

VOLUME 9

ISSUE 1

2023

ISSN 2454 – 3055



**INTERNATIONAL
JOURNAL OF
ZOOLOGICAL
INVESTIGATIONS**

*Forum for Biological and
Environmental Sciences*

Published by Saran Publications, India



International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India



ISSN: 2454-3055

Studies on Some Physico-Chemical Characteristics of Sediments of Bhagda Taal (Balrampur, Uttar Pradesh, India) in Relation to Fish Production

Singh Varsha and Prakash Sadguru*

Department of Zoology, M.L.K. P. G. College, Balrampur, U.P., India

**Corresponding Author*

Received: 20th December, 2022; **Accepted:** 24th January, 2023; **Published online:** 5th February, 2023

<https://doi.org/10.33745/ijzi.2023.v09i01.025>

Abstract: Bottom sediments form an integral part of the aquatic ecosystem, where they serve as important sinks for contaminants. However, management options for bottom sediments require an analysis of the physico-chemical properties. Therefore, the aim of the present investigation was to assess the physico-chemical properties of bottom sediments of Bhagda Taal, a wetland in order to inform their potential use in fish production. The bottom sediments were collected from three sampling sites using Ekman's dredge. The samples were analyzed for pH, electrical conductivity, organic matter content, and macronutrients content (nitrogen, phosphorous, and potassium) using standard laboratory procedures. The mean pH value of the sediments was 7.43, which was found to be slightly alkaline. The EC in the bottom sediments was found to be quite high, with a mean value of 1316.11 $\mu\text{S}/\text{cm}^{-1}$. The bottom sediments in this wetland were found to be high in the organic matter content (1.69 %). The nitrogen, potassium, and phosphorous had mean values of 26.37 mg/100g, 11.05 mg/100g, and 6.38 mg/100g, respectively. Hence, it is concluded that present wetland was highly productive in nature.

Keywords: Wetland, Bhagda Taal, Physico-chemical characteristics, Sediment, Aquatic ecosystem

Citation: Singh Varsha and Prakash Sadguru: Studies on some physico-chemical characteristics of sediments of Bhagda Taal (Balrampur, Uttar Pradesh, India) in relation to fish production. Intern. J. Zool. Invest. 9(1): 213-218, 2023.

<https://doi.org/10.33745/ijzi.2023.v09i01.025>



This is an Open Access Article licensed under a Creative Commons License: Attribution 4.0 International (CC-BY). It allows unrestricted use of articles in any medium, reproduction and distribution by providing adequate credit to the author (s) and the source of publication.

Introduction

Wetland is a generic term for various types of water bodies and includes diverse hydrological entities namely lakes, estuarine area, river flood plains to tidal mud-flats marshes, swamps, and mangroves. It play a vital role in ensuring both the quantity and quality of water for human beings and the entire range of flora and fauna. Wetlands

are crucial parts of watersheds and serve a variety of crucial roles in the environment and in society. These are the most productive ecosystem in the world, with incredible biological diversity and are regarded as one of the richest sources of biological diversity. Most wetlands have succumbed to increased levels of biologically active nutrient

deposition as a result of rapid urbanization and anthropogenic pressure (Verma and Prakash, 2018; Prakash and Verma, 2022; Singh and Prakash, 2022).

Wetlands are neither ecosystem specific nor confined to particular biodiversity hot-spots. Wetlands provide fresh water for agriculture, livestock and domestic consumption, and recharge the groundwater levels which are under immense strain of over-exploitation. Fresh water, which holds the lifeline for human beings, and for that matter for all living organisms is a rapidly shrinking resource, and is likely to be the cause of competing claims and resultant conflicts. Wetland soils are key components of wetlands and serve as long-term integrators of the impacts from contamination and nutrient loading.

The physico-chemical parameters of water are important to know the trophic nature of the water body. The productivity of a water body depends primarily on the physico-chemical and biological properties of water (Verma, 2019; Bhagde *et al.*, 2020; Verma and Prakash, 2020). These properties again depend on the nature of bottom soil and climatic conditions. So, before starting the fish culture practices in waterbody, it is necessary to study its physico-chemical properties of soil and water (Nath, 1994; Sugumaran *et al.*, 2020; Verma, 2021).

One of the most significant ecological factors is soil, which is home of species of bacteria, plants, and animals that work together to form a complex biological system. It serves as an intricate physical and biological system that gives nutrients and oxygen for the organisms (Kumari *et al.*, 2019). Particle size, distribution, kinds of clay colloids, cation and anion exchange capacity, oxidation and reduction potential, soil response, electrical conductivity, and nutrient dynamics are the main physico-chemical characteristics of soil. To provide the best nutrition availability and to avoid any unhealthy situations, a healthy and sensible reduction condition should be kept at the bottom. Soil is crucial for the health of fish populations and water bodies.

Wetland soils are key components of wetlands and serve as long-term integrators of the impacts from contamination and nutrient loading. They are enriched with organic matter that supports food webs and critical microbial processes. The basin sediments of wetland serve as the main source of productivity of this ecosystem as it releases nutrients to the water, moreover it acts as a niche for benthic floral and faunal population (Debnath and Panigrahi, 2014).

Wetlands are very much neglected. With the development of industrialization, urbanization, and population growth, the area of wetlands is decreasing and the ecological function is gradually weakening or even degenerating, which seriously threatens ecological security and regional sustainable development. Human activities threaten wetlands in several different ways. Stressors to wetlands can be chemical (e.g., toxic chemicals), physical (e.g., sedimentation), or biological (e.g., non-native species). Keeping in mind, the present study was performed to determine the nutrient status of the soil in relation to fish production of Bhagda taal, wetland of Balrampur district of Uttar Pradesh, India.

Materials and Methods

The present study was conducted for three seasons viz., pre-monsoon, monsoon and post-monsoon period of one year (April, 2021 to March, 2022) to assess the nutrient status of soil of Bhagda taal in relation to fish production. The sediments samples were collected monthly at three sampling sites of the wetland at a depth of one meter water level into a polythene container with the help of Ekman's dredge and dried to constant weight in an oven at 105° -110°C. The samples were analysed for pH, Electrical Conductivity (EC), nitrogen, phosphorous, potassium and organic matter by standard methods (Piper, 1966; Trivedy *et al.*, 1998).

Results and Discussion

Hydrogen ion concentration (pH):

pH of soil is the measure of hydrogen ion activity

and depends largely on the relative amounts of adsorbed hydrogen and metallic ions. pH of soil at a given time is a reflection of the status of biogeochemical processes because the temporal changes in pH are presumably due to change in primary production, respiration, mineralization and decomposition of organic matter in the soil (Palit and Mukherjee, 2011). The soil of the wetland was slightly alkaline in nature with average annual pH 7.43. The pH of Bhagda taal soil ranged between 7.20 to 7.79 during the study period. The maximum pH was recorded during post-monsoon season followed by pre-monsoon and monsoon (Table 1). The soil pH near neutral 6.5 to slightly alkaline 7.5 is suitable for fish culture (Prakash, 2000; Sugunan and Sinha, 2019), more than 7.5 pH was more productive and less than 6.5 pH was low productive waterbody (Sugunan and Sinha, 2019). It has been reported that a slightly alkaline soil with pH 7.5 is optimal for fish production in reservoirs (Kumari *et al.*, 2019). The pH values of the taal were around 7.43 hence, the present wetland is highly productive in nature.

Electrical Conductivity (EC):

Since ions are the carrier of electricity, the specific conductance of soil system rises according to the content of soluble salt in the soil giving rise to more ion pairs on dissociation as it happens in case of a dilute solution. Thus, the measurement of electrical conductivity can be directly related to the soluble salt concentration of the soil at any particular temperature (Debnath and Panigrahi, 2011). Electrical conductivity was associated with the release or depletion of soluble ions in the soil-water system (Das, 2000) and it play indirect role in the productivity of waterbody (Kumari *et al.*, 2019). The EC of Bhagda taal soil ranged 1255.00 to 1360.00 $\mu\text{S}/\text{cm}^{-1}$ with average annual EC 1316.11 $\mu\text{S}/\text{cm}^{-1}$ (Table 1). The fluctuations were negligible. EC progressively increases from post-monsoon onwards to be maximum in the monsoon. Decrease in conductivity during post-monsoon may be due to utilization of ionic minerals by the producer community (Kumari *et*

al., 2019).

Phosphorous:

Phosphorous is a limiting nutrient for plants in fresh waterbodies (Stickney, 2005) which regulates the phytoplankton production in presence of nitrogen (Debnath and Panigrahi, 2014). According to Banerjea (1967) less than 3 mg/100g of soil phosphorus is considered as poor, 3.6 mg/100 g is considered average and more than 6 mg/100 g is considered highly productive. In the present study, the phosphorous content in the soil of Bhagda taal ranged 4.91 to 7.27 mg/100 g with average annual 6.38 mg/100 g (Table 1). So far, the seasonal changes is concerned the value is maximum in the monsoon, which decreases in the post-monsoon wherefrom it increases further in the pre-monsoon season. Runoff from adjacent highland and detergents which mainly comes from laundering might enhance phosphate level.

Nitrogen:

Nitrogen is one of the major inorganic salts regulating the productivity. The nitrogen content in the soil of Bhagda taal ranged from 25.13 to 27.05 mg/100 g with average annual 26.37 mg/100 g (Table 1). The nitrogen concentration was maximum during monsoon (27.05 mg/100 g) that might be due to influence of heterogeneous nitrogen compounds. This is reduced to 25.13 mg/100 g in the next season i.e., post-monsoon season and then increased again to 26.93 mg/100 g in the pre-monsoon season. According to Rath (1993) the range of available nitrogen from 25 to 50 mg/100 g and 50-75 mg/100 g of soil is relatively moderate and high production for fish. A significant part of utilized nitrogen is also lost in the sediment and alters the soil nutrient status and benthic community structure (Mohanty, 2000).

Potassium:

Potassium is an essential element in both plant and human nutrition and occurs in surface waters as a result of mineral dissolution from decomposing plant material, agricultural run-off, solid waste etc. (Debnath and Panigrahi, 2011).

Table1: Seasonal variation in Physico-chemical Parameters of Sediments of Bhagda taal during different sessions of 2021-2022

Parameters	Seasons	Sites			Mean±SD	Average Annual Value
		S1	S2	S3		
pH	Pre- monsoon	7.08	7.60	7.24	7.31±0.22	7.43±0.25
	Monsoon	7.20	7.22	7.18	7.20±0.02	
	Post- monsoon	7.48	8.02	7.88	7.79±0.28	
EC (µs/cm ⁻¹)	Pre- monsoon	1330	1380	1290	1333.33±36.82	1316.11 ±54.57
	Monsoon	1380	1410	1290	1360.00±62.45	
	Post- monsoon	1250	1290	1226	1255.00±32.78	
Phosphorous (mg/100 g)	Pre- monsoon	5.32	6.22	3.18	4.91±1.56	6.38±1.28
	Monsoon	7.49	8.12	6.19	7.27±0.98	
	Post- monsoon	5.27	9.06	6.51	6.95±1.93	
Nitrogen (mg/100 g)	Pre- monsoon	25.80	30.25	24.75	26.93±2.91	26.37±1.07
	Monsoon	28.18	24.18	28.78	27.05±2.5	
	Post- monsoon	23.10	26.17	26.12	25.13±1.75	
Potassium (mg/100 g)	Pre- monsoon	10.88	13.35	10.50	11.58±1.55	11.05±0.93
	Monsoon	8.22	12.15	9.55	9.97±1.99	
	Post- monsoon	11.84	12.24	10.70	11.59±0.79	
Organic matter (%)	Pre- monsoon	1.45	1.90	1.22	1.52±0.34	1.69±0.18
	Monsoon	1.62	2.05	1.39	1.69±0.33	
	Post- monsoon	1.85	2.35	1.45	1.88±0.45	

Potassium is one of the major nutrients for terrestrial primary producer, but its impact as fish pond fertilizer is not much known (Saha, 1985). It is not a limiting factor in wetland ecosystem but it is required in all cells as an enzyme activator. The optimum range of Potassium is 4.7 to 6.2 mg/100 g for aquatic production (Bala and Mukherjee, 2011). The potassium content in the soil of Bhagda taal was ranged 9.97 to 11.59 mg/100 g with average annual 11.05 mg/100 g (Table 1). Higher range of potassium content is probably due to the periodic application of fertilizers and manures in these water bodies for better fish production.

Organic matter:

Organic matter is an index of soil productivity and the amount of carbon broken down from plants and animals that stored in soil (Debnath and Panigrahi, 2011). Nitrogen content in soil was greatly influenced by the organic matter content (Saha, 1991), but there are many occasions in wetland ecosystem where this relation is not established. This might be due to the low nutritive

values of organic matter with their slower rate of decomposition and also due to the siltation over organic layer hindering the rate of decomposition (Bala and Mukherjee, 2011). According to Das (2001) organic matter of soil not only influences the various physico-chemical characteristics of bottom sediment releasing different nutrients in a more available form in aquatic environment but also controls the oxidation reaction, an important property of reservoir ecosystem. According to Kumari *et al.* (2019), the organic matter between 1.5 to 2.5% of soil was relatively high productive. Prakash (2000) reported that organic matter ranged between 1.5 to 2.5% to be optimal for fish production. The organic matter in the soil of Bhagda taal ranged from 1.52 to 1.88% with average annual 1.69% (Table 1). There is an increasing trend in soil organic matter from pre-monsoon onwards to post-monsoon season. Hence, it was concluded that present wetland was highly productive in nature.

The above physico-chemical parameters of sediments of Bhagda taal suggested that if

scientifically managed, the fish production can be augmented to a great extent.

Conclusion

Wetlands possess a unique type of ecosystem and play a vital role in maintenance of socio-economic condition of concerned area. From the above study it is revealed that Bhagda taal is slightly alkaline in nature, the nitrogen content is 26.37 mg/100 g and organic matter is 1.69%, hence this wetland is productive in nature. It was observed that nutrients (nitrogen and phosphorous) content increased in monsoon season because the surface soil of cultivated and forest land brought by the rain water. Besides, regular application of inorganic fertilizers and manures also increase the nutrient level in this wetland. It is evident from the present findings that physico-chemical properties of soil play a key role in fish production alone or in combination with other factors. Apart from other physico-chemical parameters of sediments, the productivity of this wetland is also influenced by various factors like eutrophication, pollution and different anthropogenic activities. Eutrophication causes increased growth of aquatic plants especially algae that have detrimental effects on aquatic life (Adham, 2002). So, proper management strategies are urgently needed to upgrade the nutritional status of the sediments of this wetland which on the contrary also enhance the quality of limnological parameters resulting better production of fish and as well as fish food organism.

Acknowledgements

Authors are grateful to Principal and Management Committee, M.L.K. (P.G) College, Balrampur, U.P. for providing necessary laboratory facilities.

References

- Adham KG. (2002) Sublethal effects of aquatic pollution in Lake Mariut on the African sharptooth catfish *Clarias gariepinus* (Burchell, 1822). J Appl Ichthyol. 18: 87-94.
- Bala G and Mukherjee A. (2011) Physico-chemical properties of sediments and their role in the production process of some wetlands in Nadia district, West Bengal. J Environ Sociobiol. 8(2): 253-256.
- Bhagde RV, Pingle S A, Bhoye MR, Pansambal SS and Deshmukh DR. (2020) A comparative study of physico-chemical parameters of the freshwater ponds from Sangamner Taluka of Ahmednagar, Maharashtra, India. Int J Bioll Innov. 2(2): 137-142.
- Das AK. (2000) Role of physical and chemical features of soil in reservoir productivity. Fishing Chimes 20: 30-32.
- Das AK. (2001) Limno-chemistry of some Andhra Pradesh Reservoirs. J Inland Fish Soc India 32: 37-44.
- Debnath S and Panigrahi AK. (2011) Characterization of physico-chemical properties of water and soil in Lalbandh, a freshwater wetland in Birbhum district, West Bengal, India. Ecol Env Cons. 17(3): 557-562.
- Debnath S and Panigrahi AK. (2014) Studies on some physico-chemical properties of sediment and their role in productivity of two floodplain wetlands in West Bengal, India. Indian J Appl Res. 4(11): 5-7.
- Kumari S, Khan JA, Thakur MS and Lal H. (2019) Study of physico-chemical characteristics of water and soil in relations to fish production in Motia Lake Reservoir. J Atmos Earth Sci. 2: 6.
- Mohanty RK. (2000) Activated microbial suspension and nitrogen control in aquaculture system. Fishing Chimes 20: 50-51.
- Nath D, Mandal LN, Tripathi SD and Karmakar HC. (1994) Correlation between fish production and physico chemical parameters of water and soil in semi-intensive carp culture ponds of west Bengal, India. J Inland Fish Soc India 26(1): 106-115.
- Palit D and Mukherjee A. (2011) Characterization of physico-chemical properties of water and soil in Lalbandh, a freshwater wetland in Birbhum district, West Bengal, India. Ecol Env Cons. 17(3): 557-562.
- Piper CS. (1966) Soil and plant analysis. Hans Publishers, Bombay, pp. 368.
- Prakash S. (2000) Nutrient status of soil of a lentic fresh waterbody in relation to fish culture. Geobios 27: 128-130.
- Prakash S and Verma AK. (2022) Anthropogenic activities and biodiversity threats. Int J Biol Innov. 4(1): 94-103.
- Rath RK. (1993) Freshwater Aquaculture. Scientific Publishers, Jodhpur, India.
- Saha LC. (1985) Changes in properties of bottom soil of two fresh water ponds in relation to ecological factors. Indian J Ecol. 12(1): 147-150.

- Saha PK. (1991) Organic carbon as an index of available nitrogen in fish pond soil. *Curr Res.* 20: 171-172.
- Singh V and Prakash S. (2022) Ichthyofaunal diversity of Bhagda or Bhagta Taal, a wetland of Balrampur, Uttar Pradesh, India: Threats and conservation. *Intern J Zool Invest.* 8(1): 412-420.
- Stickney RR. (2005) *Aquaculture: An Introductory Text.* CABI Publishing, UK, pp. 265.
- Sugumaran E, Shabeen B and Radhakrishnan MV. (2020) Zooplankton diversity in Sathanur Reservoir of Thiruvannamalai (Tamilnadu), India. *Int J Biol Innov.* 2(2): 95-101.
- Sugunan V V and Sinha M. (2000). *Guidelines for Small Reservoir Fisheries Management.* Central Inland Capture Fisheries Research Institute, West Bengal, India.
- Trivedy RK, Goel PK and Trishal CL. (1998) *Practical methods in ecology and environmental science.* Enviro Media Publications, Karad, India.
- Verma AK. (2019) Studies of hydrobiological properties of Balapur Pond of Prayagraj (U.P.). *HortFlora Res Spectrum* 8(1): 9-11.
- Verma AK. (2021) Ichthyo-faunal diversity of Alwara Lake: Threats and conservation status. *Intern J Zool Invest.* 7(2): 479-485.
- Verma AK and Prakash S. (2018) Qualitative and quantitative analysis of macrozoobenthos of Beghel Taal, a wetland of U.P. *Indian J Biol.* 5(2):127-130.
- Verma AK and Prakash S. (2020) Limnological studies of Semara Taal, A wetland of district Siddharthnagar (U. P.), India. *J Fisheries Life Sci.* 5(1): 15-19.