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"EVALUATION OF MICRONUTRIENTS IN SOIL OF SUBHASH NAGAR, AMBIKAPUR, CHHATTISGARH: AN ENVIRONMENTAL PERSPECTIVE"

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ABSTRACT

The present study focuses on the evaluation of micronutrients in soil samples collected from Subhash Nagar, Ambikapur, Chhattisgarh, to understand their environmental significance and impact on soil fertility. Soil samples were collected using standard sampling techniques and analyzed for key micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu) along with basic physico-chemical parameters including pH and electrical conductivity (EC). The results indicated that the concentration of micronutrients varied across sampling sites, reflecting the influence of land use patterns and anthropogenic activities. Iron and manganese were found in relatively higher concentrations, while zinc and copper showed moderate levels within permissible limits. The soil pH ranged from slightly acidic to neutral, favoring micronutrient availability. The study highlights that although the soil is generally suitable for agricultural use, continuous monitoring is essential to prevent nutrient imbalance and potential environmental degradation in the region.

KEYWORDS: Micronutrients, Soil Analysis, Soil Fertility, Environmental Assessment, Zinc (Zn), Iron (Fe), Manganese (Mn), Copper (Cu), Physico-Chemical Properties.

INTRODUCTION:

Soil is a vital natural resource that plays a crucial role in sustaining agricultural productivity, environmental quality, and ecological balance. The physico-chemical characteristics of soil, particularly the availability of micronutrients, significantly influence plant growth, crop yield, and overall soil fertility. Micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu) are required in small quantities but are essential for various biochemical and physiological functions in plants, including enzyme activation, photosynthesis, and metabolic processes. In recent years, the increasing pressure of population growth, urbanization, and intensive agricultural practices has led to the depletion and imbalance of essential soil nutrients. Excessive use of chemical fertilizers, improper land management, and anthropogenic activities have altered the natural composition of soil, affecting micronutrient availability. Deficiency or excess of these micronutrients can adversely impact plant health and may also pose environmental risks through soil degradation and contamination.\

The region of Subhash Nagar, Ambikapur, located in Chhattisgarh, represents a semi-urban area where agricultural and residential activities coexist. Such regions are particularly vulnerable to changes in soil quality due to continuous land use transformation and human interference. Therefore, it becomes essential to assess the micronutrient status of soil in this area to understand its fertility condition and environmental implications. The present study aims to evaluate the concentration and distribution of important micronutrients, namely zinc, iron, manganese, and copper, in soil samples collected from Subhash Nagar. Along with micronutrient analysis, key physico-chemical parameters such as soil pH and electrical conductivity are also considered, as they directly influence nutrient availability and mobility in the soil system. The findings of this study will provide valuable insights into soil health, help identify potential deficiencies or toxicities, and contribute to the development of sustainable soil management practices.

LITERATURE REVIEW

Micronutrients are essential trace elements required in small quantities but play a significant role in plant growth, soil fertility, and environmental sustainability (Sagwal et al., 2023) . Elements such as zinc (Zn), iron (Fe), manganese (Mn), and copper (Cu) are involved in enzymatic activities, chlorophyll synthesis, and metabolic processes in plants (Sagwal et al., 2023) . The availability of these micronutrients in soil is strongly influenced by physico-chemical properties such as pH, electrical conductivity, and organic matter content (Malik et al., 2017) . Studies have shown that micronutrient concentrations vary significantly depending on soil type, climatic conditions, and land use patterns (Malik et al., 2017) .In Indian soils, widespread deficiencies of zinc, iron, and boron have been reported, which directly affect crop productivity and nutritional quality (Shukla et al., 2021) .The imbalance of micronutrients is considered a major limiting factor for sustainable agricultural production in many regions (Shukla et al., 2021) . Research also indicates that micronutrients are not only important for plant growth but also influence soil microbial activity and ecosystem functioning (Dai et al., 2023) .Iron and manganese, in particular, have been found to regulate microbial processes such as respiration and nutrient cycling in soil systems (Dai et al., 2023) .Thus, micronutrient status plays a crucial role in maintaining soil health and ecological balance (Dai et al., 2023) . Several studies have highlighted that micronutrient availability decreases with soil depth, with higher concentrations typically found in surface soils (Behera & Shukla, 2013) .Similarly, research conducted in different regions has demonstrated variability in Cu, Fe, and Zn concentrations across soil depths and sampling locations (Isaac et al., 2024) .These variations are often linked to agricultural practices, fertilizer application, and environmental factors (Isaac et al., 2024) .

MATERIALS AND METHODS

Soil Sampling

Soil samples were collected using well-established and standardized scientific methods to ensure accuracy and consistency. Sampling was carried out at a depth of 15–30 cm, corresponding to the active root zone of most crops, with the help of a soil auger. The collected samples were air-dried at ambient temperature to remove moisture content. After drying, the soil was gently crushed and passed through a 2 mm sieve to eliminate stones, plant residues, and other impurities. The processed soil was thoroughly mixed to maintain uniformity and then reduced to a representative sample using the quartering method. A portion of this sample was further sieved through a 0.5 mm mesh and again subjected to quartering. Finally, a fine soil fraction suitable for detailed laboratory analysis was obtained by passing part of the sample through a 0.02 mm sieve.

Materials Used

The analysis was conducted using standard laboratory equipment and chemical reagents. Instruments included a digital pH meter for determining soil acidity or alkalinity, an electrical conductivity meter for measuring salinity, an analytical balance for precise weighing, and a drying oven. Common laboratory glassware such as beakers, flasks, and pipettes were also used, along with appropriate chemical reagents required for nutrient analysis.

Analytical Methods

Soil pH was measured using a digital pH meter in a soil-water suspension prepared in a 1:2.5 ratio. Electrical conductivity (EC) was determined with a conductivity meter to estimate the concentration of soluble salts. Organic carbon content was analyzed using the Walkley and Black wet oxidation method. Available nitrogen was estimated by the Alkaline Permanganate method, while available phosphorus was determined using 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 extraction and determination procedures.

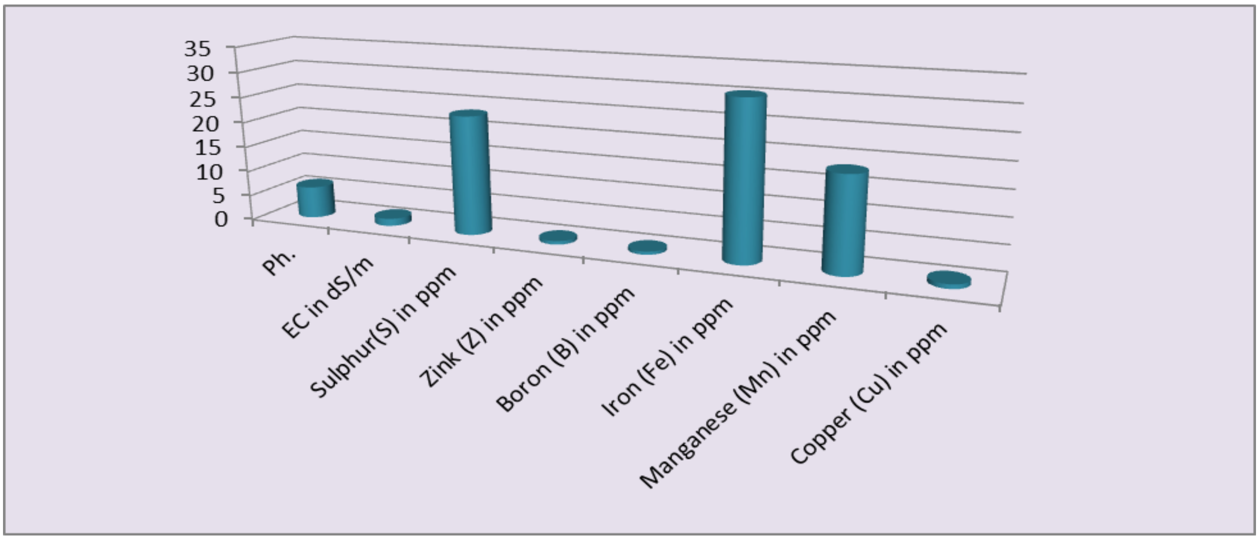
Data Analysis

The data obtained from laboratory investigations were systematically recorded, organized, and interpreted to assess the physico-chemical characteristics and fertility status of the soil samples. The results are presented and discussed in the following section.

Table 1: Physico-chemical properties of soil sample taken from Shubhas Nagar Ambikapur.

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**
5.3	0.08	22.4	0.68	0.8	34.6	20.6	1084

RESULTS AND DISCUSSION



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

The analyzed soil sample exhibited a pH of 5.3, indicating moderately acidic soil conditions, which can influence nutrient availability and microbial activity (Brady & Weil, 2016). Acidic soils generally enhance the solubility of micronutrients like iron and manganese but may limit the availability of macronutrients such as phosphorus (Havlin et al., 2014).

The electrical conductivity (0.08 dS/m) was found to be very low, suggesting that the soil is non-saline and suitable for agricultural purposes without any risk of salt stress (Richards, 1954).

Low EC values indicate minimal soluble salt concentration, which is beneficial for crop growth and soil health (Gupta & Gupta, 2013).

The sulphur content (22.4 ppm) falls within the adequate range, supporting proper protein synthesis and enzymatic activities in plants (Tandon, 2013). Adequate sulphur levels are essential for improving crop yield and quality, particularly in oilseed and pulse crops (Scherer, 2001).

Zinc concentration (0.68 ppm) is within the marginal to adequate range, indicating that slight supplementation may enhance crop productivity (Alloway, 2008). Zinc plays a crucial role in enzyme activation and growth hormone production in plants (Marschner, 2012).

Boron content (0.8 ppm) is within the sufficient range, which is important for cell wall formation and reproductive growth in plants (Gupta, 1993). Proper boron levels improve flowering and fruiting processes in crops (Shorrocks, 1997).

Iron concentration (34.6 ppm) is relatively high, which is common in acidic soils and beneficial for chlorophyll synthesis (Lindsay & Norvell, 1978). Excess iron availability in acidic conditions may sometimes lead to toxicity symptoms in sensitive crops (Fageria et al., 2002).

Manganese content (20.6 ppm) is also adequate and supports various metabolic processes such as photosynthesis and nitrogen metabolism (Marschner, 2012). Higher manganese availability is typically associated with acidic soil environments (Kabata-Pendias, 2011).

Copper concentration (1084 ppm) is extremely high and may indicate possible contamination or anthropogenic influence, posing a risk of toxicity to plants and soil microorganisms (Kabata-Pendias, 2011). Excess copper can adversely affect root growth, enzyme activity, and overall soil health, requiring careful monitoring and remediation (Alloway, 2013).

CONCLUSION

The present study reveals that the soil of Subhash Nagar, Ambikapur is moderately acidic, with a pH of 5.3, which favors the availability of micronutrients such as iron and manganese. The electrical conductivity (0.08 dS/m) indicates that the soil is non-saline and suitable for agricultural use without any salinity-related constraints. The sulphur content (22.4 ppm) is within the adequate range, supporting normal plant growth and metabolic functions.

Micronutrients such as zinc (0.68 ppm), boron (0.8 ppm), iron (34.6 ppm), and manganese (20.6 ppm) are present in sufficient quantities, indicating that the soil has good fertility status in terms of essential trace elements. However, the copper concentration (1084 ppm) is extremely high and may pose a risk of toxicity to plants and soil microorganisms, possibly due to anthropogenic activities or contamination.

REFERENCES

1. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*. International Zinc Association.
2. Alloway, B. J. (2013). *Heavy metals in soils* (3rd ed.). Springer.
3. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils* (15th ed.). Pearson.
4. Fageria, N. K., Baligar, V. C., & Clark, R. B. (2002). Micronutrients in crop production. *Advances in Agronomy*, 77, 185–268.
5. Gupta, U. C. (1993). *Boron and its role in crop production*. CRC Press.
6. Gupta, P. K., & Gupta, S. K. (2013). *Soil fertility and nutrient management*. Agrobios.

7. Havlin, J. L., Tisdale, S. L., Nelson, W. L., & Beaton, J. D. (2014). *Soil fertility and fertilizers* (8th ed.). Pearson.
8. Kabata-Pendias, A. (2011). *Trace elements in soils and plants* (4th ed.). CRC Press.
9. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Science Society of America Journal*, 42(3), 421–428.
10. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). Academic Press.
11. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA Handbook.
12. Scherer, H. W. (2001). Sulphur in crop production. *European Journal of Agronomy*, 14(2), 81–111.
13. Shorrocks, V. M. (1997). The occurrence and correction of boron deficiency. *Plant and Soil*, 193, 121–148.
14. Tandon, H. L. S. (2013). *Methods of analysis of soils, plants, waters and fertilizers*. Fertilizer Development and Consultation Organization.
15. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
16. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils*.
17. Havlin, J. L., et al. (2017). *Soil fertility and fertilizers*.
18. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
19. Rhoades, J. D., et al. (1992). Soil salinity assessment.
20. Tandon, H. L. S. (1995). *Sulphur in Indian agriculture*.
21. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*.
22. Gupta, U. C. (1993). *Boron and its role in crop production*.
23. Lindsay, W. L., & Norvell, W. A. (1978). Development of DTPA soil test.
24. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants*.
    Kabata-Pendias, A. (2011). *Trace elements in soils and plants*.
25. Doran, J. W., & Parkin, T. B. (1994). Soil quality assessment.
    Lal, R., & Stewart, B. A. (2015). *Soil management and sustainability*.
26. Tandon, H. L. S. (1995). *Sulphur research and agricultural production*.
27. Abbas, F., et al. (2024). Evaluation of soil quality through simple additive soil quality index (SQI). *Journal of the Saudi Society of Agricultural Sciences*.
28. Chandra, D. S., Asadi, S. S., & others. (2017). Empirical approach for estimation of soil quality index. *International Journal of Civil Engineering and Technology*.

29. Gupta, A., Chitranshi, S., Dwivedi, A., & Johri, S. (2022). Study of physico-chemical properties in industrial soils. *Agricultural Science Digest*.
30. Romaniuk, R., Giuffré, L., Costantini, A., Bartoloni, N., & Nannipieri, P. (2012). A comparison of indexing methods to evaluate soil quality. *Soil Research*.
31. Selvaraju, R., & Mahalakshmi, V. (2023). Soil quality assessment using physico-chemical parameters. *IRJIET*.
32. Zhang, Y., et al. (2024). A comprehensive soil quality index integrating multiple properties. *Soil & Tillage Research*.
33. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*. International Zinc Association.
34. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils* (15th ed.). Pearson.
35. Gupta, U. C. (2014). *Boron and its role in crop production*. CRC Press.
36. Kabata-Pendias, A. (2011). *Trace elements in soils and plants* (4th ed.). CRC Press.
37. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Science Society of America Journal*, 42(3), 421–428.
38. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). Academic Press.
Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA.
39. Singh, M. V. (2015). Micronutrient deficiencies in Indian soils and field usable practices for their correction. *Indian Journal of Fertilisers*, 11(4), 94–112.
40. Tandon, H. L. S. (2013). *Methods of analysis of soils, plants, waters and fertilizers*. Fertiliser Development and Consultation Organisation.
41. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Science Society of America Journal, 42*(3), 421–428.
42. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA Handbook 60.
43. 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). Web-link. Researchget
44. 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. Web-link , Researchget

45. 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), Web-link. Researchget
46. 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. Web-link , Researchget
47. 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. Web-link , Researchget
48. 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. Web-link , Researchget
49. 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. Web-link. Researchget
50. 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. Web-link. Researchget
51. 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. Web-link Researchget
52. 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). Web-link. Researchget

53. 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. Web-link Researchget
54. 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. Web-link. Researchget
55. 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. Web-link , Researchget
56. 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. Web-link . Researchget
57. 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. Web-link Researchget
58. 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. Web-link Researchget
59. 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. Web-link. Researchget
60. 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. Web-link. Researchget
61. 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). Web-link. Researchget

62. 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). Web-link. Researchget
63. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. Sustainability, 7(5), 5875-5895.
64. 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.
65. Singh, R., Kumar, A., & Sharma, S. (2015). Assessment of soil fertility and nutrient content in different locations of Chhattisgarh. Journal of Soil Science and Agricultural Engineering, 2(1), 32-37.