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Physico-Chemical Characterization of Soil in Shardapur Village, Balrampur-Ramanujganj District (C.G.)

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Abstract:
This study focuses on the physico-chemical characterization of soil samples collected from Shardapur Village in Balrampur-Ramanujganj District, Chhattisgarh. The objective is to evaluate soil quality and its suitability for agricultural and environmental applications. Key parameters analyzed include pH, electrical conductivity (EC), organic carbon, and essential micronutrients such as zinc, iron, manganese, copper, boron, and sulphur. The results indicate that the soil is moderately acidic to neutral in nature, with low to moderate salinity levels. Organic carbon content suggests moderate fertility status, while micronutrient analysis reveals varying concentrations, with some elements falling below optimal levels required for crop growth. The findings highlight the need for balanced nutrient management and appropriate soil amendments to improve soil productivity. This study provides valuable baseline data for sustainable soil management practices and supports informed decision-making for enhancing agricultural productivity in the region.
Keywords: Soil Analysis, Physico-Chemical Properties, pH, Electrical Conductivity (EC), Micronutrients, Soil Health, Karamdiha Village.

Introduction:

Soil is a fundamental natural resource that plays a crucial role in sustaining agricultural productivity, environmental quality, and ecosystem balance. The physico-chemical properties of soil, such as texture, structure, pH, electrical conductivity (EC), organic carbon content, and nutrient availability, significantly influence plant growth and crop yield. Understanding these properties is essential for assessing soil fertility and implementing appropriate land management practices.

The present study focuses on the physico-chemical characterization of soil in Shardapur Village, located in the Balrampur-Ramanujganj District of Chhattisgarh. This region is predominantly agricultural, where soil quality directly impacts the livelihood of the local population. However, continuous cultivation, improper fertilizer use, and environmental factors may lead to nutrient depletion and soil degradation over time.

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Figure 1: Sampling site Shardapur area.

In this context, systematic analysis of soil properties becomes necessary to evaluate its current status and suitability for sustainable agriculture. The study involves the assessment of important parameters including pH, EC, organic carbon, and micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), boron (B), and sulphur (S). These parameters provide insights into soil fertility, salinity, and nutrient balance. The findings of this study will help in identifying nutrient deficiencies and recommending appropriate soil management strategies. Moreover, it will contribute to the development of sustainable agricultural practices and improved crop productivity in Shardapur Village and similar agro-ecological regions.

Materials and Methods:

Soil Sampling:

Soil samples were collected by following standardized and widely accepted sampling procedures to ensure accuracy and reliability. The samples were taken from a depth of 15–30 cm using a soil auger, which represents the active root zone of most crops. After collection, the samples were air-dried under room temperature to remove moisture. The dried samples were then gently crushed and passed through a 2 mm sieve to eliminate stones, roots, and other unwanted materials. To obtain a representative sample, the sieved soil was thoroughly mixed and subjected to the quartering method. One portion was further processed by passing it through a 0.5 mm sieve, and again quartered. Finally, a fine fraction was obtained by sieving one part through a 0.02 mm sieve for precise laboratory analysis.

Materials Used:

The analysis was carried out using standard laboratory instruments and chemicals. These included a digital pH meter for measuring acidity or alkalinity, an electrical conductivity meter for salinity analysis, an analytical weighing balance for accurate measurement of samples, and an oven for drying purposes. Various glassware such as beakers, flasks, and pipettes were used along with specific chemical reagents required for determining different soil nutrients.

Analytical Methods:

Soil pH was measured using a digital pH meter in a soil-water suspension with a ratio of 1:2.5. Electrical conductivity (EC) was determined using a conductivity meter to assess the soluble salt content. Organic carbon content was estimated by the Walkley and Black wet oxidation method. Available nitrogen was analyzed using the Alkaline Permanganate method, while available phosphorus was determined by the Olsen method. Available potassium was measured with the help of a flame photometer. Micronutrients such as zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) were analyzed using standard chemical extraction and measurement techniques.

Data Analysis:

The results obtained from laboratory analysis were carefully recorded and interpreted to evaluate the physico-chemical properties and fertility status of the soil samples. The observations derived from these analyses are presented as follows.

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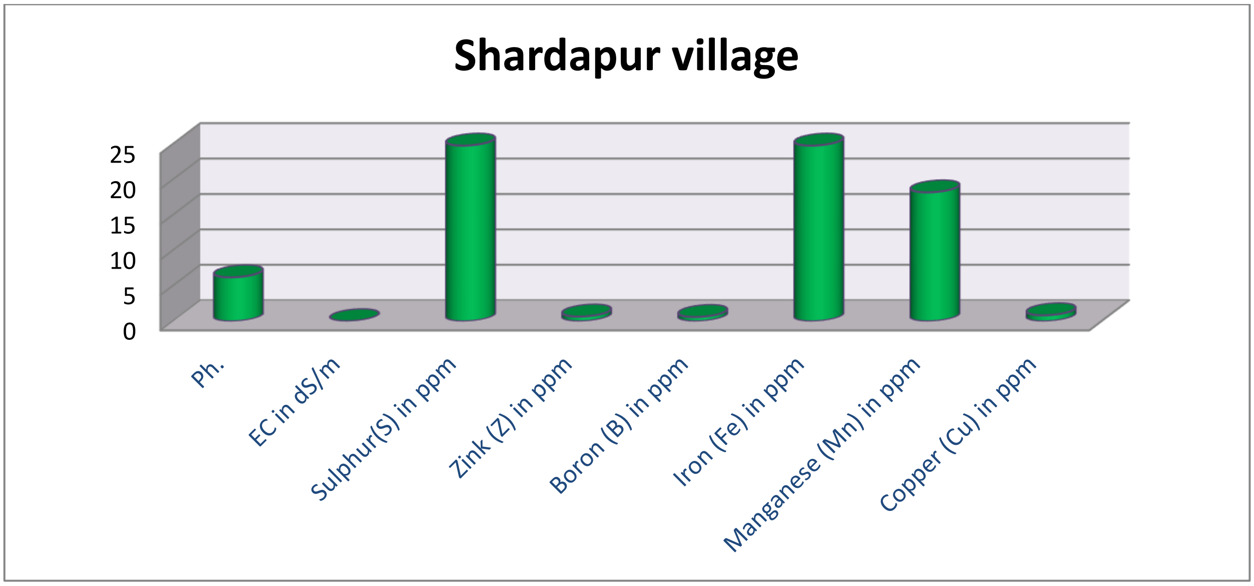
Table 1: Physico-chemical properties of soil sample taken from Shardapur village.

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
6.2	0.008	24.9	0.67	0.6	24.8	18.2	0.84

Results and Discussion:



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

The analyzed soil sample showed a pH value of 6.2, which indicates a slightly acidic nature. Such conditions are generally considered suitable for most crops, as they enhance the availability of essential nutrients in the soil (Brady & Weil, 2016). The electrical conductivity (EC) of the sample was found to be 0.008 dS/m, reflecting very low salt concentration and confirming that the soil is free from salinity hazards, making it highly suitable for agricultural use (Richards, 1954).

The sulphur (S) content was recorded at 24.8 ppm, which lies within the adequate range required for plant growth and plays a vital role in protein synthesis and enzymatic activities (Tandon, 2013). Zinc (Zn) was measured at 0.66 ppm, suggesting a marginal to sufficient level; however, regular monitoring is important because zinc deficiency is frequently observed in Indian agricultural soils (Alloway, 2008).

The boron (B) concentration was 0.6 ppm, indicating sufficient availability for plant development, particularly in reproductive growth and cell wall formation (Gupta, 2014). Iron (Fe) content was found to be 24.8 ppm, showing adequate supply necessary for chlorophyll formation and various metabolic processes (Lindsay & Norvell, 1978).

Manganese (Mn) was present at 18.2 ppm, which is within the adequate range and supports enzyme activation and photosynthesis (Marschner, 2012). Copper (Cu) content was 0.84 ppm, indicating sufficient levels for proper plant metabolic functions (Kabata-Pendias, 2011).

In general, the soil demonstrates favorable physico-chemical properties with adequate micronutrient levels. However, slight improvement in zinc management could further enhance soil fertility and crop productivity over time (Singh, 2015).

Conclusion:

The soil sample, with a pH value of 6.2, falls within the desirable range of 6.0–7.5, which is considered ideal for the growth of most crops. This pH range promotes better nutrient availability and supports active microbial processes in the soil (Brady & Weil, 2016). The electrical conductivity (EC) value of 0.008 dS/m is significantly lower than the threshold level of 1 dS/m, indicating that the soil is non-saline and well-suited for agricultural practices without any salinity-related issues (Richards, 1954).

The sulphur (S) content, measured at 24.8 ppm, lies within the sufficient range of 10–40 ppm, ensuring proper plant growth and metabolic functions (Tandon, 2013). The zinc (Zn) level of 0.66 ppm is close to the critical limit of 0.6 ppm, suggesting that while it is currently adequate, there is a possibility of deficiency in the future, and periodic supplementation may be beneficial (Alloway, 2008).

Boron (B) content was found to be 0.6 ppm, which falls within the adequate range of 0.5–1.0 ppm and is essential for reproductive development in plants (Gupta, 2014). Additionally, the concentrations of iron (Fe) at 24.8 ppm, manganese (Mn) at 18.2 ppm, and copper (Cu) at 0.84 ppm are all higher than their respective critical limits, indicating sufficient availability to support various physiological and biochemical functions in plants (Kabata-Pendias, 2011).

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