2026 Volume: 02 Issue: 07 www.ijrpa.com ISSN 2456-9995 Research Article

International Journal Research Publication Analysis

Page: 01-12

ASSESSMENT OF SOIL HEALTH AND NUTRIENT AVAILABILITY IN GANDHINAGAR REGION, AMBIKAPUR, SURGUJA, CHHATTISGARH.

Shailesh Kumar Dewangan*[1], Deepesh Kumar[2], Preeti[3], Amit soini[3]

[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.).

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

Article Received: 13 June 2026
Article Revised: 03 July 2026
Published on: 23 July 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/ijrpa.1862

ABSTRACT

Soil is a fundamental natural resource that directly influences agricultural productivity and ecosystem sustainability. The present study aims to assess the physico-chemical properties of soil in Ghandhinagar Village,Surguja District (Chhattisgarh). Soil samples were collected from different locations using standard sampling procedures and analyzed for key parameters such as pH, electrical conductivity (EC), organic carbon, and essential nutrients including nitrogen (N), phosphorus (P), potassium (K), along with selected micronutrients. The results revealed that the soil is slightly acidic to neutral in reaction, with low to moderate electrical conductivity, indicating non-saline conditions. Organic carbon content was found to be moderate, suggesting average soil fertility status. Nitrogen levels were relatively low, whereas phosphorus and potassium ranged from medium to high. The study highlights the importance of balanced nutrient management and regular soil testing to improve soil health, ensure sustainable agriculture, and enhance crop productivity in the region.

KEYWORDS: Soil Physico-Chemical Properties, Ghandhinagar Village Soil, Surguja District Soil Analysis, NPK Nutrient Status, Soil pH and Electrical Conductivity.

INTRODUCTION

Ghandhinagar Village, located in the Ambikapur under Ambikapur Block of Surguja District in the state of Chhattisgarh (Pin code: 497001), represents a typical rural setting characterized by agrarian livelihood and natural resource dependence. The region falls within a semi-tropical climatic zone, experiencing moderate to high rainfall, which supports seasonal agriculture.

Soil is a vital natural resource that supports plant growth, maintains ecological balance, and plays a significant role in agricultural productivity. The quality and fertility of soil are largely determined by its physico-chemical properties, including pH, electrical conductivity (EC), organic carbon content, texture, and the availability of essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K). Understanding these properties is crucial for sustainable land use planning and effective crop management. In India, particularly in regions like Chhattisgarh, agriculture is highly dependent on soil health. Variations in soil characteristics due to climatic conditions, topography, and agricultural practices can significantly influence crop yield. Therefore, regular assessment of soil properties is necessary to identify nutrient deficiencies and adopt appropriate soil management strategies. The present study focuses on Gandhinagar Village in Surguja District (Chhattisgarh), an area with active agricultural practices. Evaluating the physico-chemical properties of soil in this region will help in understanding its fertility status and provide recommendations for improving productivity.

Figure 1: Soil sample collection.

LITERATURE REVIEW

Kekane et al. (2015) reported that soil is an indispensable natural resource whose physico-chemical properties, including pH, electrical conductivity, moisture, texture, and nutrient status, directly influence agricultural productivity and environmental sustainability (Kekane et al., 2015).

Kekane et al. (2015) further observed that systematic assessment of soil parameters such as organic matter, available nitrogen, phosphorus, and potassium provides essential information for effective soil management and crop planning (Kekane et al., 2015).

Dewangan et al. (2024) highlighted that soil functionality is largely governed by its physico-chemical characteristics, which determine water retention capacity, nutrient cycling, pollutant filtration, and plant growth (Dewangan et al., 2024).

Dewangan et al. (2024) emphasized that soil texture and structure significantly affect aeration, root penetration, and moisture availability, thereby influencing the productivity of agricultural lands (Dewangan et al., 2024).

According to Tandon and colleagues (2025), soil health is sustained through the interaction of physical, chemical, and biological properties, which collectively regulate ecosystem services such as nutrient transformation and carbon sequestration (Tandon et al., 2025).

Tandon et al. (2025) also stated that chemical properties, including pH, cation exchange capacity, and nutrient availability, serve as reliable indicators for evaluating soil fertility and long-term agricultural sustainability (Tandon et al., 2025).

Ngo et al. (2019) demonstrated that soil pH is one of the most critical parameters affecting nutrient availability and crop yield and can be effectively used for soil profiling in precision agriculture (Ngo et al., 2019).

Delgadillo-Duran et al. (2020) reported that advances in analytical techniques and machine learning have improved the estimation and prediction of important soil chemical properties such as pH, organic matter, calcium, magnesium, and potassium (Delgadillo-Duran et al., 2020).

Dey and Baitalik (2026) found that soil organic carbon (SOC) plays a crucial role in maintaining soil fertility, improving water-holding capacity, and enhancing microbial activity in agricultural ecosystems (Dey & Baitalik, 2026).

Dey and Baitalik (2026) further reported that intensive cultivation practices and soil erosion contribute to the decline of soil organic carbon, thereby adversely affecting soil quality and agricultural productivity (Dey & Baitalik, 2026).

Recent assessments under India's Soil Health Card programme revealed that approximately 64% of soil samples are deficient in nitrogen and nearly half exhibit low organic carbon content, highlighting the need for regular soil monitoring and balanced nutrient management (Centre for Science and Environment, 2025).

Studies conducted in different agricultural regions of India have consistently shown that balanced fertilization, incorporation of organic amendments, and conservation-based agricultural practices improve soil health and sustain crop yields over time (Times of India, 2025).

The existing literature clearly indicates that assessment of physico-chemical properties of surface soil is essential for understanding soil fertility status and developing sustainable land management strategies. Therefore, the present study on the surface soils of Palldnouli Village, Odgi Block, Surajpur District (C.G.), has been undertaken to generate baseline data on soil quality and to evaluate its suitability for agricultural purposes.

MATERIALS AND METHODS

This study was conducted to assess the physico-chemical properties of soil in Ghandhinagar village, located in Ambikapur Tehsil of Ambikapur Block, Surguja District (Chhattisgarh).

Soil Sampling

Following standard sampling procedures, soil samples were collected from a depth of 15–30 cm using a soil auger. The samples were air-dried, ground, and sieved through a 2 mm sieve to remove debris and stones. Subsequently, the sample was quartered, and one portion was sieved through a 0.5 mm sieve. This portion was then quartered again, and one part was sieved through a 0.02 mm sieve

Materials Used

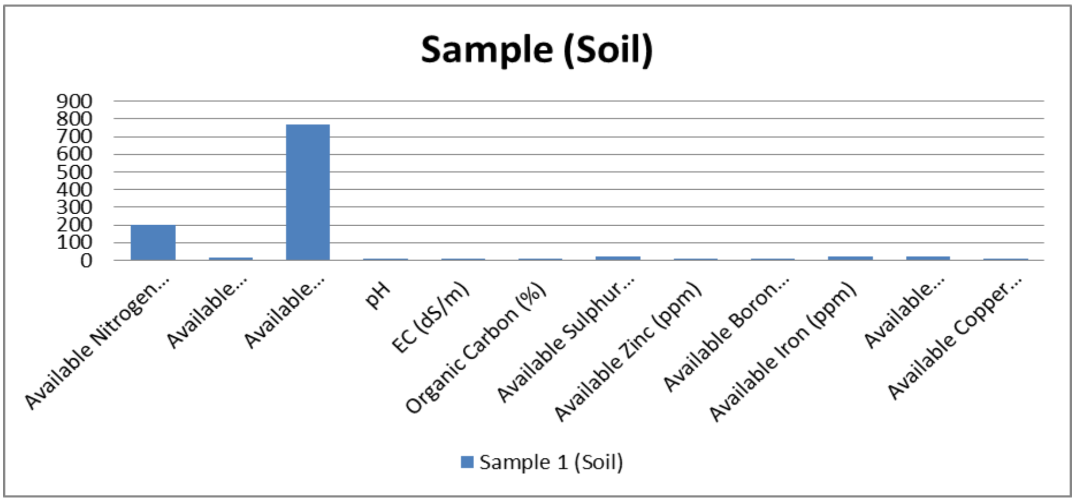
Standard laboratory equipment and chemicals were utilized, including a pH meter, electrical conductivity meter, weighing balance, oven, glassware, and reagents necessary for nutrient analysis.

Analytical Methods

The soil pH value was determined using a digital pH meter in a 1:2.5 soil-water suspension. Electrical Conductivity (EC) was measured using a conductivity meter. Organic carbon was assessed using the ‘Walkley and Black method.’ Available nitrogen was determined using the ‘Alkaline Permanganate method.’ Available phosphorus was analyzed using the ‘Olsen method.’ Available potassium was assessed using a flame photometer. Micronutrients such as zinc, iron, copper, and manganese were analyzed using standard extraction methods.

Table 1: Physico-chemical properties of soil sample taken from research area.

Parameter	Sample 1 (Soil)
Available Nitrogen (kg/ha)	200.7
Available Phosphorus (kg/ha)	14.3
Available Potassium (kg/ha)	770.5
pH	6.5
EC (dS/m)	0.44
Organic Carbon (%)	0.65
Available Sulphur (ppm)	22.4
Available Zinc (ppm)	0.63
Available Boron (ppm)	0.7
Available Iron (ppm)	18.9
Available Manganese (ppm)	18.3
Available Copper (ppm)	1.24



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

RESULT AND DISCUSSION

The physico-chemical analysis of the surface soil collected from Palldnouli Village, Odgi Block, Surajpur District, revealed considerable variation in macro- and micronutrient concentrations, indicating the overall fertility status of the study area (Brady & Weil, 2017).

The soil exhibited a pH value of 6.5, indicating a slightly acidic to neutral nature, which is considered favorable for the growth of most agricultural crops and for the availability of essential nutrients (Brady & Weil, 2017).

Similar findings have been reported by Kekane et al. (2015), who observed that soils within the pH range of 6.0–7.5 generally provide optimum conditions for nutrient uptake and microbial activity (Kekane et al., 2015).

The electrical conductivity (EC) of the soil was found to be 0.44 dS/m, suggesting the absence of salinity hazards and indicating that the soil is suitable for agricultural purposes (Richards, 1954).

According to Richards (1954), soils with EC values below 1.0 dS/m are classified as non-saline and do not adversely affect seed germination or plant growth (Richards, 1954).

The organic carbon content of the soil was recorded as 0.65%, which falls within the medium category and reflects moderate organic matter accumulation in the surface horizon (Walkley & Black, 1934).

Moderate organic carbon content contributes positively to soil structure, moisture retention, and nutrient availability, thereby enhancing soil productivity (Dey & Baitalik, 2026).

The available nitrogen content was determined to be 200.7 kg/ha, which is categorized as low according to standard soil fertility ratings, indicating the possible need for nitrogen supplementation through fertilizers or organic amendments (Subbiah & Asija, 1956).

Low nitrogen levels in agricultural soils are commonly associated with continuous cropping and insufficient replenishment of nutrients removed during harvest (Brady & Weil, 2017).

The available phosphorus concentration was found to be 14.3 kg/ha, which falls under the medium fertility class and suggests an adequate supply for crop establishment and root development (Olsen et al., 1954).

Phosphorus is essential for energy transfer and reproductive growth in plants, and its moderate concentration indicates a balanced phosphorus status in the study area (Olsen et al., 1954).

The soil exhibited a high available potassium content of 770.5 kg/ha, indicating excellent potassium reserves and a strong capacity to support crop growth and stress tolerance (Hanway & Heidel, 1952).

High potassium levels may be attributed to the weathering of potassium-bearing minerals and the parent material characteristics of the region (Brady & Weil, 2017).

The available sulphur concentration was recorded at 22.4 ppm, which lies within the sufficient range required for protein synthesis and enzymatic activities in plants (Tandon, 1995).

Sulphur availability in adequate quantities enhances nitrogen utilization efficiency and contributes to improved crop quality and yield (Tandon, 1995).

Micronutrient analysis revealed that the available zinc content was 0.63 ppm, which is near the critical limit and suggests a potential risk of zinc deficiency in sensitive crops (Lindsay & Norvell, 1978).

Zinc plays a significant role in enzyme activation and auxin synthesis, and its deficiency can adversely affect plant growth and productivity (Lindsay & Norvell, 1978).

The available boron content was measured at 0.70 ppm, indicating a sufficient concentration for supporting cell wall development, flowering, and seed formation (Gupta, 1993).

The available iron concentration was found to be 18.9 ppm, which is considerably higher than the critical limit, suggesting an adequate supply for chlorophyll synthesis and metabolic processes in plants (Lindsay & Norvell, 1978).

Similarly, the available manganese content was 18.3 ppm, indicating sufficient availability for photosynthesis and enzyme-mediated biochemical reactions (Brady & Weil, 2017).

The copper concentration in the soil was recorded as 1.24 ppm, which exceeds the critical deficiency threshold and reflects a favorable micronutrient status (Lindsay & Norvell, 1978).

CONCLUSION

The soil exhibited a pH of 6.5 and an electrical conductivity of 0.44 dS/m, indicating a slightly acidic, non-saline nature that is suitable for the cultivation of a wide range of crops. The organic carbon content (0.65%) was found to be moderate, suggesting satisfactory soil organic matter status and a reasonable capacity for nutrient retention. The macronutrient analysis revealed that available nitrogen (200.7 kg/ha) was comparatively low, whereas available phosphorus (14.3 kg/ha) was present at a medium level. In contrast, the soil showed a high concentration of available potassium (770.5 kg/ha), indicating excellent potassium reserves. The available sulphur content (22.4 ppm) was found to be adequate for supporting normal plant metabolic activities.

Micronutrient analysis demonstrated sufficient levels of boron (0.70 ppm), iron (18.9 ppm), manganese (18.3 ppm), and copper (1.24 ppm), which are essential for various physiological and biochemical processes in plants. However, the zinc concentration (0.63 ppm) was observed to be close to the critical deficiency limit, suggesting that zinc supplementation may be beneficial for maintaining optimum crop productivity.

REFERENCES

1. Abbas, F., et al. (2024). Evaluation of soil quality through simple additive soil quality index (SQI). *Journal of the Saudi Society of Agricultural Sciences*.
2. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*.
3. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*. International Zinc Association.
4. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils*.

5. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils* (15th ed.). Pearson.
6. Brady, N. C., & Weil, R. R. (2017). *The nature and properties of soils* (15th ed.). Pearson Education.
7. Chandra, D. S., Asadi, S. S., & others. (2017). Empirical approach for estimation of soil quality index. *International Journal of Civil Engineering and Technology*.
8. 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
9. 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
10. 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
11. 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
12. 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
13. 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
14. 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
15. 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
16. 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
17. 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
18. 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
19. 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
20. 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
21. 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
22. 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

23. 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
24. 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
25. 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
26. 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
27. 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
28. Dey, P., & Baitalik, A. (2026). *Unravelling the key drivers of soil organic carbon (SOC) dynamics: A comprehensive review and meta-analysis*. Journal of the Indian Society of Soil Science, 73(3), 400–416.
29. Doran, J. W., & Parkin, T. B. (1994). Soil quality assessment. Lal, R., & Stewart, B. A. (2015). *Soil management and sustainability*.
30. Gupta, A., Chitranshi, S., Dwivedi, A., & Johri, S. (2022). Study of physico-chemical properties in industrial soils. *Agricultural Science Digest*.
31. Gupta, U. C. (1993). *Boron and its role in crop production*.
32. Gupta, U. C. (1993). *Boron and its role in crop production*.
33. Gupta, U. C. (1993). *Boron and its role in crop production*. CRC Press.
34. Gupta, U. C. (2014). *Boron and its role in crop production*. CRC Press.
35. Hanway, J. J., & Heidel, H. (1952). Soil analysis methods as used in Iowa State College Soil Testing Laboratory. *Iowa Agriculture, 57*, 1–31.
36. Havlin, J. L., et al. (2017). *Soil fertility and fertilizers*.

37. Kabata-Pendias, A. (2011). *Trace elements in soils and plants* (4th ed.). CRC Press.
38. Kabata-Pendias, A. (2011). *Trace elements in soils and plants*.
39. Kekane, S. S., Chavan, R. P., Shinde, D. N., Patil, C. L., & Sagar, S. S. (2015). *A review on physico-chemical properties of soil*. International Journal of Chemical Studies, 3(4), 29–32.
40. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. Sustainability, 7(5), 5875-5895.
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. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test.
43. 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.
44. 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.
45. Lindsay, W. L., & Norvell, W. A. (1978). Development of DTPA soil test.
46. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants*. Kabata-Pendias, A. (2011). *Trace elements in soils and plants*.
47. 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.
48. Olsen, S. R., Cole, C. V., Watanabe, F. S., & Dean, L. A. (1954). *Estimation of available phosphorus in soils by extraction with sodium bicarbonate*. USDA Circular 939.
49. 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.
50. Rhoades, J. D., et al. (1992). Soil salinity assessment.
51. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. U.S. Department of Agriculture.
52. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
53. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
54. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA Handbook 60.
55. Romaniuk, R., Giuffré, L., Costantini, A., Bartoloni, N., & Nannipieri, P. (2012). A comparison of indexing methods to evaluate soil quality. *Soil Research*.

56. Selvaraju, R., & Mahalakshmi, V. (2023). Soil quality assessment using physico-chemical parameters. *IRJIET*.
57. Singh, M. V. (2015). Micronutrient deficiencies in Indian soils and field usable practices for their correction. *Indian Journal of Fertilisers*, 11(4), 94–112.
58. 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.
59. Subbiah, B. V., & Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in soils. *Current Science, 25*(8), 259–260.
60. Tandon, H. L. S. (1995). *Sulphur in Indian agriculture*.
61. Tandon, H. L. S. (1995). *Sulphur research and agricultural production in India* (3rd ed.). Fertiliser Development and Consultation Organisation.
62. Tandon, H. L. S. (1995). *Sulphur research and agricultural production*.
63. Tandon, H. L. S. (2013). *Methods of analysis of soils, plants, waters, fertilizers and organic manures*. Fertiliser Development and Consultation Organisation.
64. Tandon, H. L. S. (2013). *Methods of analysis of soils, plants, waters and fertilizers*. Fertiliser Development and Consultation Organisation.
65. Zhang, Y., et al. (2024). A comprehensive soil quality index integrating multiple properties. *Soil & Tillage Research*.
66. Walkley, A., & Black, I. A. (1934). An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science, 37*(1), 29–38.