www.ijarp.com ISSN 2456-9992 Page: 01-10

International Journal Advanced Research Publications

Research Article

Volume: 02
Issue: 04

"ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF SOIL IN MAHUAPARA REGION, AMBIKAPUR (C.G.)"

Shailesh Kumar Dewangan*[1], Sejal Ekka[2]

[1]Assistant Professor & HOD Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).

[2]Students M.Sc.II[nd] Semester, Physics. Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).

Article Received: 24 February 2026, Article Revised: 14 March 2026, Published on: 03 April 2026

***Corresponding Author: Shailesh Kumar Dewangan**

Assistant Professor & HOD Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).

DOI: https://doi-doi.org/101555/ijarp.6085

ABSTRACT:

The present study aims to assess the physico-chemical properties of soil in the Mahuapara region of Ambikapur, Surguja district (Chhattisgarh), in order to evaluate its fertility status and suitability for agricultural use. Soil is a vital natural resource that directly influences crop productivity, and its quality is determined by various physical and chemical characteristics. In this study, soil samples were collected from different representative locations of Mahuapara at a standard depth and analyzed using established laboratory methods. The physico-chemical parameters analyzed include soil pH, electrical conductivity (EC), organic carbon content, texture (sand, silt, and clay), bulk density, particle density, porosity, water holding capacity (WHC), and essential nutrients such as nitrogen (N), phosphorus (P), potassium (K), and micronutrients like zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu). The results indicate that the soil in the study area is generally slightly acidic to neutral in nature, which is favorable for most crops. Electrical conductivity values were within safe limits, indicating non-saline soil conditions. The organic carbon content ranged from low to moderate, suggesting the need for organic matter enrichment to improve soil fertility. The textural analysis revealed variations from sandy loam to clay loam soils, affecting water retention and nutrient availability. Nutrient analysis showed that while some essential nutrients were present in adequate amounts, certain micronutrients exhibited deficiencies in specific locations.

KEYWORDS: Soil Analysis, Physico-Chemical Properties, pH, Electrical Conductivity (EC), Micronutrients.

INTRODUCTION:

Soil is a fundamental natural resource that plays a crucial role in sustaining life on Earth by supporting plant growth, regulating water flow, and maintaining ecological balance. The productivity and sustainability of agricultural systems largely depend on the quality of soil, which is determined by its physical and chemical characteristics. Physico-chemical properties such as soil pH, electrical conductivity (EC), texture, bulk density, porosity, water holding capacity, and nutrient content directly influence soil fertility, crop yield, and environmental health.

In recent years, increasing population pressure, intensive agricultural practices, and the excessive use of chemical fertilizers and pesticides have significantly affected soil quality. These factors can lead to nutrient imbalance, soil degradation, and reduced agricultural productivity. Therefore, the systematic assessment of soil properties has become essential for sustainable land management and optimal crop production. The analysis of physico-chemical properties provides valuable information about soil behavior, nutrient availability, and its suitability for different crops. Soil pH influences nutrient solubility and microbial activity, while electrical conductivity indicates the presence of soluble salts. Soil texture (proportions of sand, silt, and clay) affects water retention, aeration, and root penetration. Similarly, parameters like organic carbon and essential nutrients such as nitrogen (N), phosphorus (P), potassium (K), and micronutrients (Zn, Fe, Mn, Cu) are critical for plant growth and development. Mahuapara, located in Ambikapur of Surguja district, Chhattisgarh, is an agriculturally important region where soil quality directly impacts the livelihood of local farmers. Despite its significance, limited scientific studies have been conducted to evaluate the detailed physico-chemical properties of soils in this area. Understanding these properties is necessary to identify soil fertility status, detect nutrient deficiencies, and recommend appropriate soil management practices.

LITERATURE REVIEW:

Soil physico-chemical properties are fundamental indicators of soil fertility and play a vital role in determining agricultural productivity and environmental sustainability (Brady & Weil, 2016). These properties, including soil pH, electrical conductivity (EC), texture, and organic carbon, significantly influence nutrient availability and plant growth (Havlin et al., 2014).

Soil pH is considered one of the most important parameters, as it controls the solubility of nutrients and microbial activity in soil systems (McLean, 1982). Electrical conductivity reflects the concentration of soluble salts in soil and is a key factor affecting plant growth and soil salinity status (Richards, 1954). Organic carbon is essential for maintaining soil structure, improving water holding capacity, and enhancing microbial processes (Walkley & Black, 1934).

Several studies conducted in different regions of India have reported variations in soil physico-chemical properties due to differences in land use and management practices (Singh et al., 2017). For example, soils in agricultural regions often show nutrient depletion due to continuous cropping and excessive use of chemical fertilizers (Kumar et al., 2018). In contrast, soils under forest or vegetation cover generally exhibit higher organic carbon content and better nutrient status (Sharma et al., 2019).

Research conducted on soil fertility in central India has indicated that most soils are slightly acidic to neutral in nature, which is suitable for a wide range of crops (Patel et al., 2015). However, deficiencies in essential nutrients such as nitrogen, phosphorus, and micronutrients like zinc and iron have been reported in several studies, affecting crop productivity (Verma et al., 2020).

The role of micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu) is also critical for plant growth, as they are involved in various enzymatic and metabolic processes (Alloway, 2008). Deficiency or excess of these micronutrients can lead to reduced crop yield and soil degradation (Gupta, 2004).

Recent studies have emphasized the importance of sustainable soil management practices, including the use of organic fertilizers, crop rotation, and conservation agriculture, in improving soil physico-chemical properties (Lal, 2015). These practices help in maintaining soil health, enhancing nutrient cycling, and reducing environmental degradation (FAO, 2017).

Despite extensive research on soil properties in different regions, there is limited scientific data available for the Mahuapara region of Ambikapur, Surguja district (Chhattisgarh). Therefore, a detailed study on the physico-chemical properties of soil in this area is essential to assess soil fertility status and to recommend appropriate management practices for sustainable agriculture (Indian Council of Agricultural Research [ICAR], 2012).

MATERIALS AND METHODS:

Soil Sampling:

Soil samples were collected by following standardized and widely accepted sampling procedures to ensure accuracy and reliability. The samples were taken from a depth of 15–30 cm using a soil auger, which represents the active root zone of most crops. After collection, the samples were air-dried under room temperature to remove moisture. The dried samples were then gently crushed and passed through a 2 mm sieve to eliminate stones, roots, and other unwanted materials. To obtain a representative sample, the sieved soil was thoroughly mixed and subjected to the quartering method. One portion was further processed by passing it through a 0.5 mm sieve, and again quartered. Finally, a fine fraction was obtained by sieving one part through a 0.02 mm sieve for precise laboratory analysis.

Materials Used:

The analysis was carried out using standard laboratory instruments and chemicals. These included a digital pH meter for measuring acidity or alkalinity, an electrical conductivity meter for salinity analysis, an analytical weighing balance for accurate measurement of samples, and an oven for drying purposes. Various glassware such as beakers, flasks, and pipettes were used along with specific chemical reagents required for determining different soil nutrients.

Analytical Methods:

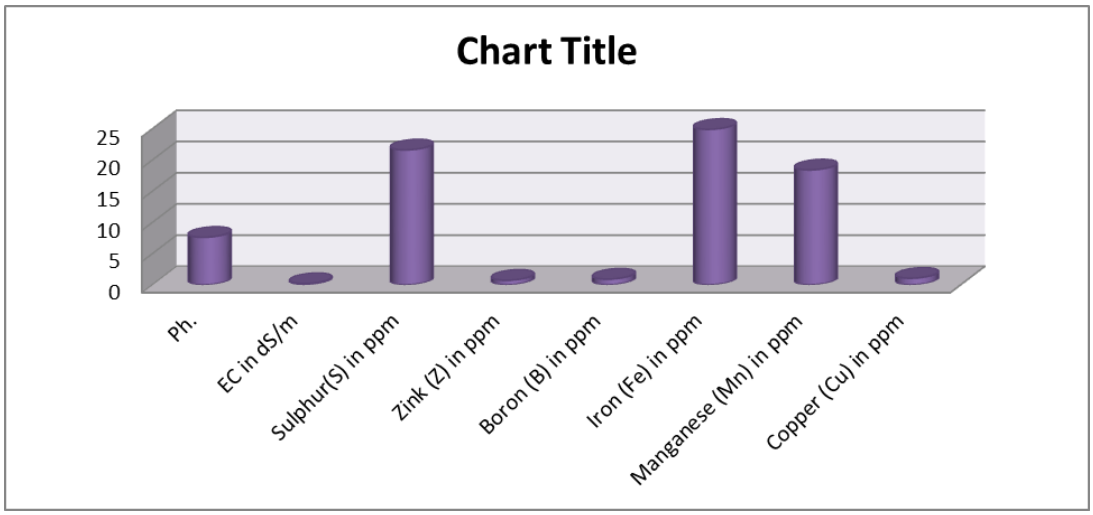
Soil pH was measured using a digital pH meter in a soil-water suspension with a ratio of 1:2.5. Electrical conductivity (EC) was determined using a conductivity meter to assess the soluble salt content. Organic carbon content was estimated by the Walkley and Black wet oxidation method. Available nitrogen was analyzed using the Alkaline Permanganate method, while available phosphorus was determined by the Olsen method. Available potassium was measured with the help of a flame photometer. Micronutrients such as zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) were analyzed using standard chemical extraction and measurement techniques.

Data Analysis:

The results obtained from laboratory analysis were carefully recorded and interpreted to evaluate the physico-chemical properties and fertility status of the soil samples. The observations derived from these analyses are presented as follows.

Table 1: Physico-chemical properties of soil sample taken from Shardapur village.

Ph.	EC in dS/m	Sulphur(S) in ppm	Zink (Z) in ppm	Boron (B) in ppm	Iron (Fe) in ppm	Manganese (Mn) in ppm	Copper (Cu) in ppm
7.6	0.18	21.6	0.72	0.9	24.9	18.4	1.04



Graph: 1: All Physico-chemical properties of soil sample.

RESULTS AND DISCUSSION:

The analyzed soil sample shows a pH value of 7.6, indicating slightly alkaline soil conditions, which are generally suitable for most crops but may reduce the availability of certain micronutrients such as iron and zinc at higher levels (Brady & Weil, 2016). The electrical conductivity (EC) value of 0.18 dS/m indicates that the soil is non-saline and does not pose any salinity hazard to plant growth (Richards, 1954).

The sulphur (S) content of 21.6 ppm falls within the adequate range for plant growth, suggesting sufficient availability for protein synthesis and enzymatic activities in crops (Tandon, 1995). Zinc (Zn) concentration of 0.72 ppm is considered marginal to adequate, indicating that while deficiency is not severe, continuous cropping may lead to zinc depletion over time (Alloway, 2008).

The boron (B) content of 0.9 ppm is within the optimal range for most crops, playing a crucial role in cell wall formation and reproductive growth (Gupta, 2004). Iron (Fe) content of 24.9 ppm is adequate for plant requirements; however, its availability may be affected by the slightly alkaline pH of the soil (Lindsay & Norvell, 1978).

Manganese (Mn) concentration of 18.4 ppm is sufficient and supports various physiological processes such as photosynthesis and enzyme activation in plants (Marschner, 2012). Copper (Cu) content of 1.04 ppm is also within the adequate range, indicating no deficiency or toxicity issues for plant growth (Kabata-Pendias, 2011).

CONCLUSION:

The analyzed soil sample with a pH of 7.6 indicates slightly alkaline conditions, which are generally favorable for crop production but may influence the availability of certain micronutrients (Brady & Weil, 2016). The electrical conductivity value of 0.18 dS/m confirms that the soil is non-saline and suitable for agricultural use without any salinity-related constraints (Richards, 1954). The sulphur content (21.6 ppm) is within the adequate range, ensuring proper plant growth and metabolic activities (Tandon, 1995). The zinc concentration (0.72 ppm) is marginally sufficient, suggesting that continuous cultivation may require zinc supplementation to avoid deficiency in the future (Alloway, 2008). The boron level (0.9 ppm) is optimal for plant development, particularly in reproductive processes and cell formation (Gupta, 2004). Iron content (24.9 ppm) is adequate; however, its bioavailability may be slightly reduced due to the alkaline nature of the soil (Lindsay & Norvell, 1978). Manganese (18.4 ppm) and copper (1.04 ppm) concentrations are within the sufficient range, supporting various enzymatic and physiological functions in plants (Marschner, 2012). Overall, the soil exhibits good physico-chemical characteristics with adequate micronutrient status, making it suitable for agricultural practices (Havlin et al., 2014). However, to maintain long-term soil fertility and productivity, the application of organic matter and balanced fertilization is recommended, particularly to improve micronutrient availability under slightly alkaline conditions (Lal, 2015).

REFERENCES:

1. Alloway, B. J. (2008). Zinc in soils and crop nutrition. International Zinc Association.
2. Brady, N. C., & Weil, R. R. (2016). The nature and properties of soils (15th ed.). Pearson.
3. Dewangan, S. K., Jaiswal, A., Shukla, N., Pandey, U., Kumar, A., & Kumari, N. (2022). Characterization of agriculture Soil of Gangapur area located in Latori, Surguja division of Chhattisgarh. International Journal of Science, Engineering And Technology, 11(1).
4. Dewangan, S. K., Kumari, J., Tiwari, V., Kumari, L. (2022). Study the Physico-Chemical Properties of Red Soil of Duldula Area Located in Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Scientific Research in Engineering and Management (IJSREM), 06(11), 1-5.
5. Dewangan, S. K., Kumari, L., Minj, P., Kumari, J., & Sahu, R. (2023). The Effects of Soil pH on Soil Health and Environmental Sustainability: A Review. International Journal of Emerging Technologies and Innovative Research, 10(6),

6. Dewangan, S. K., Kumari, L., Tiwari, V., Kumari, J. (2022). Study the Physio-Chemical Properties of Red Soil of Kandora Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Innovative Research in Engineering (IJIRE), 3(6), 172-175.
7. Dewangan, S. K., Minj, A. K., & Yadav, S. (2022). Study the Physico-Chemical Properties of Soil of Bouncing Land Jaljali Mainpat, Surguja Division of Chhattisgarh, India. International Journal of Creative Research Thoughts, 10(10), 312-315.
8. Dewangan, S. K., Minj, P., Singh, P., Singh, P., Shivlochani. (2022). Analysis of the Physico-Chemical Properties of Red Soil Located in Koranga Mal Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Advanced Research Journal in Science, Engineering and Technology, 9(11), 116-119.
9. Dewangan, S. K., Sahu, K., Tirkey, G., Jaiswal, A., Keshri, A., Kumari, N., Kumar, N., Gautam, S. (2022). Experimental Investigation of Physico-Chemical Properties of Soil taken from Bantidand Area, Balrampur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 04(12), 751-755.
10. Dewangan, S. K., Sahu, R., Haldar, R., & Kedia, S. (2022). Study the physico-chemical properties of black soil of girwani village of balrampur district, surguja division of chhattisgarh, india. Epra International Journal of Agriculture and Rural Economic Research (ARER), 10(11), 53-56.
11. Dewangan, S. K., Sharma, G. K., & Srivasrava, S. K. (2022). Characterization of agriculture Soil of Gangapur area located in Latori, Surguja division of Chhattisgarh. International Journal of Science, Engineering And Technology, 11(1), 1-3. Dewangan, S. K., Shrivastava, S. K., Kehri, D., Minj, A., & Yadav, V. (2023). A Review of the Study Impact of Micronutrients on Soil Physicochemical Properties and Environmental Sustainability. International Journal of Agriculture and Rural Economic Research (ARER), 11(6).
12. Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., Yadav, M., & Sahu, K. (2023). Using the Soil Texture Triangle to Evaluate the Effect of Soil Texture on Water Flow: A Review. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(6), 389-390.
13. Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., Yadav, M., & Sahu, K. (2023). Using the Soil Texture Triangle to Evaluate the Effect of

Soil Texture on Water Flow: A Review. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(6), 389-390.

14. Dewangan, S. K., Singh, D., Haldar, R., & Tirkey, G. (2022). Study the Physio-Chemical Properties of Hair Wash Soil of Kardana Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Journal of Novel Research and Development, 7(11), 13-17.
15. Dewangan, S. K., Soni, A. K., & Sahu, K. (2022). Study the Physico-Chemical Properties of Rock Soil of Sangam River, Wadrafnagar, Surguja Division of Chhattisgarh, India. International Journal of Research and Analytical Reviews, 9(4), 119-121. Dewangan, S. K., Yadav, M. K., Tirkey, G. (2022). Study the Physico-Chemical Properties of Salt Soil of Talkeshwarpur Area Located in Balrampur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 4(11), 791-797.
16. Dewangan, S. K., Yadav, R., Haldar, R. (2022). Study the Physio-Chemical Properties of Clay Soil of Kandora Village of Jashpur District, Surguja Division of Chhattisgarh, India. EPRA International Journal of Research and Development (IJRD), 7(11), 87-91. Dewangan, S. K., Yadav, V., Sahu, K. (2022). Study the Physio-Chemical Properties of Black Soil of Bahora Village of Jashpur District, Surguja Division of Chhattisgarh, India. International Research Journal of Modernization in Engineering Technology and Science, 04(11), 1962-1965. Dewangan, S.K., Kehri, D., Preeti . & Yadav, A.(2022). Study The Physico-Chemical Properties Of Brown Soil Of Gaura Village Of Surajpur District, Surguja Division Of Chhattisgarh, India. International Journal of Engineering Inventions,11(11),80-83.
17. Dewangana, S. K., Mahantb, M. (2023). Physical Characterization of Soil from BudhaBagicha Area, Balrampur, Chhattisgarh and its Comparative Study with Soils of Other Areas. International Journal of Science, Engineering and Technology, 11(6). Dewangana, S. K., Yadavb, N., & Preetic. (2023). A Study on the Physicochemical Properties of Soil of Butapani Area Located in Self-Flowing Water, Lundra Block, Surguja District, Chhattisgarh, India. EPRA International Journal of Research and Development (IJRD), 8(12).
18. FAO. (2017). Soil organic carbon: The hidden potential. Food and Agriculture Organization.
19. Gupta, U. C. (2004). Micronutrients in soils, crops, and livestock. CABI Publishing.

20. Havlin, J. L., Tisdale, S. L., Nelson, W. L., & Beaton, J. D. (2014). Soil fertility and fertilizers (8th ed.). Pearson.
21. ICAR. (2012). Handbook of agriculture. Indian Council of Agricultural Research.
22. Kabata-Pendias, A. (2011). Trace elements in soils and plants (4th ed.). CRC Press.
23. Kumar, A., Singh, B., & Sharma, P. (2018). Assessment of soil fertility under intensive agriculture. Journal of Soil Science, 10(2), 45–52.
24. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. Sustainability, 7(5), 5875–5895.
25. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test. Soil Science Society of America Journal, 42(3), 421–428.
26. Marschner, P. (2012). Marschner's mineral nutrition of higher plants (3rd ed.). Academic Press.
27. McLean, E. O. (1982). Soil pH and lime requirement. In A. L. Page (Ed.), Methods of soil analysis (pp. 199–224). ASA.
28. Naveed, M., Moldrup, P., Arthur, E., de Jonge, L. W., & Vogel, H. J. (2018). Soil organic carbon content effects on soil water retention on the Loess Plateau, China: A review. Journal of Hydrology, 565, 607-617.
29. Patel, K. S., Sharma, R., & Verma, S. (2015). Soil quality assessment in central India. Indian Journal of Agricultural Research, 49(3), 210–215.
30. Prajapati, S., Singh, V., & Singh, S. (2019). Assessment of soil physicochemical properties in Korba district, Chhattisgarh. International Journal of Chemical Studies, 7(1), 281-286.
31. Qadir, M., Tubeileh, A., Akhtar, J., Larbi, A., & Minhas, P. S. (2008). Productivity enhancement of salt-affected environments through crop diversification. Land Degradation & Development, 19(4), 429-453.
32. Rhoades, J. D., Chanduvi, F., & Lesch, S. M. (1999). Soil salinity assessment: methods and interpretation of electrical conductivity measurements. Food and Agriculture Organization of the United Nations.
33. Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Handbook 60.
34. Rillig, M. C., Aguilar-Trigueros, C. A., Bergmann, J., Verbruggen, E., Veresoglou, S. D., & Lehmann, A. (2015). Plant root and mycorrhizal fungal traits for understanding soil aggregation. New Phytologist, 205(4), 1385-1388.

35. Sharma, R., Singh, H., & Kaur, M. (2019). Impact of vegetation on soil properties. Environmental Monitoring and Assessment, 191(3), 150.
36. Singh, D., Kumar, V., & Yadav, R. (2017). Variability in soil properties under different land uses. International Journal of Soil Science, 12(1), 1–10.
37. Tandon, H. L. S. (1995). Sulphur research and agricultural production in India. Fertiliser Development and Consultation Organisation.
38. Tandon, H. L. S. (2013). Methods of analysis of soils, plants, waters and fertilizers. Fertiliser Development and Consultation Organisation.
39. Verma, S., Patel, K., & Singh, P. (2020). Micronutrient status of agricultural soils. Journal of Plant Nutrition, 43(5), 789–799.
40. Walkley, A., & Black, I. A. (1934). An examination of soil organic carbon. Soil Science, 37(1), 29–38.