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Study of Physio-Chemical Analysis of Soil Taken from Lafri, Area of Surguja District of Chhattisgarh, India

Mr. Govind Prasad[1]; Dr. M.K. Maurya[2]; Mr. Ravi Kiran Toppo[3]; Miss Nicky Dubey[4]

Asst. Prof, & H.O.D. Department of Physics, Saraswati Mahavidyalaya Subhashnagar Ambikapur (CG)[1]
Asst. Prof. & H.O.D. Department of Physics, Rajiv Gandhi Govt. P.G. College Ambikapur (CG)[2]
M.Sc. Student of Physics, Saraswati Mahavidyalaya Subhashnagar Ambikapur (CG)[3]
M.Sc. Student of Physics, Saraswati Mahavidyalaya Subhashnagar Ambikapur (CG)[4]

ABSTRACT:

This research paper presents a comprehensive analysis of the physio-chemical properties of soil samples collected from Lafri area of Surguja district, Chhattisgarh. Soil samples were collected from different depths and their physical and chemical characteristics were studied. The analysis included evaluation of soil texture, pH value, electrical conductivity, organic carbon content, nitrogen, phosphorus, and potassium levels. The results highlight the importance of physio-chemical analysis in understanding soil quality and fertility. The findings of this study can help in understanding the soil characteristics of the region and improving agricultural practices.

Keywords: Soil analysis, physio-chemical properties, Surguja district, Lafri area, soil quality, agricultural practices.

1.INTRODUCTION:

- Soil is a vital component of our ecosystem, providing essential nutrients for plant growth and development. Soil quality and fertility have a direct impact on crop productivity and quality. Surguja district, Chhattisgarh is an important agricultural region, where various crops are grown. There is a need for a comprehensive study to understand the soil characteristics of Lafri area, which can help improve agricultural practices in the region.
- **Study Area:** Lafri waterfall, located in the Surguja district of Chhattisgarh, is an area with significant agricultural potential. The region's soil characteristics play a crucial role in determining crop productivity and sustainability.

Lat. 23.602488°

Long. 82.835251°

- The objective of this study is to conduct a physio-chemical analysis of soil samples collected from Lafri area, evaluating soil texture, pH value, electrical conductivity, organic carbon content, nitrogen, phosphorus, and potassium levels. The results of this study can help understand the soil characteristics of the region and improve agricultural practices.

II. LITERATURE REVIEW

Understanding the physio-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 physio-chemical properties, focusing on parameters relevant to the Lafri, area of Surguja district, Chhattisgarh.

1.Soil Texture and Structure: Soil texture, determined by the relative proportions of sand, silt, and clay, is a key determinant of soil behaviour, including water retention, drainage, and nutrient holding capacity. Research by Sahuetal.(2014) on soil characteristics in the Raipur district of Chhattisgarh found that soils with a higher proportion of clay tend to retain more water, whereas sandy soils exhibit good drainage but lower water retention (Sahu, S. S., & Thakur, S. S.,2014). In the Baikunthpur area,variations in soil texture are expected to influence irrigation practices and crop selection.

2.Dewangan S.K. and Yadav et al (2023), discuss on his paper, the soil in both Sample A (6 inches depth) and Sample B (8 inches depth) shows relatively good electrical conductivity and neutral pH levels, indicating favourable soil conditions. However, levels of carbon, zinc, copper, iron, manganese, boron and molybdenum are deficient, as they are below critical levels for optimal plant growth and nutrient availability. To ensure sustainable land management and improve soil fertility, it is recommended to overcome these deficiencies through proper nutrient management practices, such as adding organic matter and targeted fertilization[1].

3.Dewangan, S.K. & Tonde, et al, (2025), investigates the physio-chemical properties of soil from the Chhindiya (Bandhpara) and Baikunthpur areas of Korea District, Chhattisgarh, with the aim of assessing soil health and its suitability for agricultural practices. The results revealed that the soils in Chhindiya (Bandhpara) and Baikunthpur exhibit varying physical properties, with differences in texture and structure that influence water retention and drainage capabilities. The study highlights the importance of soil amendments and management practices to optimize soil fertility and improve agricultural productivity in these areas.

4.Impact of Human Activity and Land Use on Soil Properties: Human activities, including agricultural practices and deforestation, have significant impacts on soil properties. Research by Rao et al. (2019) in Chhattisgarh highlighted how intensive farming and deforestation have led to the depletion of soil organic matter and reduced nutrient levels in certain regions (Rao et al., 2019). In the Chhindiya and Baikunthpur areas, land use practices such as crop rotation, organic farming, and the use of organic fertilizers could play a vital role in maintaining soil health and fertility.

III. MATERIAL & METHOD

The study was conducted in the Lafri area located in the Surguja District of Chhattisgarh, India. These regions are known for their agricultural activities, which depend heavily on the fertility of the soil. The geographical location and climate conditions of these areas influence the physio-chemical properties of the soil. The study aimed to evaluate these properties to assess soil health and its suitability for different crops.

Soil testing is an important process to assess soil fertility, nutrients and pH levels. It helps determine specific requirements for plant growth and allows proper amendments and fertilization. Here is a basic method of soil testing:

- **Sample Collection:** Soil samples were collected from Lafri, Surguja District, Chhattisgarh by using a clean sampling tool (such as a soil auger or shovel) to collect soil samples. Soil was taken from surface and a depth of about 15-30cm.
- **Sample Preparation:** Samples were air-dried, ground, and remove any plant debris, stones or roots from the soil sample and sieved through a 2 mm sieve.
- **Test Parameters:**

Determine the specific parameters we want to test for:

- pH
- Electrical Conductivity (EC)
- Organic Carbon (OC)
- Nitrogen (N)
- Phosphorus (P)
- Potassium (K) etc.

- **Laboratory Testing:**

Since we do not have a modern soil laboratory in our lab, we sent the soil samples to a nearby soil testing centre. After testing, the soil testing centre gave the following results, which are as follows:-

Sample-A

- Sample ID - 230|25
- Date -03/05/2025
- Depth - 0-10cm(From Surface)
- Location -Tamki
- Collector's name- Ravi Kiran Toppo / Nicky Dubey

Soil Test Results and Soil Evaluation

Table-1

Description	**Test results**	**Level description**
pH	6.24	5.5 to 6.5 moderately acidic
Electrical conductivity (dS/m)	0.13	Less than 1.0 is normal
Organic Carbon (%)	0.54	0.50 to 0.75 medium
Available Nitrogen (kg/ha)	214.00	Below 280 – Low
Available Phosphorus (kg/ha)	18.00	12 to 24 Moderate
Available potash (kg/ha)	322.00	135 to 335 Moderate
Calcium (kg/ha)	130.00	672 less – low 672
Magnesium (kg/ha)	102.00	Below 270 – Low
Sulphate (kg/ha)	16.50	Under 22 – Low
micronutrients		**Critical level**
Zinc (mg/kg)	0.2	Less than 0.6
Copper (mg/kg)	0.1	Less than 0.2
Iron (mg/kg)	0.5	Less than 4.5
Manganese (mg/kg)	0.9	Less than 3.5
Boron (mg/kg)	0.2	Less than 0.5
Molybdenum (mg/kg)	0.1	Less than 0

Fertilizer recommendation based on soil test result (kg/ha)

Table-2

1	To improve pH	Chosen calcium carbonate	84 kg/ha.
2	For NPK level	Nitrogen urea phosphor Super Phosphate muriate of potash	60 kg/ha. 60 kg/ha. 40 kg/ha.
3	For micro element improvement	Zinc sulphate Borax	03 kg/ha. 03 kg/ha.
4	Other	Compost fertilizer vermi compost	1.5Ton/ha. 1.5ton/ha.
5	Recommended crop	Rice.Corn Sugarcane. Chickpea. Potato. Onion.	
6	Other suggestions	1) To prevent fungal diseases in the soil, it would be beneficial to use bio-fungus drug Tricoderma.	

Sample-B

- Sample ID - 231|25
- Date - 03/05/2025
- Depth - 15-30cm
- Location - Tamki

- Collector's name- Ravi Kiran Toppo / Nicky Dubey

Soil Test Results and Soil Evaluation

Table-3

Description	**Test results**	**Level description**
pH	6.52	6.5 to 7.5 neutral
Electrical conductivity (ds/m)	0.66	Less than 1.0 is normal
Organic Carbon (%)	0.91	More than 0.75-high
Available Nitrogen (kg/ha)	314.00	280 to 560 Medium
Available Phosphorus (kg/ha)	16.00	12 to 24 Moderate
Available potash (kg/ha)	306.00	135 to 335 Moderate
Calcium (kg/ha)	142.00	672 less – low 672
Magnesium (kg/ha)	110.00	Below 270 – Low
Sulphate (kg/ha)	24.50	22 to 35 Medium
micronutrients		**Critical level**
Zinc (mg/kg)	0.2	Less than 0.6
Copper (mg/kg)	0.1	Less than 0.2
Iron (mg/kg)	1.4	Less than 4.5
Manganese (mg/kg)	0.8	Less than 3.5
Boron (mg/kg)	0.2	Less than 0.5
Molybdenum (mg/kg	0.1	Less than 0

Fertilizer recommendation based on soil test result (kg/ha)

Table-4

1.	To improve pH	Chosen calcium carbonate	45 kg/ha.
2.	For NPK level	nitrogen urea Phosphor Super Phosphate muriate of potash	50 kg/ha. 55 kg/ha. 50 kg/ha.
3.	For micro element improvement	zinc sulphate borax	03 kg/ha. 03 kg/ha.
4.	Other	compost fertilizer vermi compost	1.5 Ton/ha. 1.5 Ton/ha.
5.	recommended crop	Rice, corn, sugarcane, potato, ginger, chili	
6.	Other suggestions	1) To prevent fungal diseases in the soil, it would be beneficial to use bio-fungus drug Tricoderma.	

IV Results and Discussion

This study analyzed surface and subsurface soil samples from Lafari, Surguja district of Chhattisgarh. The results reflect variation in pH, electrical conductivity, macronutrients (N, P, K), organic carbon, and micronutrients (S, B, Zn, Fe, Mn, Cu). The spatial and depth-wise differences are discussed below:

1. Soil pH

- The pH values ranged from 5.5 to 6.5, indicating slightly acidic to moderately acidic conditions.
- Soil acidity can influence nutrient availability and microbial activity. Slightly acidic conditions are favourable for most crops, though extremely low pH can hinder phosphorus availability (Brady & Weil, 2008).[2]

2. Electrical Conductivity (EC)

The electrical conductivity (EC) of the soil was found to be 0.13 Ds/m for surface soil and 0.66 for depth soil, which is less than 1, considered low. EC values in soils are indicative of the level of soluble salts. Soils with an EC value of less than 0.2 Ds/m typically have no significant salinity problems, which is beneficial for crop growth (Rhoades, 1996). This suggests that the soils in these areas are not saline and should support healthy plant growth without the risk of salinity-induced stress.

3. Carbon (C):

The organic carbon content of the soil was 0.54 kg/hectare for surface soil and 0.91 kg/hectare for depth soil, which is considered 0.50 to 0.75 medium and more than 0.75 is high. Organic carbon is a key indicator of soil fertility, influencing nutrient availability, water retention, and soil structure. The low organic carbon content in the soil suggests that the soil might not have sufficient organic matter to support high levels of microbial activity and nutrient cycling (Singh et al., 2019). Adding organic matter, such as compost or green manure, could help improve the organic carbon content and overall soil health.

4. Zinc (Zn):

The zinc (Zn) concentration in the soil was found to be 0.2mg/kg. Zinc is an essential micronutrient that plays a vital role in plant growth, especially in enzyme activation and protein synthesis. The concentration of zinc in the soil is within the normal range for most agricultural soils (Baker, 1982). However, the availability of zinc may be influenced by soil pH, and since the soil is slightly acidic, zinc availability should be monitored for crops that are sensitive to zinc deficiency.

5. Copper (Cu):

The copper (Cu) concentration was found to be at 0.1 mg/kg. Copper is another important micronutrient required for various plant functions. The concentration of copper in the soil is within the adequate range for crops (Baker, 1982), suggesting that copper deficiency is unlikely to occur in these soils. However, excessive copper concentrations can be toxic to plants, so it is important to monitor for potential build up (Kumar et al., 2025).

6. Iron (Fe):

The iron (Fe) concentration in the soil was found to be 0.5mg/kg for surface and 1.4mg/kg for depth soil, which is less than 4.5 considered adequate for most crops. Iron is an essential micronutrient involved in chlorophyll formation and other metabolic processes in plants. The high concentration of iron is likely to support healthy plant growth and can enhance the color and quality of crops, especially in soils with high organic matter (Sahu et al., 2016).

7. Manganese (Mn):

Manganese (Mn) was measured at 0.8mg/kg for surface soil and 0.9mg/kg for depth soil,that is less than 3.5, which is within the normal range for soils. Manganese is crucial for photosynthesis, respiration, and nitrogen metabolism in plants (Sahu et al., 2016). This level of manganese will likely be sufficient for most crops, although it can become toxic at higher concentrations, particularly in acidic soils.

8. Boron (B):

The boron (B) concentration was 0.2mg/kg for both surface and depth soil, which is less than 0.5. Boron is vital for cell wall synthesis and reproductive development in plants. The soil boron levels in the study area are within the normal range for agricultural soils (Baker, 1982), indicating that boron deficiency is unlikely, although excessive boron can sometimes be harmful to plants.

9. Sulphate:

The Sulphate concentration in the soil was found to be 24.50kg/ha and 16.50kg/ha for depth and surface soil respectively. Sulphate is an essential macronutrient required for the synthesis of amino acids and proteins in plants. Sulphate level is adequate for most crops, and Sulphate deficiencies are unlikely in these soils (Singh et al., 2019). However, the availability of Sulphate may be influenced by soil pH and microbial activity.

Discussion:

The results of the physio-chemical analysis indicate that the soil in the Lafri area located in the Surguja District of Chhattisgarh, India, is generally suitable for agriculture, with some considerations for improvement:

- The low EC indicates that the soil is non-saline, which is favorable for plant growth.
- The acidic pH (6.24) may limit nutrient availability and affect plant growth. Amendments like lime can be used to raise the pH to a more neutral level, improving nutrient availability.

- The low organic carbon content suggests that the soil fertility could be enhanced by adding organic matter to increase microbial activity and nutrient cycling.
- The levels of essential micronutrients (zinc, copper, iron, manganese, boron, and sulfur) are adequate for most crops, but it is important to monitor soil health periodically to ensure that nutrient imbalances or deficiencies do not occur, particularly in relation to the soil's pH.

Conclusion:

The soil from Lafri area located in the Surguja District of Chhattisgarh, India,shows favourable conditions for agriculture with some considerations. The low electrical conductivity (0.13 Ds/m and 0.66Ds/m) indicates non-saline soil, while the acidic pH (5.5) may require pH amendments for better nutrient availability. The organic carbon content (0.54 kg/hectare and 0.91kg/hectare) is low, suggesting the need for organic amendments to improve soil fertility. Micronutrient levels, including zinc, copper, iron, manganese, boron, and sulfur, are within adequate ranges, supporting healthy plant growth. Overall, with proper soil management, the soil is suitable for agricultural use.

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