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Assessment of seasonal variations in Soil quality in the vicinity of Hathaikheda Reservoir, Bhopal, Madhya Pradesh

Jain Pankaja [1,*], Sarsaiya Surendra [2, 3] and Gupta Amita [1]

[1] *Department of Biochemistry, Mansarovar Global University, Sehore Madhya Pradesh, India.*
[2] *CES Analytical and Research Services India Pvt Ltd, Bhopal, Madhya Pradesh, India.*
[3] *Laboratory of Basic Pharmacology and Joint International Research Laboratory of Ethnomedicine of Ministry of Education, Zunyi Medical University, Zunyi, 563003, China.*

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Abstract

This study investigates the seasonal dynamics of Water and soil quality in the vicinity of Hathaikheda Reservoir, Bhopal, Madhya Pradesh. The analysis of Soil quality revealed the foundation for agricultural practices, providing nutrients, supporting plant growth and influencing crop productivity. The physical properties of the soil such as its texture, grain size distribution and moisture contents, have significant impact on its fertility, water holding capacity and drainage characteristics. The chemical composition of the soil including pH, conductivity, organic matter content and nutrient level, directly affect the availability of essential elements for plant growth. Additionally, the presence of contaminants in the soil such as, heavy metals and pollutants can pose risk to both the environment and human health.

Keywords: Soil Quality; Seasonal Variations; Hathaikheda Reservoir; Human health

1. Introduction

Water and soil quality are vital components of the natural environment, sustaining ecosystems and ensuring human well-being. The Hathaikheda Reservoir, situated in Bhopal, Madhya Pradesh, is characterized by its diverse soil and water resources. The regions soil composition play a crucial role in supporting various human activities and ecological system. Understanding the characteristics and quality of this resource is vital for sustainable development and environmental Management.

Bhopal the capital city of Madhya Pradesh is home to a large number of lentic water resources including the famous Bhoj Wetland, the maiden Ramsar site of the state. Despite having a large number of water bodies in and around it, the city witness decreased water supply, especially during the drier months of the year. The water quality of the water resources which are not used for potable purposes is often neglected hence the water of the water bodies is unfit for human uses. Hathaikheda reservoir like many others in the state was constructed for irrigation but now it is an important water resource to supply water to the Industrial area of Govindpura and also used for fish culture. This is a multipurpose reservoir of Bhopal, situated about 5 km from BHEL Township in the northeast direction. It has been observed that significant efforts have not been done so far, for detection of the soil quality of the surrounding of the dam. In this project it is proposed to carry out a detail soil- quality investigation of Hathaikheda dam so that as per the quality of soil appropriate measures may be suggested to the local BHEL administration authority for improvement of soil quality which will further improved ground water quality, agriculture activities and thus environment. Analysis of sample will reveal the quality of soil in the adjoining area so that further improvement and conservation steps can be taken.

*Corresponding author: Jain Pankaja

This research paper aims to provide a comprehensive assessment of the seasonal variations in water and soil quality in the vicinity of Hathaikheda Reservoir, Bhopal, Madhya Pradesh. By integrating recent research findings and employing advanced analytical techniques, this study seeks to analyze the seasonal trends in water quality parameters, elucidating the key factors influencing water quality dynamics in the reservoir and its catchment area. Understanding the seasonal dynamics of soil quality in this region is essential for informed decision-making and the development of effective environmental management policies. This research contributes to the broader goal of safeguarding the natural resources and ecosystems surrounding Hathaikheda Reservoir.

2. Material and methods

2.1. Study Area Selection

The study area is located within a 2 km radius of the Hathaikheda Reservoir in Bhopal, Madhya Pradesh. Soil was extracted from the adjacent area of the reservoir for sample collection and analysis.

2.2. Soil Sampling

Soil samples were collected periodically to assess seasonal variation. The following parameters were examined:-

Moisture content, pH, Electrical Conductivity, organic matter , organic carbon, water holding capacity, sodium, potassium, Sulphates, Phosphate, Chlorides, Calcium Carbonate, etc.

These all-Parameters Tests were performed in CES Analytical Research & Services 42, Doorsanchar Nagar, Gulmohar, Bhopal, which is accredited by NABL and MOEF&CC.

2.3. Sampling Procedure

Soil samples were collected and analyzed as per the guideline provided in the IS Code and the guideline of CPCB, ensuring standardized and accurate measurement.

2.4. Sample Preservation

After collection, soil samples were stored in appropriate containers and transported to the laboratory for analysis. Samples were kept in controlled laboratory conditions, ensuring proper inspection, and moderate temperature.

2.5. Data Analysis

Data collected from various sampling points was statistically analyzed to identify seasonal trends, variations, and any potential impacts of human activities on soil quality. This analysis contributed to the assessment of environmental conditions in the study area.

3. Results and discussion

The analysis of soil quality around the Hathaikheda Reservoir, Bhopal, revealed several noteworthy findings. The moisture or water content in 25 gram soil was 4 gram in monsoon, 2.83 gram in winter and 1.5 gram in summer season. The pH of the soil exhibited a slightly acidic trend with an average value of 6.68. Conductivity, as measured in monsoon season was 741.2 µS/ppm in 30 gram of soil, in winter 161.2 µS/ppm and in summer season as 169.8 µS/ppm. Organic matter was measured as 0.0234436 in monsoon, 0.382184 in winter and 2.78 on summer season.

Organic carbon was measured in 0.01363% in monsoon season, 0.22% in winter season 1.61% in summer season. Water holding capacity in 100 gm of soil- 46% in monsoon season, 29.4% in winter season and 30.6% in summer seasons. Sodium was found 13.08 mg/kg in monsoon season, 28.60 mg/kg in winter season and 37.14 mg/kg in summer season. Potassium was found in 8.90 mg/kg in monsoon season 31.65 mg/kg in winter season and 16.63 mg/kg in summer season. Sulphate was found at concentration of 131.339 mg/kg in monsoon season, 253.773 mg/kg in winter, and 612.2605 mg/kg in summer. Phosphate was found 0.41616 mg/kg in monsoon season, 1.1628 mg/kg in winter season, and 5.81808 mg/kg in summer. Chloride was found 19.99 gm /100 gm in monsoon season, 0.00283 gm/100gm in winter season and 0.009964 gm/100gm in summer. Calcium carbonate was found 68 % in monsoon, 83.5 % in winter, and 28 % in summer season. Nitrogen was found 222.5 kg/ha in monsoon season, 222.29 kg/ha in winter season, and 226.3 kg/ha in summer.

Table 1 Physical and Chemical properties of soil around Hathaikheda Reservoir, Bhopal

S No	Parameter	Unit	Monsoon	Winter	Summer
1	pH	in 30 gm	6.16	7.26	6.62
2	Moisture or water content	in 25 gm	4	2.83	1.5
3	Electrical Conductivity	mho/cm	0.7412	0.1612	0.1698
4	Organic Matter	%	0.023	0.38	2.78
5	Organic Carbon	%	0.013	0.22	1.61
6	Water Holding capacity	% in 100gm	46	29.4	30.6
7	Sodium	mg/kg	13.08	28.6	37.14
8	Potassium	mg/kg	8.9	31.65	16.6
9	Sulphate as SO_4	mg/kg	131.33	253.77	612.26
10	Phosphate as PO_4	mg/kg	0.416	1.16	5.81
11	Chloride as Cl	mg/kg	19.99	28.3	99.96
12	Calcium Carbonate $CaCO_3$	%	68	83.5	28
13	Nitrogen	kg/ha	222.5	229.29	226.3

The assessment of seasonal changes in soil quality around the Hathaikheda Reservoir Bhopal Madhya Pradesh provides valuable insight into the environmental condition of this critical ecosystem. The discussion of the studies finding highlights key observations, implications and potential areas for further research. The study revealed significant seasonal variation in soil quality. The ideal soil ph for most plants is between 6.0 and 7.4. This is considered the best general purpose ph for gardens because it allows a wide range of plant to grow. In winter and summer season electrical conductivity was found low so crops will not be able to receive enough nutrients. In monsoon and winter season organic matter and organic carbon was found to Low, which is not suitable for agriculture purpose. Water holding capacity were found between 29.4 to 46% which is satisfactory value. Most plant will typically suffer injury if sodium exceed 70 mg/lit in water, so sodium level was found within desirable limit. Potassium concentration was found within 8 to 31 mg per kg which is low, it stunts plant growth and reduces yield. Sulphate was between range 131.3-612.6 mg/kg, which is acceptable for growth of plant. Phosphate level was found in monsoon and winter season very low and in summer season acceptable value was found. Chloride level was found low in monsoon season, but in winter and summer, chloride level was found within desirable range which is good for soil fertility and crop growth. Calcium carbonate percentage in soil sample significant variability but do not exceed acceptable limits.

4. Conclusion

Seasonal changes have marked the significant effect in soil physiochemical properties. Results show the variation in soil parameters in different season. Organic matter, K and Na content of the soil were found to follow the order of abundance in winter, rainy, and summer. It can be inferred that climatic conditions had a profound effect on soil parameters as the winters in this region are extreme winters and summer are also extreme. Almost all the measured parameters had reported a measurable difference in their value with transition in weather.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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