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"INVESTIGATION OF SOIL QUALITY AND NUTRIENT AVAILABILITY IN PATPARIYA AREA OF AMBIKAPUR USING PHYSICO-CHEMICAL ANALYSIS"

Shailesh Kumar Dewangan*[1], Anju Jaiswal[2], Md. Nurain Ansari[2], Preeti[3], Amit soni[3]

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

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

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

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***Corresponding Author: Shailesh Kumar Dewangan**
Assistant Professor & HOD Department of Physics, Shri Sai Baba Aadarsh Mahavidyalaya, Ambikapur(C.G.).
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ABSTRACT

Soil quality plays a vital role in determining agricultural productivity, ecosystem sustainability, and nutrient cycling. The present study investigates the soil quality and nutrient availability of the Patpariya area in Ambikapur, Chhattisgarh, through comprehensive physico-chemical analysis. Surface soil samples were collected from selected locations and analyzed for key parameters including pH, electrical conductivity (EC), organic carbon, available nitrogen, phosphorus, potassium, moisture content, and soil texture. The findings provide valuable insights into the fertility status and nutrient dynamics of the study area. Variations in soil properties were observed, reflecting the influence of local environmental conditions and land-use practices. The assessment revealed that the soils are generally suitable for agricultural purposes; however, certain nutrients exhibited deficiencies that may affect crop productivity if not managed appropriately. The study emphasizes the importance of periodic soil monitoring and site-specific nutrient management strategies to improve soil health and ensure sustainable agricultural development. The results generated from this investigation can serve as baseline data for farmers, researchers, and policymakers in planning effective soil conservation and fertility enhancement measures in the Patpariya region of Ambikapur.

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

INTRODUCTION

Soil is one of the most important natural resources and serves as the foundation for agricultural productivity, environmental sustainability, and ecosystem functioning. It acts as a medium for plant growth by providing essential nutrients, water, and support to vegetation. The physico-chemical characteristics of soil, such as pH, electrical conductivity, organic matter content, texture, and nutrient composition, significantly influence its fertility and productivity. Therefore, the assessment of soil quality is essential for understanding the capability of soils to sustain agricultural activities and maintain ecological balance.

In recent years, increasing agricultural intensification, changing land-use patterns, and environmental degradation have adversely affected soil health in many regions. Nutrient depletion, soil erosion, and improper fertilizer application practices have become major concerns, particularly in rural and semi-urban areas. Regular monitoring of soil quality and nutrient availability is necessary to develop effective soil management strategies and ensure sustainable agricultural development.

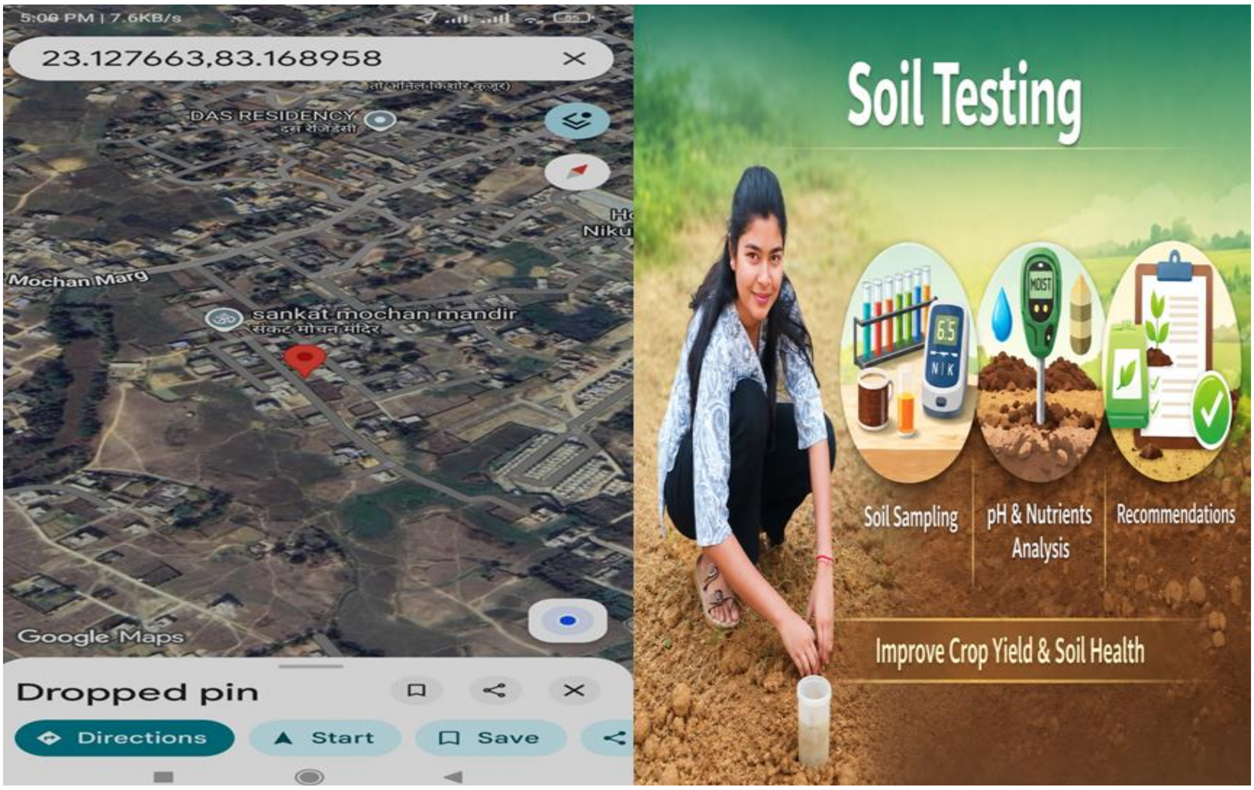


Figure 1: Soil sample collection.

The Patpariya area of Ambikapur, located in the Surguja district of Chhattisgarh, is characterized by diverse agricultural practices and varying soil conditions. Agriculture is a primary source of livelihood for the local population, making soil fertility a critical factor in determining crop yield and economic stability. Despite its agricultural importance, limited scientific information is available regarding the physico-chemical properties and nutrient status of soils in this region. Consequently, a detailed investigation of soil quality is required to generate baseline data for future agricultural planning and soil conservation initiatives.

Physico-chemical analysis provides a reliable and scientific approach for evaluating soil quality. Parameters such as soil pH, electrical conductivity (EC), organic carbon, available nitrogen (N), phosphorus (P), potassium (K), moisture content, and soil texture offer valuable information about the nutrient availability and overall health of soils. Understanding these properties helps identify nutrient deficiencies, assess soil suitability for crop cultivation, and recommend appropriate soil amendments and fertilizer management practices.

Literature Review

Parameters such as soil pH, electrical conductivity (EC), and organic carbon are widely recognized as key factors controlling soil productivity and agricultural performance (Imrana, 2019) . Soil pH plays a significant role in regulating nutrient solubility and microbial activity, with slightly acidic to neutral conditions being most suitable for crop growth (Imrana, 2019) . Electrical conductivity is an important measure of soil salinity, and higher EC values can negatively affect plant growth and soil structure (Imrana, 2019) . Organic carbon is a critical component of soil that enhances aggregation, porosity, and water retention capacity, thereby improving overall soil physical properties (Soil Advances, 2024) . Studies have shown that increased soil organic carbon significantly improves macro-aggregate formation and soil structural stability (Soil Advances, 2024) . The role of soil texture, clay minerals, and cation exchange capacity (CEC) is also important in determining nutrient retention and mobility within the soil system (Singh et al., 2017) . Clay fractions with higher surface area and charge density exhibit greater ability to retain dissolved organic carbon and nutrients (Singh et al., 2017) . Agricultural practices such as the use of fertilizers, organic amendments, and conservation techniques significantly influence soil physico-chemical properties and nutrient dynamics (Kumar et al., 2025) . Research indicates that conservation agriculture practices can enhance soil organic carbon and maintain stable pH and EC levels over time (Kumar et al., 2025) . Furthermore, integrated nutrient management practices have been found to improve soil fertility and nutrient uptake in crops (Pandey et al., 2015) . Overall, previous studies highlight that a comprehensive understanding of soil physico-chemical properties is crucial for sustainable soil management and improved agricultural productivity (Patra et al., 2024) The concept of Soil Quality Index (SQI) has been developed to simplify the complex interactions of multiple soil parameters into a single value for better interpretation and comparison (Chandra et al., 2017) . SQI integrates selected indicators such as pH, organic matter, phosphorus, potassium, and EC to classify soil into categories like good, moderate, or poor quality (Chandra et al., 2017) . This approach helps in identifying degraded soils and guiding appropriate management practices for sustainable land use (Chandra et al., 2017). Recent research has also highlighted the use of additive and weighted index methods for calculating SQI, which improve the accuracy and reliability of soil quality assessment (Abbas et al., 2024) . These methods involve assigning weights to different soil parameters based on their relative importance in influencing soil functions (Abbas et al., 2024) . Furthermore, studies have shown that spatial variability in soil properties can significantly affect SQI values, emphasizing the need for multi-site sampling and geospatial analysis (Abbas et al., 2024).

MATERIALS AND METHODS

1 Study Area

The present investigation was conducted in the Patpariya area of Ambikapur, situated in the Surguja district of Chhattisgarh, India. The region lies within the northern part of the state and is characterized by a tropical climate with distinct summer, monsoon, and winter seasons. Agriculture is the predominant occupation of the local population, and the area supports the cultivation of crops such as paddy, maize, pulses, and vegetables. The soils of Patpariya are influenced by climatic conditions, topography, and land-use practices, making it an ideal location for evaluating soil quality and nutrient status.

2 Collection of Soil Samples

Surface soil samples were collected from selected agricultural sites in the Patpariya area during the study period. Samples were obtained from a depth of 0–15 cm using a stainless-steel auger following standard soil sampling procedures. At each sampling location, multiple subsamples were collected and mixed thoroughly to prepare a representative composite sample. The collected samples were stored in clean polyethylene bags, properly labeled, and transported to the laboratory for further analysis.

3 Sample Preparation

The soil samples were air-dried at room temperature and subsequently crushed gently using a mortar and pestle to remove aggregates. The dried samples were passed through a 2 mm sieve to obtain a uniform particle size. Prepared samples were stored in airtight containers until analysis to prevent contamination and moisture absorption.

4 Materials and Instruments Used

The following materials and instruments were employed during the study:

- Soil auger
- Polyethylene sampling bags
- Mortar and pestle
- 2 mm sieve
- Digital pH meter
- Electrical Conductivity (EC) meter
- Analytical balance
- Hot air oven
- Glassware (beakers, conical flasks, pipettes, measuring cylinders)
- Spectrophotometer
- Flame photometer
- Distilled water and analytical grade reagents

5 Physico-Chemical Analysis of Soil

The collected soil samples were analyzed for various physico-chemical parameters using standard analytical methods. The methodologies adopted are summarized below:

Parameter	Method Used
pH	Digital pH Meter (1:2.5 Soil-Water Suspension)
Electrical Conductivity (EC)	Conductivity Meter
Organic Carbon	Walkley and Black Method
Available Nitrogen	Alkaline Permanganate Method
Available Phosphorus	Olsen's Method
Available Potassium	Flame Photometric Method
Moisture Content	Oven Drying Method
Soil Texture	Hydrometer Method

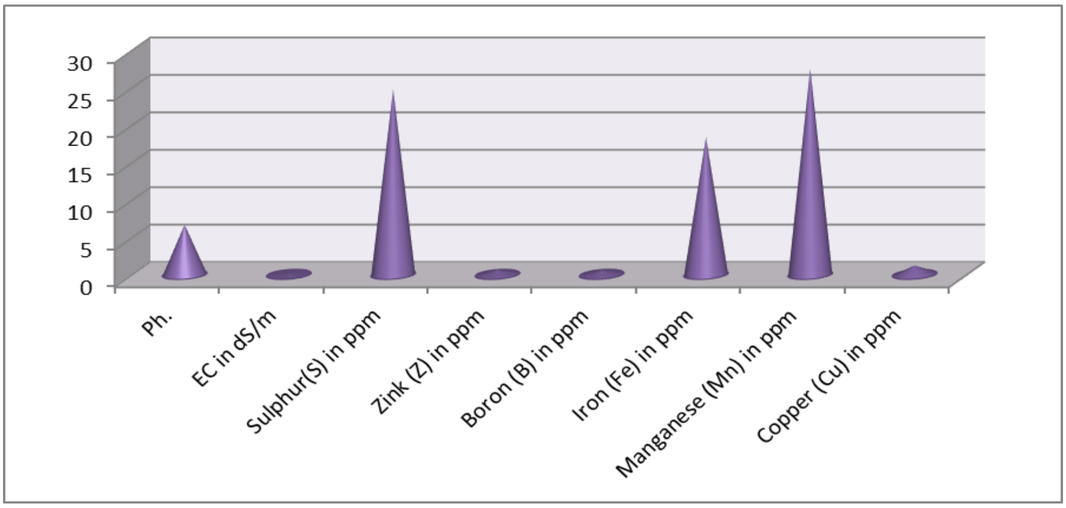
6 Data Analysis

The analytical data obtained from the physico-chemical examination of soil samples were compiled and subjected to descriptive statistical analysis. Mean values and standard deviations were calculated for the measured parameters wherever applicable. The observed values were compared with standard soil fertility ratings to assess the nutrient status and suitability of the soils for agricultural purposes.

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

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
6.7	0.15	24.8	0.64	0.6	18.4	27.6	1.24

RESULTS AND DISCUSSION



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

The soil exhibited a pH value of 6.7, indicating a slightly acidic to nearly neutral nature. Such soils are generally considered favorable for the availability of most essential plant nutrients and support the growth of a wide variety of crops. Soil pH plays a crucial role in regulating nutrient solubility, microbial activity, and overall soil fertility (Brady & Weil, 2017).

The electrical conductivity (EC) of the soil was found to be 0.15 dS/m, which is well below the threshold for saline soils. This suggests that the soil possesses low soluble salt content and is suitable for agricultural practices without the risk of salinity-induced stress on crops. According to Richards (1954), soils with EC values below 2.0 dS/m are generally classified as non-saline and suitable for crop cultivation.

The sulphur concentration in the soil was recorded as 24.8 ppm, indicating an adequate supply for plant growth. Sulphur is an essential secondary nutrient involved in protein synthesis, enzyme activation, and chlorophyll formation. The observed concentration suggests that the soil can support crop productivity without immediate sulphur supplementation (Havlin et al., 2014).

Zinc concentration was determined to be 0.64 ppm. Zinc is an essential micronutrient required for enzyme activity, protein synthesis, and auxin metabolism. The observed value is slightly above the commonly accepted critical limit of 0.6 ppm, indicating that the soil is marginally sufficient in zinc. However, continuous cultivation and intensive farming practices may lead to future zinc depletion, warranting regular monitoring (Lindsay & Norvell, 1978).

The boron content of the soil was found to be 0.60 ppm, which falls within the adequate range for most agricultural crops. Boron plays a significant role in cell wall development, pollen germination, and carbohydrate transport. Adequate boron availability contributes to improved crop yield and reproductive development (Gupta, 1993).

Iron concentration was measured at 18.4 ppm, substantially exceeding the critical deficiency level of approximately 4.5 ppm. Iron is essential for chlorophyll synthesis and various metabolic processes. Similarly, manganese and copper concentrations were observed to be 27.6 ppm and 1.24 ppm, respectively, both of which indicate sufficient availability for normal plant growth. These micronutrients are important for photosynthesis, enzyme activation, and disease resistance mechanisms in plants (Alloway, 2008).

CONCLUSION

The present study The soil sample showed a **pH of 6.7**, indicating a **slightly acidic to neutral reaction**, which is generally favorable for the availability of most plant nutrients. The **electrical conductivity (EC) of 0.15 dS/m** indicates that the soil is **non-saline** and suitable for crop cultivation.

The **available sulphur content (24.8 ppm)** is within the adequate range for most crops. The micronutrient analysis revealed that **zinc (0.64 ppm)** is marginal to adequate, while **boron (0.6 ppm)** is sufficient for normal plant growth. The concentrations of **iron (18.4 ppm)**, **manganese (27.6 ppm)**, and **copper (1.24 ppm)** are well above their critical deficiency levels, indicating adequate availability of these nutrients in the soil.

REFERENCES

1. Gupta, U. C. (1993). *Boron and its role in crop production*.
2. Kabata-Pendias, A. (2011). *Trace elements in soils and plants*.
3. Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test.

4. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
5. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils*.
6. Havlin, J. L., et al. (2017). *Soil fertility and fertilizers*.
7. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*.
8. Rhoades, J. D., et al. (1992). Soil salinity assessment.
9. Tandon, H. L. S. (1995). *Sulphur in Indian agriculture*.
10. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*.
11. Gupta, U. C. (1993). *Boron and its role in crop production*.
12. Lindsay, W. L., & Norvell, W. A. (1978). Development of DTPA soil test.
13. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants*.
14. Kabata-Pendias, A. (2011). *Trace elements in soils and plants*.
15. Doran, J. W., & Parkin, T. B. (1994). Soil quality assessment.
16. Lal, R., & Stewart, B. A. (2015). *Soil management and sustainability*.
17. Tandon, H. L. S. (1995). *Sulphur research and agricultural production*.
18. Abbas, F., et al. (2024). Evaluation of soil quality through simple additive soil quality index (SQI). *Journal of the Saudi Society of Agricultural Sciences*.
19. Chandra, D. S., Asadi, S. S., & others. (2017). Empirical approach for estimation of soil quality index. *International Journal of Civil Engineering and Technology*.
20. Gupta, A., Chitranshi, S., Dwivedi, A., & Johri, S. (2022). Study of physico-chemical properties in industrial soils. *Agricultural Science Digest*.
21. Romaniuk, R., Giuffré, L., Costantini, A., Bartoloni, N., & Nannipieri, P. (2012). A comparison of indexing methods to evaluate soil quality. *Soil Research*.
22. Selvaraju, R., & Mahalakshmi, V. (2023). Soil quality assessment using physico-chemical parameters. *IRJIET*.
23. Zhang, Y., et al. (2024). A comprehensive soil quality index integrating multiple properties. *Soil & Tillage Research*.
24. Alloway, B. J. (2008). *Zinc in soils and crop nutrition*. International Zinc Association.
25. Brady, N. C., & Weil, R. R. (2016). *The nature and properties of soils* (15th ed.). Pearson.
26. Gupta, U. C. (2014). *Boron and its role in crop production*. CRC Press.
27. Kabata-Pendias, A. (2011). *Trace elements in soils and plants* (4th ed.). CRC Press.
28. 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.

29. Marschner, P. (2012). *Marschner's mineral nutrition of higher plants* (3rd ed.). Academic Press.
30. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA.
31. Singh, M. V. (2015). Micronutrient deficiencies in Indian soils and field usable practices for their correction. *Indian Journal of Fertilisers*, 11(4), 94–112.
32. Tandon, H. L. S. (2013). *Methods of analysis of soils, plants, waters and fertilizers*. Fertiliser Development and Consultation Organisation.
33. 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.
34. Richards, L. A. (1954). *Diagnosis and improvement of saline and alkali soils*. USDA Handbook 60.
35. 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
36. 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
37. 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
38. 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
39. 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
40. 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

41. 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
42. 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
43. 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
44. 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
45. 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
46. 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
47. 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
48. 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

49. 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
50. 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
51. 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
52. 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
53. 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
54. 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
55. Lal, R. (2015). Restoring soil quality to mitigate soil degradation. Sustainability, 7(5), 5875-5895.
56. 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.
57. 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.