters	WHO	Bureau of Indian Standards (BIS)
Temperature	28-31	-
pH	6.5-8.5	6.5-8.5
EC (µS)	1000	1500
TDS (mg/l)	500	500
Salinity (ppt)	-	-
Total Hardness (mg/l)	500	300-600
Turbidity (NTU)	5	5-10
DO (mg/l)	4-6	-
COD (mg/l)	10	-
BOD (mg/l)	6	30
Alkalinity (mg/l)	150	200
Chloride (mg/l)	250	250
Nitrates (mg/l)	45-50	45
Phosphates (mg/l)	5	-
Sulphates (mg/l)	250	200-400
Sodium (ppm)	200	180
Potassium (ppm)	200	-
Magnesium (ppm)	30	30
Calcium (ppm)	75	-
Iron (mg/l)	0.3	0.5
Nickel (mg/l)	0.02	-

According to Mitharwal *et al*., (2009), it typically imparts a flavour to the water. According to WHO (2011), the presence of turbidity in water is due to the presence of suspended particles or colloidal matter that prevents light from passing through the water. According to Abolude (2007), high turbidity readings in groundwater may be a sign that the wells may not be lined appropriately. pH value was obtained as 7.34 in the given sample. According to Rao (2006), the pH of water is closely related to all of the chemical and biological interactions that take place in water. In the course of the research, the pH varied anywhere from 4.18 to 7.2. The electrical conductivity (EC) of the sample was determined to be 807 (µS/cm), this parameter of the water is an essential water quality measure for determining the presence of salt problems. It's possible that the discrepancies in EC levels are caused by the underlying geology of the research region. In this geology, different chemical species interact with different anions and cations in aquifers, which in turn affects the water quality of the area.

When there is a high percentage of chloride in the water, this suggests that there is a significant level of sewage and organic contamination. According to Singh *et al*. (2012)'s findings, there have been no documented cases of drinking water with high levels of chloride causing detrimental effects on human health. However, if the amount of chloride in drinking water is too high (over 200 mg/l), the water will have a salty flavor, and when it interacts with calcium and magnesium salts, the corrosivity of the water may rise (Tatawat and Singh, 2007).

According to Foster *et al*., (2002), urban and industrial wastewater, such as leachates from dumpsites, sludge disposal, and sanitary landfills, contribute to a rise in the naturally occurring number of nitrates in groundwater. Methemoglobinemia, also known as blue baby illness, is a condition that affects newborns and is caused when the body's normal process of converting nitrate to nitrite results in an excess of methenoglobin. This condition reduces the capacity of the blood to transport oxygen throughout the body and may be deadly, particularly in young children (Chapman, 1996).

Concentration of phosphate ion was measured and the value of phosphate ion was 1.13 mg/L. According to Abolude (2007), levels of PO4 3- even at 0.1 mg/l in water might have detrimental impacts on water quality, and such traces could stimulate the proliferation of algae in the water. This research was published in the journal Environmental Science and Technology. Unless they are present in very high concentrations, phosphates do not pose a health risk to either humans or animals. According to Singh *et al*., (2012), the quantity of calcium and magnesium salts in water is the primary factor that determines how hard the water is. Hard water limits the production of lather. According to Mitharwal *et al*., (2009), it is one of the most significant parameters to consider when assessing whether or not water may be used for a variety of purposes.

One of the most significant indicators of the quality of water is dissolved oxygen. It was measured and the value was 4.2 mg/L Underground water may have a lower concentration of dissolved oxygen (DO) due to the movement and transport of untreated sewage flows, leachates, and other potential sources of pollution. On the other hand, according to Guner (2010), temperatures that are above normal might cause a drop in DO.

DISCUSSION

A physico-chemical analysis was done to evaluate the wetland's suitability for agricultural productivity. Temperature, pH, electrical conductivity, DO, total hardness, alkalinity, COD, TDS, nitrate, sulphate, nitrite, and phosphate were a few of the variables used to evaluate the sample's quality. After the physico-chemical test for temperature, the temperature value was obtained as 25°C. pH value was obtained as 7.34. TDS was measured for the sample and TDS value was 478 mg/L. Electrical conductivity for the sample was determined, and EC value was 807. Total hardness test was performed and value of total hardness for the sample was 597 mg/L. Chloride content for the sample was measured, and the value of chloride content was 90 mg/L. Alkalinity test was performed to obtain the alkalinity value for the sample and the value was 287 mg/L. Dissolved oxygen (DO) was measured and the value of DO was 4.2 mg/L. COD test was performed for the sample and the value of COD was 110 mg/L.

Concentration of Nitrate ion was measured and the value of Nitrate ion was 0.53 mg/L. Concentration of Phosphate ion was measured and the value of Phosphate ion was 1.13 mg/L. Concentration of Sulphate ion was measured and the value of sulphate ion was 1.54 mg/L. Concentration of Nitrite ion was measured and the value of Nitrite ion was 0.78mg/L.

Certainly, Bihar is home to various wetlands, each with its unique characteristics, ecological significance, and relevance to agricultural productivity. Some prominent regions in Bihar and their associated wetlands are Kosi Floodplain, Champaran Wetlands, Ganga Floodplain, Barhara Lake, Bhojpur Wetlands. Kosi Floodplain region is known for its extensive floodplains along the Kosi River. These floodplains provide fertile alluvial soils and water during the monsoon season, making them suitable for rice cultivation. Champaran Wetlands in the Champaran region, there are several wetlands and low-lying areas that play a crucial role in rice cultivation. The Gandak River and its associated wetlands are significant in this context. Ganga Floodplain in the central region of Bihar, particularly areas along the Ganges River, features fertile floodplains. These wetlands are essential for various crops, including rice, wheat, and sugarcane.

Barhara Lake located in Bhojpur district is a significant wetland. It not only supports agricultural activities but also serves as a habitat for various bird species. Anga Reservoirs in the Anga region, comprising Bhagalpur and neighbouring districts, has several reservoirs and wetlands. These water bodies support agriculture, especially horticultural crops like mangoes. Apart from the Kosi Floodplain in the north, the Kosi River basin extends into eastern Bihar. This region's wetlands are significant for rice cultivation, but they also face the challenge of periodic flooding. Similarly, Bhojpur wetlands farmers rely on these water bodies for cropping patterns. Many of these wetlands in Bihar face environmental challenges, including pollution, encroachment, and siltation. Conservation efforts are essential to maintain their ecological health and support sustainable agriculture. Wetland management practices, such as the construction of check dams, silt control structures, and community-based water resource management, can help improve agricultural productivity. Government agencies and non-governmental organizations (NGOs) often work together to promote sustainable agriculture and wetland conservation in Bihar. It's important to note that the specific wetlands and their relevance to agricultural productivity may vary within these regions. Local conditions, crops, and land use practices play a significant role in determining the importance of wetlands for agriculture in each area.

CONCLUSION

The productivity of the soil is an important environmental component for the growth of agriculture. Physico-chemical analysis method is being pursued to fulfil the escalating requirements of a rapidly expanding population. A physico-chemical analysis was done to evaluate the wetland's suitability for agricultural productivity. Temperature, pH, Electrical Conductivity, DO, Total Hardness, Alkalinity, COD, TDS, nitrate, sulphate, nitrite, and phosphate were a few of the variables used to evaluate the sample's quality. Thus, further research may be needed to evaluate the parameters in more concise form to produce agricultural products.

CONFLICT OF INTEREST

There is no conflict of interest regarding the publication.

ACKNOWLEDGEMENTS

The authors would like to extend his gratitude to Department of Botany and research scholars of the department for their provision of laboratory facilities and support throughout the study process.

REFERENCES

Abolude D. S. 2007. Water quality and metal concentrations in sediments and fish from Ahmadu Bello University. Reservoir, Zaria using Neutron Activation Analysis and Atomic Absorption Spectrophotometry. An unpublished Ph.D. thesis submitted to Postgraduate School, Ahmadu Bello University, Zaria.

APHA 1998. Standard methods for the examination of water and waste watershed. Washington, USA.

Assessment M.E. 2005. *Ecosystems and human well-being* (Vol. 5, p. 563). Island Press, Washington, DC.

Bohra C. and Kumar A. 2002. Primary productivity of sewage fed aquatic ecosystem. *Ecology and Ethonology of Aquatic Biota. (Ed. A. Kumar) Daya Publishing House, Delhi*, 373-392.

Chapman D. 1996. Water Quality Assessments: A Guide to the Use of Biota, Sediments and Water in Environmental Monitoring. London, UK. Chapman and Hall.

Foster, S. Gardino, H. Kempa, K. Turnhof, A. Marcella, N. and Dumars, C. 2002. Groundwater Quality Protection defining strategy and setting priorities. Sustainable groundwater management, concept tools. Briefing note series: The world Bank global water partnership association program, page 3-38.

Guner U. 2010. Bioaccumulation of some heavy metals in freshwater crayfish. *Pollution Science, Technology and Abatement, Impact, Monitoring and Management of Environmental Pollution*. ISBN: 978-1-60876-449-58.

Hassan R. 2005. *Ecosystems and human well-being*. Washington.

Jayaraman P. R., Ganga D. T., and Vasudena, N. 2003. Water quality studies on Karamana River, Thiruvananthapuram District South Kerela, India. *Pollution Research,* 22(I): 89-100.

Kumari P. and Kumar A. 2002. Periodicity and Biomass Potentials of Macrophytes on polluted aquatic environment of Jharkhand. *Ecology of Polluted Waters*. 45-52.

Mitharwal S., Yadav R., and Angasaria R. 2009. Water Quality analysis in Pilani of Jhunjhunu District, Rajasthan. *Rasayan Journal of Chemistry.* 2(4): 920-923.

Rao N. S. 2006. Seasonal variation of groundwater quality in a part of Guntur District, Andhra Pradesh, India. *Environmental Geology,* 49: 413-429.

Singh M., Jha D., and Jadoun J. 2012. Assessment of Physico-chemical status of Groundwater Samples of Dholpur District, Rajasthan, India. *International Journal of Chemistry*. 4(4): 96-104.

Soja R. and Wiejaczka L. 2014. The impact of a reservoir on the physicochemical properties of water in a mountain river. *Water and Environment Journal*. 28(4): 473-482.

Tatawat R. and Singh C. 2007. Quality of Groundwater of Jaipur City, Rajasthan (India) and its Suitability for Domestic and Irrigation Purpose. *Applied Ecology and Environmental Research*. 6(2): 79-88.

Verhoeven J. T. and Setter T. L. 2010. Agricultural use of wetlands: opportunities and limitations. *Annals of Botany*. 105 (1): 155-163.

World Health Organization. 2011. Guidelines for drinking water quality. WHO, Geneva.

Zedler J. B. 2005. Restoring wetland plant diversity: a comparison of existing and adaptive approaches. *Wetlands Ecology and Management*, 13: 5-14.