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ANALYSIS OF PHYSICO-CHEMICAL PROPERTIES OF SOIL FROM GANGAPUR, AMBIKAPUR, SURGUJA DIVISION, CHHATTISGARH

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ABSTRACT

The physico-chemical properties of soil play a critical role in determining its fertility, productivity, and ecological functions. This study investigates the soil from Gangapur, located in the Ambikapur region of Surguja division, Chhattisgarh, to understand its physico-chemical characteristics and assess its quality. Soil samples were collected using systematic sampling techniques from various locations within the Gangapur area. Key parameters, including texture (sand, silt, clay composition), bulk density, porosity, water holding capacity (WHC), permeability, pH, electrical conductivity (EC), organic carbon content, and concentrations of essential micronutrients (zinc, copper, iron, manganese) and macronutrients (nitrogen, phosphorus, potassium), were analyzed. The results reveal significant insights into the soil's texture, nutrient availability, and chemical properties, which are essential for agricultural practices and environmental health. The soil exhibits a silty clay texture, moderate organic carbon content, and slightly acidic pH, with variations across sampling sites. Additionally, trace element concentrations were found to be within permissible limits, indicating potential suitability for agricultural use. However, challenges related to water retention and soil compaction were identified, suggesting a need for proper soil management strategies.

Keywords: Soil Physical Properties, Chemical Properties, Conductivity.

I. INTRODUCTION

Soil is a fundamental component of terrestrial ecosystems, providing essential support for plant growth, water filtration, and nutrient cycling. Its physical and chemical properties are critical indicators of soil health, agricultural potential, and environmental sustainability. Understanding these properties is vital for effective land management, sustainable agricultural practices, and the conservation of natural resources. The Gangapur area, located in the Ambikapur region of Surguja division, Chhattisgarh, is characterized by diverse land use patterns and agricultural practices. However, comprehensive data on the physico-chemical properties of its soil is limited. The region's climate, topography, and anthropogenic activities, such as farming and deforestation, are likely to influence soil characteristics, including its texture, nutrient content, pH, and water retention capacity. These factors, in turn, directly affect crop yield, ecosystem health, and the region's overall productivity.

This study focuses on analyzing the physico-chemical properties of soil from Gangapur to establish a baseline understanding of its quality and suitability for agricultural and ecological purposes. By examining key parameters such as soil texture, bulk density, porosity, water holding capacity (WHC), pH, electrical conductivity (EC), and nutrient concentrations, this research aims to provide insights into the soil's current state and identify areas for potential improvement. The findings of this study are expected to contribute to the development of targeted soil management strategies and inform sustainable agricultural practices in Gangapur and surrounding areas. Moreover, this research addresses a broader need for localized soil quality assessments in regions with limited prior studies, aiding in the formulation of region-specific recommendations for land use and resource conservation.

II. LITERATURE REVIEW

Understanding the physico-chemical properties of soil is crucial for assessing its fertility, productivity, and ecological health. Several studies have emphasized the importance of soil characterization in agricultural planning and environmental conservation. This section reviews existing literature on soil physico-chemical properties, focusing on parameters relevant to the Gangapur region in Ambikapur, Surguja division, Chhattisgarh.

1. Soil Texture and Physical Properties: Soil texture, defined by the relative proportions of sand, silt, and clay, significantly influences soil structure, water holding capacity (WHC), and permeability. According to Brady and Weil (2016), finer-textured soils, such as silty clay, exhibit higher WHC but reduced permeability, which can impact root penetration and drainage. The bulk density and porosity are also critical indicators of soil compaction and aeration (Lal & Shukla, 2004).

2. Soil pH and Electrical Conductivity: Soil pH affects nutrient availability and microbial activity, with most crops thriving in a slightly acidic to neutral range (pH 6.0–7.5). Deviations from this range can lead to nutrient imbalances and reduced crop productivity (Fageria et al., 2011). Electrical conductivity (EC) measures the soil's salinity, which influences its ability to support plant growth. High salinity can inhibit plant uptake of water and nutrients (Rhoades et al., 1999).

3. Organic Carbon and Nutrient Availability: Organic carbon content is a key determinant of soil fertility, influencing its nutrient-holding capacity and microbial activity. Studies have shown that soils with higher organic matter content have improved nutrient retention and enhanced soil structure (Lehmann & Kleber, 2015). Essential macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), along with micronutrients like zinc (Zn), copper (Cu), and iron (Fe), are critical for plant growth and development (Marschner, 2012).

4. Regional Studies on Soil Properties: In the context of Chhattisgarh, studies by Sharma et al. (2018) highlighted the variability of soil properties across different agro-climatic zones. Their work revealed that soils in the Surguja division are generally characterized by high clay content, slightly acidic pH, and moderate organic carbon levels. Similar findings were reported by Singh et al. (2020), who emphasized the need for localized soil assessments to optimize agricultural practices in the region.

5. Anthropogenic and Environmental Influences: Anthropogenic activities, such as intensive farming and deforestation, can significantly alter soil properties over time. Lal (2003) discussed the impact of land use changes on soil quality, emphasizing the importance of sustainable practices to mitigate soil degradation. Additionally, climatic factors, including rainfall and temperature variations, influence soil moisture and nutrient dynamics (Jenny, 1941).

III. MATERIALS AND METHODS

This section outlines the materials and methods used to analyse the physicochemical properties of soil of Gangapur, Ambikapur, located in the Surguja division of Chhattisgarh. The study used a systematic approach for soil sampling, preparation and analysis to ensure reliable and reproducible results.

1. Study area: The study was conducted in Gangapur, Ambikapur, a region known for its agricultural practices and diverse soil types. The region has a tropical climate with moderate rainfall, which influences soil characteristics. Geographically, Gangapur is located in the Surguja division, characterized by rugged terrain and forest areas.

2. Soil sampling: Soil samples were collected using a systematic sampling method to ensure representative coverage of the study area. At this location, soil samples were collected from a depth of 15–30 cm using a stainless steel auger, following standard procedures outlined by Carter and Gregorich (2008). Samples were air-dried, sieved through a 2 mm mesh and stored in labelled containers for further analysis.

3. Laboratory analysis: Physico-chemical properties of soil were determined using the following methods:

3.1. Physical properties: Soil texture: Determined using the hydrometer method (Bucos, 1962) to classify soil into sand, silt and clay fractions.

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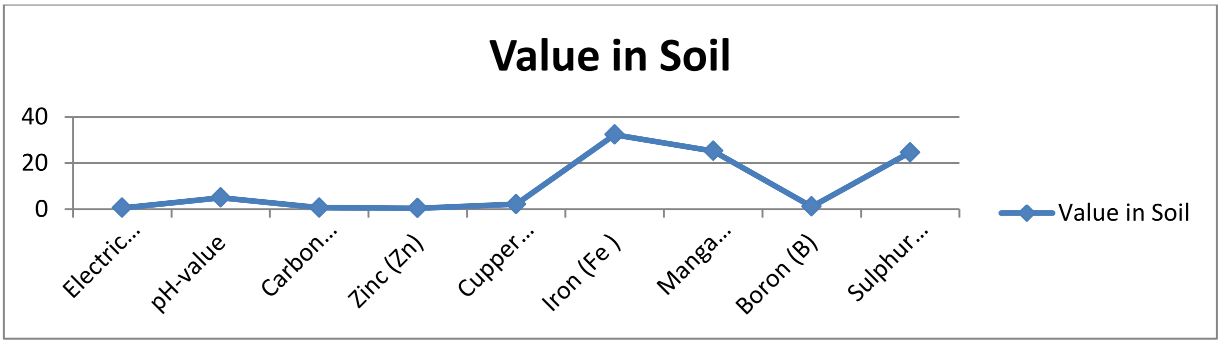
Bulk density and porosity: Measured using the core method described by Blake and Hartge (1986). Water holding capacity (WHC): Assessed by saturating soil samples and measuring the water retained (Clute, 1986).

3.2. Chemical properties: pH: measured using a digital pH meter in 1:2.5 soil-water suspension (Jackson, 1973). Electrical conductivity (EC): measured using a conductivity meter in the same suspension. Organic carbon: determined by the Walkley-Black method (Walkley and Black, 1934). Macronutrients: Nitrogen (N) was analyzed using the Kjeldahl method, phosphorus (P) was analyzed using the Olson method, and potassium (K) was analyzed using a flame photometer (Page et al., 1982). Micronutrients: Zinc (Zn), copper (Cu), iron (Fe), and manganese (Mn) concentrations were measured using atomic absorption spectrophotometry (Lindsay and Norvell, 1978).

Table 1: Physical properties of Soil sample taken from Gangapur area, Ambikapur.

S.No.	Physio-chemical properties	Unit	Value in Soil	Level Description/ Critical Level
01	**Electrical Conductivity**	**Ds/m**	**0.52**	Less than 1.0-Normal
02	**pH-value**	**pH-Scale**	**5.0**	Neutral 7
03	**Carbone (C)**	**Kg/Hactare**	**0.60**	Less than 0.50- Lower
04	**Zinc (Zn)**	**ppm**	**0.42**	0.6
05	**Cupper (Cu)**	**ppm**	**2.11**	0.2
06	**Iron (Fe)**	**ppm**	**32.2**	4.5
07	**Manganese (Mn)**	**ppm**	**25.2**	3.5
08	**Boron (B)**	**ppm**	**1.1**	0.5
09	**Sulphur(S)**	**ppm**	**24.52**	10

IV. RESULT & DISCUSSION



1. Electrical Conductivity (EC)

- **Value**: 0.52 dS/m
- **Interpretation**: The soil's electrical conductivity falls below the critical level of 1.0 dS/m, indicating normal salinity conditions. This suggests that the soil does not pose risks of salinity stress for crops and is suitable for agricultural use.

2. pH Value

- **Value**: 5.0
- **Interpretation**: The soil is slightly acidic, as neutral pH is 7. This acidity may limit the availability of certain nutrients, such as phosphorus and molybdenum, while enhancing the solubility of micronutrients like iron and manganese. Proper lime application could help in pH correction if required for specific crops.

3. Organic Carbon (C)

- **Value**: 0.60 kg/ha

- **Interpretation**: The organic carbon content is slightly above the lower critical level of 0.50 kg/ha, indicating moderate fertility. This suggests adequate organic matter, which supports microbial activity and improves soil structure. However, continuous organic matter addition is recommended to maintain soil fertility.

4. Micronutrients

a. Zinc (Zn)

- **Value**: 0.42 ppm
- **Interpretation**: Zinc content is below the critical level of 0.6 ppm, indicating a deficiency. Zinc deficiency can impair crop growth and development, requiring supplementation through zinc fertilizers.

b. Copper (Cu)

- **Value**: 2.11 ppm
- **Interpretation**: Copper content exceeds the critical level of 0.2 ppm, indicating sufficiency. This micronutrient is essential for enzyme activity in plants and poses no risk of deficiency.

c. Iron (Fe)

- **Value**: 32.2 ppm
- **Interpretation**: Iron levels are significantly higher than the critical level of 4.5 ppm. This sufficiency is beneficial for chlorophyll synthesis, particularly in acidic soils where iron availability increases.

d. Manganese (Mn)

- **Value**: 25.2 ppm
- **Interpretation**: Manganese content is well above the critical level of 3.5 ppm, ensuring sufficient availability for plant metabolic functions, especially in acidic soils.

e. Boron (B)

- **Value**: 1.1 ppm
- **Interpretation**: Boron content is above the critical level of 0.5 ppm, indicating adequacy. This nutrient supports reproductive growth and cell wall development in plants.

5. Sulfur (S)

- **Value**: 24.52 ppm
- **Interpretation**: Sulfur content exceeds the critical level of 10 ppm, highlighting sufficient availability for protein synthesis and enzyme activation. This makes the soil well-suited for sulfur-demanding crops like oilseeds.

V. CONCLUSION

The physico-chemical analysis of soil from Gangapur, Ambikapur, in the Surguja division of Chhattisgarh, revealed significant insights into its nutrient status and fertility potential. The following conclusions can be drawn:

1. Electrical Conductivity (EC): The soil exhibits normal salinity levels (0.52 dS/m), indicating no risk of salinity stress for crops.

2. pH Value: The slightly acidic pH (5.0) may influence the availability of certain nutrients, necessitating lime application for crops requiring neutral pH.

3. Organic Carbon: The organic carbon content (0.60 kg/ha) is moderately adequate, reflecting a need for continuous organic matter input to maintain soil fertility and enhance microbial activity.

4. Micronutrient Status:

✓ **Zinc (Zn)**: The deficiency (0.42 ppm) highlights the need for zinc supplementation to avoid growth limitations in crops.

✓ **Copper (Cu)**: Sufficient levels (2.11 ppm) ensure proper enzyme functionality and plant health.

✓ **Iron (Fe)**: High levels (32.2 ppm) indicate no risk of deficiency, particularly beneficial in acidic soils.

✓ **Manganese (Mn)**: Adequate levels (25.2 ppm) ensure essential metabolic processes in plants.

✓ **Boron (B)**: The sufficiency (1.1 ppm) supports reproductive growth and structural development.

5. Sulfur (S): The sulfur content (24.52 ppm) exceeds the critical level, ensuring its availability for essential functions like protein synthesis and enzyme activation.

VI. RECOMMENDATIONS

- **Nutrient Management**: Zinc fertilizers should be applied to address deficiencies, while balanced fertilization can optimize crop productivity.
- **Soil pH Adjustment**: Lime application may be required to neutralize acidity for crops sensitive to low pH.
- **Organic Matter Enhancement**: Continuous addition of compost or green manure is recommended to improve organic carbon levels and overall soil health.
- **Sustainable Practices**: Regular soil testing and site-specific nutrient management are crucial to maintaining soil fertility and preventing nutrient imbalances.

VII. REFERENCES

[1] Blake, G. R., & Hartge, K. H. (1986). Bulk density. In A. Klute (Ed.), Methods of Soil Analysis: Part 1—Physical and Mineralogical Methods (pp. 363-375). American Society of Agronomy.

[2] Bouyoucos, G. J. (1962). Hydrometer method improved for making particle size analyses of soils. Agronomy Journal, 54(5), 464-465. https://doi.org/10.2134/agronj1962.00021962005400050028x

[3] Carter, M. R., & Gregorich, E. G. (2008). Soil Sampling and Methods of Analysis (2nd ed.). CRC Press.

[4] Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd.

[5] Klute, A. (1986). Water retention: Laboratory methods. In A. Klute (Ed.), Methods of Soil Analysis: Part 1—Physical and Mineralogical Methods (pp. 635-662). American Society of Agronomy.

[6] 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.
https://doi.org/10.2136/sssaj1978.03615995004200030009x

[7] Page, A. L., Miller, R. H., & Keeney, D. R. (Eds.). (1982). Methods of Soil Analysis: Part 2—Chemical and Microbiological Properties (2nd ed.). American Society of Agronomy.

[8] 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.Dewangan, S. K. (2022). Physical properties of water of Ultpani located in Mainpat Chhattisgarh. International Education and Research Journal, 9(10), 19-20. Researchgate ,

[9] Dewangan, S. K., Kadri,A, Chouhan, G. (2022). Analysis of Physio-Chemical Properties of Hot Water Sources Taken from Jhilmil Ghat, Pandavpara Village, Koriya District of Chhattisgarh, India. INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY, 9(6), 518-522, Weblink , Researchgate

[10] Dewangan, S. K., Chaohan, B. R., Shrivastava, S. K., & Yadav, S. (2022). Analysis of the Physico-Chemical Properties of Red Soil Located in Koranga Mal Village of Jashpur District, Surguja Division of Chhattisgarh, India. GIS Science Journal, 9(12), 1-5. Researchgate

[11] Dewangan, S. K., Chaohan, B. R., Shrivatava, S. K., & Shrivastava, A. K. (2023). Comparative Characterization of Water Source Flowing in UltaPani Drain and Water Samples of Other Nearby Sources. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(11). Researchget

[12] Dewangan, S. K., Kadri, M. A., Saruta, S., Yadav, S., Minj, N. (2023). TEMPERATURE EFFECT ON ELECTRICAL CONDUCTIVITY (EC) & TOTAL DISSOLVED SOLIDS (TDS) OF WATER: A REVIEW. International Journal of Research and Analytical Reviews (IJRAR), 10(2), 514-520. Researchgate.

[13] Dewangan, S. K., Minj, N., Namrata, Nayak, N. (2022). Physico-Chemical Analysis of Water taken from Well Located in Morbhanj Village, Surajpur District of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 696-698. Researchgate

[14] Dewangan, S. K., Namrata, Poonam, & Shivlochani. (2015). Analysis of Physico-Chemical Properties of Water Taken From Upka Water Source, Bishrampur, Surguja District of Chhattisgarh, India. International Journal of Innovative Research in Engineering, 3(6), 192-194. Researchgate

[15] Dewangan, S. K., Saruta, S., & Sonwani, P. (2022). Study the Physio-Chemical Properties of hot water source of Pahad Karwa, Wadraf Nagar, Sarguja division of Chhattisgarh, India. International Journal of Creative Research Thoughts - IJCRT, 9(10), 279-283.Researchgate

[16] Dewangan, S. K., Shrivastava, S. K., Haldar, R., Yadav, A., Giri, V. (2023). Effect of Density and Viscosity on Flow Characteristics of Water: A Review. International Journal of Research Publication and Reviews, 4(6), 1982-1985. Researchgate.

[17] Dewangan, S. K., Shrivastava, S. K., Tigga, V., Lakra, M., Namrata, Preeti. (2023). REVIEW PAPER ON THE ROLE OF PH IN WATER QUALITY IMPLICATIONS FOR AQUATIC LIFE, HUMAN HEALTH, AND ENVIRONMENTAL SUSTAINABILITY. International Advanced Research Journal in Science, Engineering and Technology, 10(6), 215-218. Researchgate.

[18] Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., Sawaiyan, A. (2022). Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 1723-1726. Researchgate

[19] Dewangan, S. K., Tigga, P., Kumar, N., & Shrivastava, S. K. (2023). Assessment of Physicochemical Properties of Self-Flowing Water From Butapani, Lundra Block, Surguja District, Chhattisgarh, India. IJSART, 9(11). Researchget

[20] Dewangan, S. K., Tigga, V., Lakra, M., & Preeti. (2022). Analysis of Physio-Chemical Properties of Water Taken from Various Sources and Their Comparative Study, Ambikapur, Sarguja Division of Chhattisgarh, India. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 10(11), 703-705. Researchgate

[21] Dewangan, S. K., Toppo, D. N., Kujur, A. (2023). Investigating the Impact of pH Levels on Water Quality: An Experimental Approach. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(IX), 756-760. Researchgate.

[22] Dewangan, S. K., Yadav, K., Shrivastava, S. K. (2023). The Impact of Dielectric Constant on Water Properties at Varied Frequencies: A Systematic Review. International Journal of Research Publication and Reviews, 4(6), 1982-1985. Researchgate.

[23] Dewangana, S. K., Minj, D., Paul, A. C., & Shrivastava, S. K. (2023). Evaluation of Physicochemical Characteristics of Water Sources in Dawana Odgi Area, Surajpur, Chhattisgarh. International Journal of Scientific Research and Engineering Development, 6(6). Rsearchget.

[24] Dewangan, S. K., Chaohan, B. R., Shrivastava, S. K., & Shrivastava, A. K. (2023). Comparative Characterization of Water Source Flowing in Ultapani Drain and Water Samples of other nearby Sources. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 11(11).

[25] Dewangan, S. K., Toppo, D. N., & Kujur, A. (2023). Investigating the impact of pH levels on water quality: an experimental approach. International Journal for Research in Applied Science and Engineering Technology, 11(9), 756-759.

[26] 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. measurements, 2, 3.

[27] Dewangan, S. K., Shrivastava, S. K., Soni, A. K., Yadav, R., Singh, D., Sharma, G. K., ... & 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.

[28] Dewangan, S. K., Sahu, K., Tirkey, G., Jaiswal, A., Keshri, A., Kumari, N., ... & Gautam, S. (2022). Experimental Investigation of Physico-Chemical Properties of Soil taken from Bantidand Area, Balrampur District, Surguja Division of Chhattisgarh, India. measurements, 3, 4.

[29] Dewangan, S. K., Gupta, K., Paul, A. C., & Shrivatava, S. K. Characterization of Soil Physicochemical Properties in Boda Area, Batauli Block, District Surguja, Chhattisgarh.

[30] Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., & Sawaiyan, A. (2022).

Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 1723-1726.

[31] Dewangan, S. K., Shukla, N., Pandey, U., Kushwaha, S., Mistry, A., Kumar, A., & Sawaiyan, A. (2022). Experimental Investigation of Physico-Chemical Properties of Water taken from Bantidand River, Balrampur District, Surguja Division of Chhattisgarh, India. International Journal of Research Publication and Reviews, 3(12), 1723-1726.

[32] Dewangan, S. K., Saruta, S., & Sonwani, P. (2022). Study the Physio-Chemical Properties of hot water source of Pahad Karwa, Wadraf Nagar, Sarguja division of Chhattisgarh, India. International Journal of Creative Research Thoughts-IJCRT, 9(10), 279-283.

[33] 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.

[34] 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

[35] 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

[36] 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

[37] 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

[38] 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

[39] 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

[40] 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

[41] 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

[42] 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

[43] 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

[44] 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

[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., 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

[47] 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

[48] 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

[49] 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

[50] 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

[51] 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

[52] 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

[53] 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

[54] Hillel, D. (2004). Introduction to environmental soil physics. Elsevier Academic Press.

[55] Lal, R. (2016). Soil health and carbon management. Food and Energy Security, 5(4), 212-222. https://doi.org/10.1002/fes3.100

[56] Marschner, P. (2012). Marschner's mineral nutrition of higher plants (3rd ed.). Academic Press.

[57] Rengasamy, P. (2010). Soil processes affecting crop production in salt-affected soils. Functional Plant Biology, 37(7), 613-620. https://doi.org/10.1071/FP09253

[58] Rowell, D. L. (1994). Soil science: Methods and applications. Longman Scientific & Technical.

[59] Six, J., Conant, R. T., Paul, E. A., & Paustian, K. (2002). Stabilization mechanisms of soil organic matter. Biogeochemistry, 59(1-2), 33-57. https://doi.org/10.1023/A:1021310808594

[60] Tóth, B., Hermann, T., da Silva, M. R., & Montanarella, L. (2017). Monitoring soil moisture for sustainable agriculture. Environmental Research Letters, 12(7), 074001. https://doi.org/10.1088/1748-9326/aa75c5

[61] Vance, A. S. (2006). Soil organic matter and its impact on soil fertility. Agronomy Journal, 98(2), 366-371. https://doi.org/10.2134/agronj2005.0182

[62] 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.