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ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF SURFACE SOIL IN PALLDNOULI VILLAGE, ODGI BLOCK, SURAJPUR DISTRICT (C.G.)

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ABSTRACT

Soil quality plays a fundamental role in determining agricultural productivity and environmental sustainability. The present study focuses on the assessment of physico-chemical properties of surface soil (0–15 cm depth) collected from Palldnouli Village, located in Odgi Block of Surajpur District, Chhattisgarh. The objective of this research is to evaluate soil fertility status and identify key factors influencing soil health in the study area.

Soil samples were collected from different locations of the village using standard sampling techniques and analyzed for important physico-chemical parameters, including pH, electrical conductivity (EC), organic carbon, macronutrients (nitrogen, phosphorus, potassium), and micronutrients such as zinc (Zn), iron (Fe), manganese (Mn), copper (Cu), and boron (B). The results revealed that the soil in the study area is generally acidic to slightly acidic in nature, with low to moderate electrical conductivity, indicating non-saline conditions. Organic carbon content was found to be moderate, suggesting average soil fertility.

The analysis of nutrients indicated variability across sampling sites, with some locations showing deficiencies in essential nutrients like nitrogen and micronutrients, particularly zinc and boron. However, the levels of iron and manganese were observed to be within adequate ranges for plant growth. These variations may be attributed to differences in land use patterns, agricultural practices, and natural soil formation processes.

The study concludes that while the soils of Palldnouli Village are suitable for agriculture, there is a need for proper nutrient management and soil conservation practices to enhance productivity and maintain soil health. The findings provide valuable baseline data for farmers, researchers, and policymakers to develop sustainable soil management strategies and improve crop yield in the region.

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

INTRODUCTION

Soil is a vital natural resource that plays a crucial role in sustaining agricultural productivity, environmental quality, and ecosystem stability. The physico-chemical properties of soil, such as pH, electrical conductivity (EC), organic carbon, texture, and nutrient content, significantly influence soil fertility and crop yield. Understanding these properties is essential for evaluating soil health and ensuring sustainable land management practices. In rural and semi-urban regions, where agriculture is the primary livelihood, periodic assessment of soil quality becomes even more important.

The analysis of surface soil (0–15 cm depth) is particularly significant because this layer is most active biologically and is directly involved in plant growth and nutrient exchange. It contains higher organic matter and microbial activity compared to deeper layers, making it highly responsive to environmental and anthropogenic changes. Factors such as agricultural practices, irrigation, use of fertilizers and pesticides, and natural weathering processes can alter the physico-chemical characteristics of surface soil.

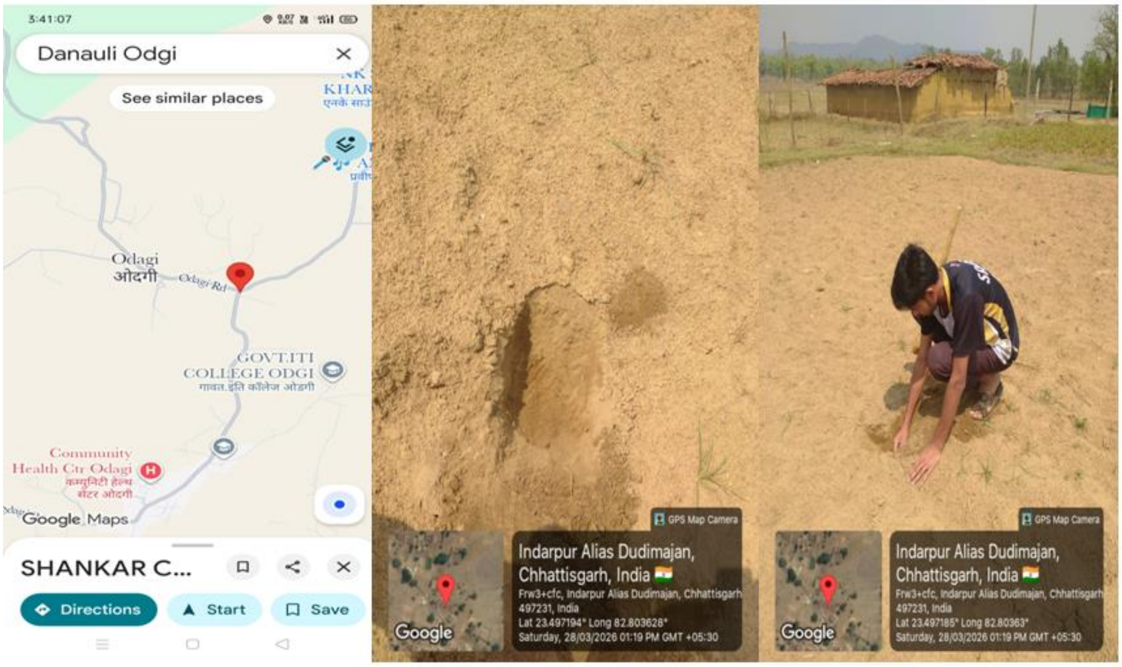


Figure 1: Soil sample collection.

Palldnouli Village, located in Odgi Block of Surajpur District (Chhattisgarh), is predominantly an agricultural area where soil quality directly impacts crop production and local livelihoods. However, limited scientific data is available regarding the soil characteristics of this region. Therefore, a systematic study of soil properties is necessary to assess its fertility status and identify any deficiencies or imbalances in essential nutrients.

LITERATURE REVIEW

Soil physico-chemical properties are essential indicators of soil quality, fertility, and ecosystem sustainability, as they directly influence nutrient availability and plant growth (Li et al., 2020) . 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

Soil Sampling

Soil samples were collected by following standard and widely accepted scientific procedures to ensure precision and reliability. Sampling was performed at a depth of 5–15 cm of surface soil, representing the active root zone of most crops, using a soil auger. The collected samples were air-dried at room temperature to eliminate moisture. After drying, the soil was carefully crushed and passed through a 2 mm sieve to remove stones, roots, and other unwanted materials. The sieved soil was mixed thoroughly to achieve uniformity and then reduced using the quartering technique to obtain a representative sample. A portion of this sample was further sieved through a 0.5 mm mesh and again reduced by quartering. Finally, a fine soil fraction suitable for detailed laboratory analysis was prepared by passing part of the sample through a 0.02 mm sieve.

Materials Used

The analysis was carried out using standard laboratory instruments and chemical reagents. Equipment used included a digital pH meter to measure soil acidity or alkalinity, an electrical conductivity meter to assess salinity, an analytical balance for accurate weighing, and an oven for drying purposes. Various laboratory glassware such as beakers, flasks, and pipettes were also utilized, along with appropriate reagents required for the estimation of different soil nutrients.

Analytical Methods

Soil pH was determined using a digital pH meter in a soil-water suspension with a ratio of 1:2.5. Electrical conductivity (EC) was measured using a conductivity meter to estimate the concentration of soluble salts present in the soil. 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 using a flame photometer. Micronutrients such as zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) were analyzed using standard extraction and estimation techniques.

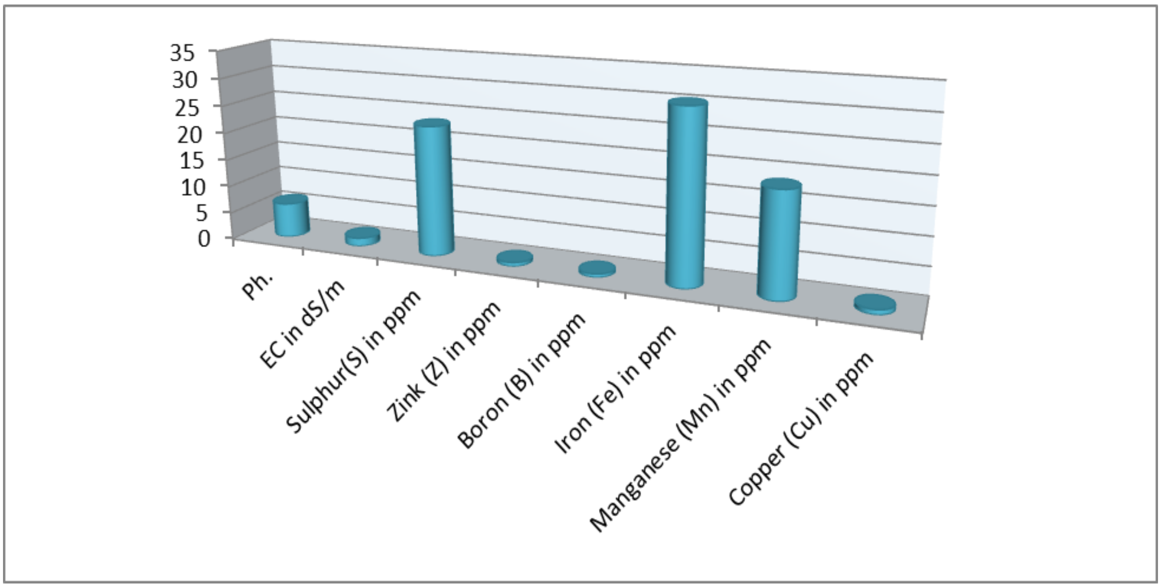
Data Analysis

The data obtained from laboratory analysis were carefully recorded, organized, and interpreted to evaluate the physico-chemical properties and fertility status of the soil samples. The analyzed results are presented and discussed in the subsequent section.

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
5.9	0.15	24.8	0.68	0.6	38.9	30.5	1.54

RESULTS AND DISCUSSION



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

The analyzed soil sample from Palldnouli Village shows a pH value of **5.9**, indicating that the soil is **slightly acidic**, which can affect nutrient availability and microbial activity in the soil (Brady & Weil, 2016). The electrical conductivity (EC) value of **0.15 dS/m** indicates that the soil is **non-saline**, which is suitable for most crops and does not pose any salinity-related stress (Richards, 1954). The sulphur content (**24.8 ppm**) falls within the **moderate range**, suggesting that the soil can adequately support plant metabolic activities such as protein synthesis (Tandon, 2013). The zinc (Zn) concentration of **0.68 ppm** is considered **low to marginal**, which may limit plant growth and crop productivity if not supplemented (Alloway, 2008).The boron (B) level of **0.6 ppm** is also in the **deficient to marginal range**, which can negatively impact flowering, fruiting, and cell wall formation in plants (Gupta, 1993). The iron (Fe) content (**38.9 ppm**) is **sufficient to high**, which is typical for acidic soils and beneficial for chlorophyll synthesis and enzyme activity (Lindsay & Norvell, 1978).

The manganese (Mn) concentration of **30.5 ppm** is also **adequate to high**, supporting various enzymatic reactions and photosynthetic processes in plants (Marschner, 2012). The copper (Cu) level (**1.54 ppm**) falls within the **adequate range**, indicating no deficiency and sufficient availability for plant physiological functions (Kabata-Pendias, 2011).

CONCLUSION

The present study on the physico-chemical properties of surface soil from Palldnouli Village, Odgi Block, Surajpur District (C.G.) reveals that the soil is **slightly acidic (pH 5.9)** in nature, which can influence nutrient availability and crop performance. The **electrical conductivity (0.15 dS/m)** indicates that the soil is **non-saline**, making it suitable for agricultural use without salinity-related constraints. The **sulphur content (24.8 ppm)** is within a moderate range, supporting essential plant metabolic functions. Among micronutrients, **iron (38.9 ppm)**, **manganese (30.5 ppm)**, and **copper (1.54 ppm)** are found in **adequate to high concentrations**, which is beneficial for plant growth and enzymatic activities. However, **zinc (0.68 ppm)** and **boron (0.6 ppm)** are in the **low to marginal range**, indicating potential deficiencies that may limit crop productivity if not properly managed.

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