RP Current Trends in Engineering and Technology
Vol. 1, No. 6 (December 2022) pp. 108–112
e-ISSN: 2583-5491

Cite this article: Shamina, Study of the artificial lake's soil (sediment) quality in the Bhindawas Wildlife Sanctuary: The role of essential living systems in the ecosystem, *RP Cur. Tr. Eng. Tech.* **1** (2022) 108–112.

Original Research Article

Study of the artificial lake's soil (sediment) quality in the Bhindawas Wildlife Sanctuary: The role of essential living systems in the ecosystem

Shamina
Department of Zoology, Janta Vidya Mandir Ganpat Rai Rasiwasia College, Charkhi Dadri – 127306, Haryana, India
*Corresponding author, E-mail: zoologyshamina@gmail.com

ARTICLE HISTORY
Received: 3 October 2022
Revised: 7 Dec. 2022
Accepted: 9 Dec. 2022
Published online: 10 Dec. 2022

KEYWORDS
Organic carbon; Atmospheric pollution; Soil quality.

ABSTRACT
In order for a living system to maintain production, improve water quality, and promote plant and animal health, the soil (or sediment) must be able to carry out certain essential duties. This study's objective was to evaluate the soil (sediment) quality of the artificial lake in the Bhindawas Wildlife Sanctuary. This is situated in India's Haryana province's Jhajjar district. This 12-month study, which started in August 2021, involved collecting soil (sediment) samples from three distinct locations around the lake on a monthly basis. pH, nitrogen, phosphorus, potassium, and other soil quality factors were evaluated. The majority of the variables fell within the usual range. According to this study, the artificial lake in the Bhindawas Wildlife Sanctuary has good soil (sediment) quality that can support a variety of flora and wildlife.

1. Introduction

Sediment, or soil, is a crucial element of the earth's biosphere. The production of food and fibre, as well as the preservation of the local, regional, and global environment's quality, depend heavily on the soil [1]. Agriculture, the growth of natural plants, and communities are all impacted by soil quality. The degradation of soil can be brought on by sanitization, air pollution, and soil erosion [2]. Environmental issues created by humans, such as climate change and ozone layer thinning, which may result in a significant drop in biodiversity, may induce soil degradation and loss of soil productivity.

The soil science society of America defines soil quality as "the ability of a particular sort of soil to perform within the confines of natural or managed ecosystem, to sustain plant and animal productivity, to maintain and improve water and air quality, and support human health habitation" [3]. A variety of living species that need to be managed and conserved perform the functions of the soil, which is a living, dynamic system [4]. Extreme environments and anthropogenic perturbations impair the health of soil, its malleability, and ultimately biodiversity [5]. The ability of the soil to act as a vital living system to sustain biological productivity, advance water quality, and uphold plant and animal health is known as soil health. The addition of contaminants from various sources and pest control in agriculture and the water ecosystem have a significant impact on the deterioration and loss of soil health [6].

Seasonal variations in the ecological factors have an impact on the distribution of plants and animals as well as their population density [7]. It is possible to utilise soil chemistry as a gauge of how well terrestrial ecosystems are doing. The main biogeochemical cycles have an impact on the chemical makeup of the soil's liquid and solid phases.

Physical and microbiological aspects of the soil have an impact on its chemical composition. By assessing the soil quality of the lake, this study aims to determine the condition of the artificial lake within the ecology of the Bhindawas Wildlife Sanctuary.

2. Materials and methods

About 15 kilometres from Jhajjar in Haryana's Jhajjar district is where you'll find the Bhindawas Wildlife Sanctuary Ramsar site. It was also designated a bird sanctuary by the Indian government on June 3, 2009. This is a significant portion of the Sahibi River's ecological corridor, which runs from the Aravalli Mountains in Rajasthan to the Yamuna via the Masani Barrage, Matanhail Forest, Chhuchhakwas-Godhari, Khaparwas Wildlife Sanctuary, Bhindawas Wildlife Sanctuary, Outfall Drain Number 6 (a canalised portion of the Sahibi River in Haryana), Outfall Drain Number 8 (a canalised portion of the Dohan River in Haryana. This 411.55 hectare sanctuary is 105 km from Delhi, the capital of India. The primary sources of water in the bird sanctuary are rainwater, the JLN Feeder canal, and its escape channel.

About 250 different species of migratory and resident birds frequent the Bhindawas Lake. The water hyacinth problem, which has harmed the lake's drainage system and put it in danger of drying up because there is no permanent source of water, is a challenge that this lovely lake is currently dealing with. Blue peafowl, gray francolin, black francolin, graylag goose, ruddy shelduck, bar-headed goose, comb duck, gadwall, eurasian wigeon, great cormorant, common teal, northern pintail, northern shoveler, red vented bulbul, common pochard, black-rumped flameback, common hoopoe, white-throated kingfisher, green bee-eater, black drongo, pied cuckoo, common hawk cuckoo, rose-ringed parakeet, spotted owlet, blue rock pigeon, great egret, purple swamphen, eurasian collared dove, mallard, crested lark, jungle babbler, ashy prinia etc. are some of the more common birds found in Bhindawas Bird Sanctuary.

The current investigation was conducted during the entire calendar year. A sampling by month was carried out. A weekly sampling was carried out. For ease, the lake region was separated into three stations: East (station 1), West (station 2), and North (station 3). As instructed in a soil analysis kit, the sampling was carried out. To separate the coarse pieces (> 2 mm), the obtained soil samples were first air dried, then they were pounded in a wooden mortar with a pestle. For analysis, the fine soil samples were kept in separate containers. The assessment included the physical and chemical characteristics of pH, potassium, phosphorus, and nitrogen. Utilizing a Prerana soil analysis kit, standard analysis techniques were used for the entire analysis. Using a pH metre, the pH of the soil was measured in water suspension (1:1 soil to solution ratio).

Figure 1. (a) Artificial lake in Bhindawas Wildlife Sanctuary.

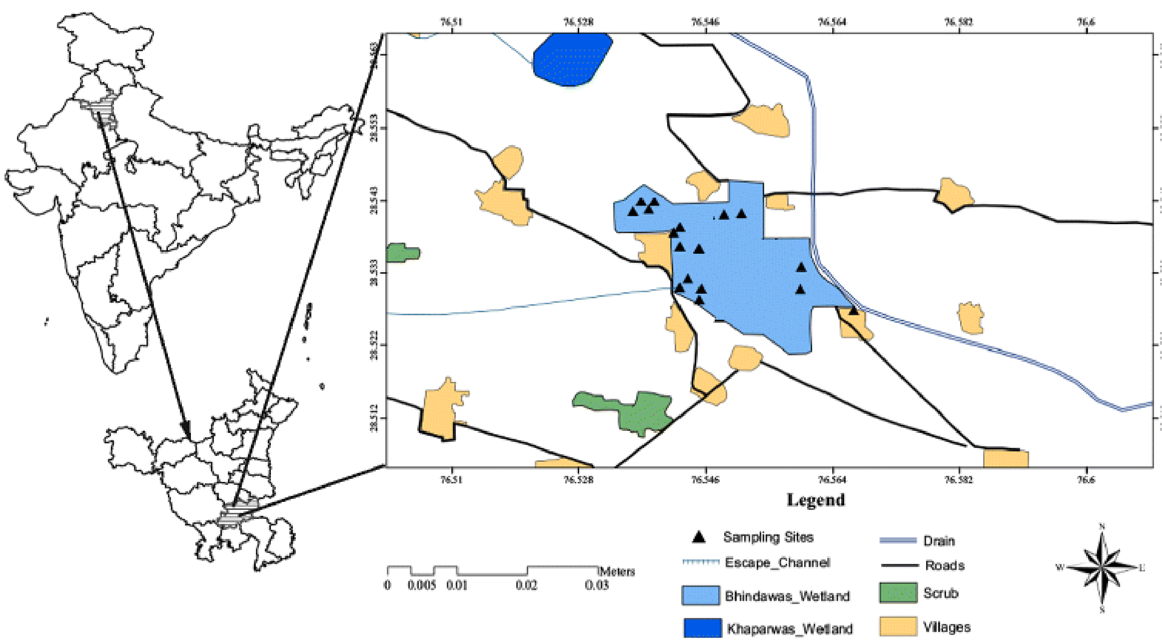

Figure 1. (b) Site map of artificial lake in Bhindawas Wildlife Sanctuary in District Jhajjar of State Haryana, India.

3. Results and discussion

Soil pH: The pH of the soil samples used in this study ranged from 6.70 to 6.9, showing that the study area's soils met Indian standard specifications (6.5 to 8.5). pH values below 6.6 indicate an acidic soil, neutral soils are between 6.7 and 7.72, while alkaline soils exceed 7.3. All of the stations have found that the pH value varies with the seasons, being higher in the winter months than in the summer and wet ones. The pH is high at station East from September through December. It is between 6.7 and 6.8 in the summer and reaches 6.9 in the winter (Figure 2).

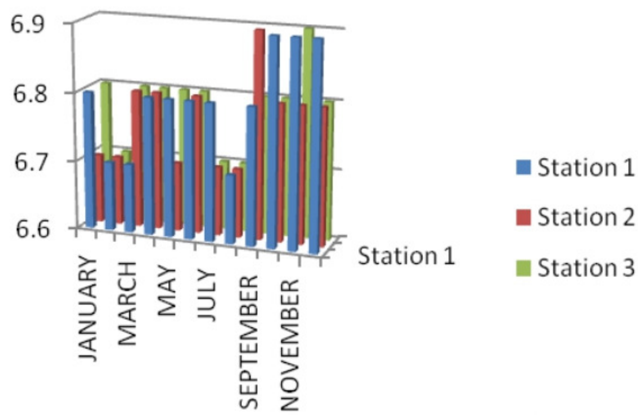

Figure 2. Variation in the pH of Soil at three different stations of artificial lake in Bhindawas Wildlife Sanctuary throughout the year. The y-axis represents pH.

Soil nitrogen: The nutrient nitrogen is movable in the soil. The average nitrogen level in the soil of the artificial lake at the Bhindawas Wildlife Sanctuary Lake is 701.92 (Kg/Ha) in the current study (Figure 3). The nitrogen content of the soil was dramatically raised by the sewage water [8]. In the current study region, soil nitrogen levels were discovered to be consistent across all stations and seasons of the year.

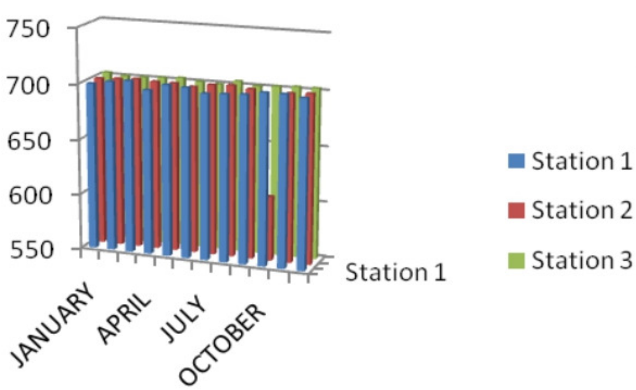

Figure 3. Variation in the nitrogen of soil at three different stations of artificial lake in Bhindawas Wildlife Sanctuary throughout the Year. The y-axis represents nitrogen in kg/Ha.

Soil phosphorus: Due to the comparatively high amounts of phosphorus that plants need, phosphorus is a necessary element that is categorised as a macronutrient. At North Station, phosphorus values are observed to be high from June to September (Figure 4). The fields surround this station. Due to farmers' usage of fertilisers in the fields during the wet season, phosphorus may have leached into the lake. In the current study region, phosphorus levels in the soil were found to be higher in February, 13 kg/Ha higher. The amount of phosphorus that is readily available in the soil that has been irrigated with sewage water is higher, and during the rainy season, a lot of sewage water drains into this lake.

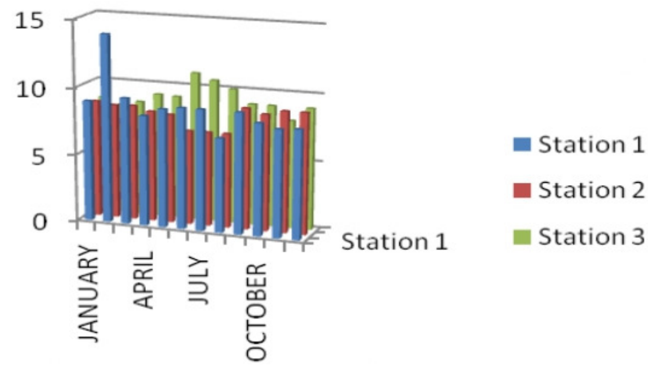

Figure 4. Variation in the phosphorus of soil at three different stations of artificial lake in Bhindawas Wildlife Sanctuary throughout the year. The y-axis represents phosphorus in kg/Ha.

Soil organic carbon: Due to its improvement of nutrient delivery, detoxification of hazardous soil components, preservation of moisture and nutrients, and participation in the construction of soil structure, soil organic carbon is a vital resource.

In the current investigation, the author discovered that although the soil's organic carbon level remained constant (almost 1%) throughout the year, it only decreased in the month of June. Increased decomposability of crop residues, decreased organic matter inputs, and tillage effects that lessen the amount of physical protection to decomposition are all responsible for a large portion of this loss in soil organic carbon. Except for June, when its value was discovered to be reduced to 0.6%, the value of soil organic carbon in the current research region was determined to be in the range of 1% at all stations throughout the year (Figure 5).

Soil potassium: At several locations, it was discovered that the potassium amount varied. In comparison to winter, readings at every site were higher in the summer and throughout the wet season. West station recorded 304 kg/Ha as its maximum figure (Figure 6).

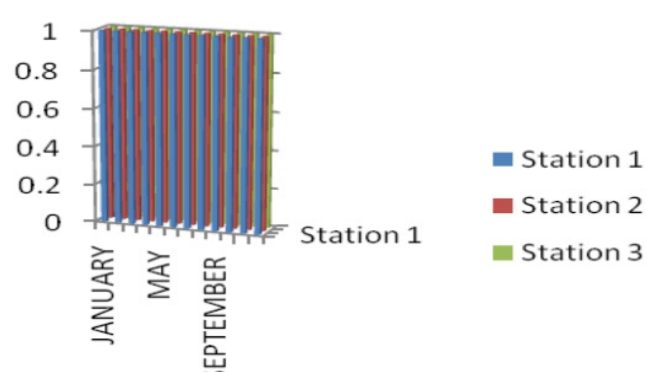

Figure 5. Variation in the organic carbon of soil at three different stations of artificial lake in Bhindawas Wildlife Sanctuary throughout the year. The y-axis represents nitrogen (in %).

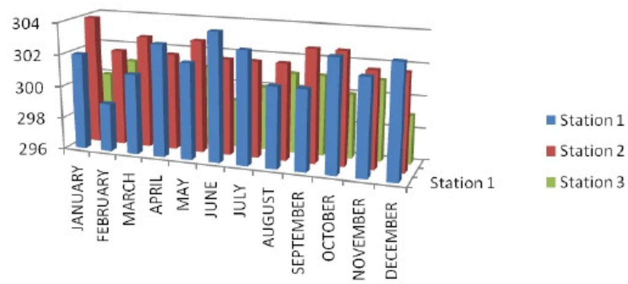

Figure 6. Variation in the potassium of soil at three different stations of artificial lake in Bhindawas Wildlife Sanctuary throughout the year. The y-axis represents potassium in kg/Ha.

It is well known that soils play a significant role in plant productivity. Qualities of the lake's soil (sediment) have an impact on the water and air. By measuring pH, one can assess intensive land management practises, carbon imbalances, and the acidity or alkalinity of a substance. Since the pH of soil affects the availability of vital plant nutrients, it can be regarded as one of the most significant soil properties. The pH of the soil is also impacted by rain; it falls during the rainy season [9]. The movement of water causes basic nutrients like calcium and magnesium to be washed out of the soil [10]. The pH of soil is lower during wet seasons than it is during dry ones. A higher pH encourages the solubilization of Pb in soil, and a rise in lead levels lowers microbial activity as well as enzyme activity [11], both of which are indicators of soil contamination.

The most crucial component of fertilisers is nitrogen. Plants respond quickly to the administration of nitrogen. Nitrogen provides the plants a green hue and promotes vegetative development. Nitrogen is absorbed by plant roots as NO_3 and NH_4 molecules. Surface and subsurface water quality is impacted by the nitrogen and water cycles in the soil. Nitrate and nitrogen, which are produced when intact land is converted to intensive agriculture, animal manures, air deposition, and fertilisers, are the main contaminants of water. Due to human modifications of nitrogen cycles, there is a significant increase in the transport of nitrogen from land to the atmosphere, as well as to water bodies, rivers, estuaries, and coastal oceans [12]. Higher levels of organic matter in the soil are often capable of releasing more nitrogen.

In fertilisers, phosphorus, an essential nutrient, is supplied to the soil. The transfer of energy is phosphorus' significant function in living things. Similar to nitrogen, phosphorus has valence states ranging from +5 to -3. Although phosphite, hypophosphite, and phosphine can all form from phosphate in anaerobic environments and their presence has been confirmed [13], this is only true thermodynamically. The migration of the orthophosphate ion is the primary transformation of phosphorus in anaerobic conditions. Higher levels of phosphorus are readily available in sewage-irrigated soil, which is important for plant growth.

The ecological integrity and development or progress of a wetland are both indicated by the soil composition. Because it responds to environmental disturbance and has an impact on other ecosystem processes, the National Research Council has referred to soil organic matter content (also known as soil organic carbon) as the "best" measure of soil quality [14].

Overall, the contents of soil organic carbon are quite low, ranging from 0.6 to 1%. Heavy metals and micronutrient availability in soil are influenced by the status of organic carbon [15]. Organic carbon in the soil is decreased as farmed land replaces wild plants. The organic matter in the soil rapidly diminishes as a result of different land usage [16–20].

One of the sixteen essential minerals for plant growth and reproduction is potassium. Of the crust of the planet, potassium makes up 2.4%. It is categorised as a macronutrient, along with phosphorus and nitrogen. In its ionic form, potassium ion, it is absorbed by plants. In a soil, the total amount of exchangeable and water soluble potassium is typically known as the available potassium. The non-exchangeable potassium and the mineral potassium are the reserve forms of potassium in soils. Some of the reserve potassium comes from weathering of feldspars and micas and becomes exchangeable as the exchangeable potassium of soils is reduced through cropping or leaching [21].

Additionally, land management practises like tillage, crop rotation, and the application of fertilisers and pesticides have an impact on water quality. Due to management techniques, the soil's capacity to create or absorb significant gases including carbon dioxide, nitrous oxide, and methane may change [22, 23]. Environmental quality, plant, animal, and human health are all influenced by the quality and health of the soil [24, 25, 26].

Understanding the issues with productive areas and keeping track of changes in sustainability and environmental quality requires an assessment of the quality and health of the soil [27]. When evaluating the sustainability of management practises, applications of indicators of soil quality and health would help to bridge the gap between science and practise [28]. Indicators of soil quality and health could be used to define ecosystem processes, integrate physical, chemical, and biological properties, their management sensitivity, variations in climatic conditions, and their usefulness and accessibility to agricultural experts, conservationists, and policy makers.

4. Conclusions

The soil of the lake is suitable for the growth of fauna and flora as well as other essential functions of the lake, and the values of the physicochemical parameters of the artificial lake in the Bhindawas Wildlife Sanctuary were found to be within normal range. As a result, the lake may contain a variety of richly coloured plants and animals.

References

[1] J.T. Glanz, Saving Our Soil: Solutions for Sustaining Earth's Vital Resource. Johnson Books, Boulder, USA (1995).

[2] L.R. Oldeman, The global extent of soil degradation, in: Soil Resilience and Sustainable Land Use, D.J. Greenland, I. Szabolcs, (Eds.), CAB International, Wallingford, Oxon, UK (1994) pp. 99–118.

[3] D.L. Karlen, M.J. Mausbach, J.W. Doran, R.G. Cline, R.F. Harris, G.E. Schuman, Soil quality: a concept, definition, and framework for evaluation, *Soil Sci. Soc. Am. J.* **61** (1997) 4-10.

[4] J.W. Doran, Soil quality and sustainability, *Proc. XXVI Braz. Cong. of Soil Sci.*, Rio de Janeiro, Brazil, (1997).

[5] D.W. Freckman, Virginia low-diversity Antarctic soil nematode communities: distribution and response to disturbance, *Ecology* **78** (1997) 363-369.
[6] D.W. Saunders, International activities in assessing and monitoring soil degradation (Special Issue on Soil Quality) *Am. J. Alter. Agric*. **7** (1992) 17-24.
[7] E.P. Odum, Fundamentals of Ecology, 3rd ed. W.B. Sawnders Company, Toronto (1984).
[8] H.S. Baddesha, R. Chabbra, B.S. Ghuman, *J. Ind. Soc. Soil Sci.* **45** (1997) 358-362.
[9] S. De, D.D. Mishra, A. Bajpai, N. Verma N, Studies on soil status in and around Satpura thermal power station Sarni (M.P.), *Asian J. Exp. Sci*. **23** (2009) 611-614.
[10] L. Bernstein, Effects of salinity and sodicity on plant growth, *Annual review of phytopathology* **13** (1975) 295-312.
[11] C. Marzodoni, C. Liavatta, C. Gessa, Effect of lead pollution on different soil enzyme activities, *Biol. Ferti.Soils* **22** (1986) 53-58.
[12] P.M. Vitousek, J.D. Aber, R.W. Howarth, G.E. Likens, P.A. Matson, Human alteration of the global nitrogen cycle-sources and consequences, *Ecol. Appl.* **7** (1997) 737–750.
[13] G.E. Hutchinson, A Treatise on Limnology, Wiley, New York (1957).
[14] National Research Council, Ecological Indicators for the Nation. National Academy Press, Washington, D.C. (2000).
[15] S.P. Trehan, Contribution of properties of Ustochrept soil to potato yield. *J. Ind. Soc. Soil Sci*. **44** (1996) 528-530.
[16] H. Jenny, Factors of Soil Formation, McGraw-Hill, New York (1941).
[17] E.A. Davidson, I.L. Ackerman, Changes in soil carbon inventories following cultivation of previously untilled soils, *Biogeochemistry* **20** (1993) 161-193.
[18] L.K. Mann, Changes in soil carbon after cultivation, *Soil Sci*. **142** (1986) 279-288.
[19] W.H. Schlesinger, Changes in soil carbon storage and associated properties with disturbance and recovery, in: The Changing Carbon Cycle: A Global Analysis, J.R. Trabalka, D.E. Reichle (Eds.), Springer-Verlag, New York (1985).
[20] W.M. Post, L.K. Mann, Changes in soil organic carbon and nitrogen as a result of cultivation, in: Soils and the Greenhouse Effect, A.F. Bouwman (Ed.), John Wiley & Sons, New York (1990) pp. 401-406.
[21] S. Basavaraja, K.N. Chandrashekarappa, Soil, Quality Status of Tunga Left Bank Command area, Shimoga & Davanagere Districts, Karnataka, India. *Global J. Human Soc. Sci*. (2011) 83-88.
[22] D.E. Rolston, L.A. Harper, A.R. Mosier, J.M. Duxbury, Agricultural Ecosystem Effects on Trace Gases and Global Climate Change, American Society of Agronomy, Special Publication 55, Madison, WI, USA (1993).
[23] A.R. Mosier, Soil processes and global change, *Biol. Fertil. Soils* **27** (1998) 221-229.
[24] G.M. Pierzynski, J.L. Schnoor, M.K. Banks, J. Tracy, L. Licht, L.E. Erickson, Issues in Environmental Sciences and Technology, in: Mining and its Environmental Impact, Royal Society of Chemistry, Cambridge UK (1994) pp. 49-69.
[25] J. Haberern, Viewpoint: a soil health index, *J. Soil Water Conserv*. **47** (1992) 6.
[26] R.F. Harris, D.L. Karlen, D.J. Mulla, A conceptual framework for assessment and management of soil quality and health, in: Methods for Assessing Soil Quality, J.W. Doran, A.J. Jones, (Eds.), Soil Science Society of America, Special Publication 49, Madison, WI (1996) pp. 61–82.
[27] D. Granatstein, D.F. Bezdicek, The need for a soil quality index: local and regional perspectives, *Am. J. Altern. Agric*. **7** (1992) 12-16.
[28] D.E. Romig, M.J. Garlynd, R.F. Harris, Farmer-based assessment of soil quality: A soil health scorecard, in: Methods for Assessing Soil Quality, J.W. Doran, A.J. Jones (Eds.), Soil Science Society of America, Special Publication 49, Madison, WI (1996) pp. 39–60.