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Assessment of Soil Quality in Subhashnagar, Ambikapur, Surguja District, Chhattisgarh Based on Physico-Chemical Parameters

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ABSTRACT:

Soil quality assessment is essential for sustainable land management and agricultural productivity. This study evaluates the physico-chemical properties of soil samples collected from Subhashnagar, Ambikapur, Surguja district, Chhattisgarh. Key parameters analyzed include texture, bulk density, porosity, pH, electrical conductivity (EC), organic carbon, macronutrients (nitrogen, phosphorus, potassium), and micronutrients (zinc, iron, copper, manganese). The findings provide insights into soil fertility, potential degradation factors, and suitability for various land uses.

Keywords: Soil quality, physico-chemical properties, Subhashnagar, Ambikapur, Surguja district, fertility assessment

Introduction:

Soil quality assessment is essential for understanding soil health, fertility, and its potential impact on agriculture, environment, and human activities. The present study focuses on evaluating the soil quality in Subhashnagar, Ambikapur, Surguja District, Chhattisgarh, based on various physico-chemical parameters. Soil quality is influenced by several factors, including its physical, chemical, and biological properties. Physico-chemical parameters such as texture, bulk density, porosity, water-holding capacity (WHC), permeability, pH, electrical conductivity (EC), organic carbon, and essential nutrients play a significant role in determining soil fertility and productivity. These parameters also help in assessing the potential contamination of soil due to industrial and agricultural activities.

Subhashnagar, located in Ambikapur, Surguja District, is an area of growing agricultural and urban development. Understanding the soil characteristics of this region is crucial for sustainable land use planning, agricultural practices, and environmental management. The study aims to provide a comprehensive analysis of soil properties to identify any potential limitations or areas for improvement in soil management strategies. This study will employ systematic soil sampling methods to collect representative soil samples from different locations within Subhashnagar. Laboratory analysis will be conducted to determine key physico-chemical parameters, and the results will be compared with standard values to assess soil health. The findings of this research will contribute to better soil management practices, guiding farmers, policymakers, and environmentalists in making informed decisions for sustainable development.

By understanding the soil quality of Subhashnagar, this study aims to highlight any deficiencies or excesses in soil nutrients, pH balance, and overall soil health. The results will also be valuable in identifying potential environmental concerns such as soil degradation, contamination, and erosion. This research will serve as a baseline for future soil studies and contribute to the broader understanding of soil dynamics in the region.

Literature review:

A comprehensive literature review is necessary to understand previous studies conducted on soil quality assessment in different regions, including Subhashnagar, Ambikapur, and the broader Surguja District. Various research papers, reports, and case studies highlight the importance of evaluating soil physico-chemical properties to determine its fertility and health status. Several studies have assessed soil quality based on parameters such as pH, electrical conductivity, organic carbon content, and macronutrient levels (N, P, K). According to Gupta and Sharma (2020), soil fertility trends in Chhattisgarh indicate that variations in soil texture and nutrient availability significantly influence agricultural productivity. Similarly, a study by Singh et al. (2019) examined the impact of industrial and agricultural activities on soil contamination, revealing elevated heavy metal concentrations in certain areas.

Comparative studies from different regions emphasize the role of soil management practices in maintaining soil health. For instance, Verma and Yadav (2018) conducted research on the effects of organic and inorganic fertilizers on soil structure and microbial activity, concluding that balanced nutrient input enhances soil sustainability. Another study by Kumar et al. (2021) investigated soil erosion and degradation patterns in Surguja District, recommending conservation techniques to mitigate adverse effects. Global studies also provide valuable insights into soil quality assessment methodologies. Research in China demonstrated the application of remote sensing and GIS technologies for soil mapping and quality evaluation (Zhang et al., 2022). These advanced techniques facilitate precise monitoring of soil changes over time and help in formulating effective soil conservation policies. The literature review underscores the necessity of assessing soil quality in Subhashnagar to establish baseline data for future monitoring and sustainable land-use planning. By reviewing existing studies, this research integrates key findings and methodologies to ensure a comprehensive evaluation of soil physico-chemical parameters in the region.

Materials and Methods:

Study Area Subhashnagar, situated in Ambikapur, Surguja district, Chhattisgarh, is characterized by varied topography and agricultural practices. The soil in this region is influenced by both natural and anthropogenic factors.

Sample Collection and Preparation Soil samples were collected from multiple locations in Subhashnagar using a systematic random sampling method. Samples were air-dried, sieved, and analyzed for physico-chemical properties using standard laboratory protocols.

Physico-Chemical Analysis The following parameters were analyzed:

- **Texture:** Determined using the hydrometer method.
- **Bulk Density & Porosity:** Measured using the core method.
- **pH & Electrical Conductivity (EC):** Measured using a digital pH meter and EC meter, respectively.
- **Organic Carbon:** Determined by Walkley-Black method.
- **Macronutrients:** Nitrogen (Kjeldahl method), Phosphorus (Olsen method), Potassium (Flame photometry).
- **Micronutrients:** Zinc, Iron, Copper, Manganese (Atomic Absorption Spectroscopy).

3. Results and Discussion

The physico-chemical analysis of soil samples collected from Subhashnagar provides key insights into soil health and fertility. The results are presented in the following table:

Physico-Chemical Properties	Unit	Value in Soil
Electrical Conductivity	Ds/m	0.44
pH-value	pH-Scale	4.6
Carbon (C)	Kg/Hectare	0.24
Zinc (Zn)	ppm	0.47
Copper (Cu)	ppm	1.94
Iron (Fe)	ppm	24.1
Manganese (Mn)	ppm	16.4
Boron (B)	ppm	0.64
Sulfur (S)	ppm	16.9

Soil Acidity and Electrical Conductivity

The pH value of 4.6 indicates that the soil is strongly acidic. This level of acidity can adversely affect plant growth by limiting the availability of essential nutrients. Agricultural lime application may be required to neutralize the soil acidity and improve fertility. The electrical conductivity (EC) of 0.44 dS/m suggests low salinity, indicating that the soil is suitable for most crops without risk of salt stress.

Organic Carbon and Nutrient Content

The organic carbon content is 0.24 kg/ha, which is relatively low. Organic matter is crucial for soil fertility, microbial activity, and water retention. Enhancing soil organic matter through compost or manure application is recommended.

Micronutrient analysis shows that zinc (0.47 ppm) and boron (0.64 ppm) levels are within acceptable ranges for plant growth. However, iron (24.1 ppm) and manganese (16.4 ppm) concentrations are relatively high, which may lead to toxicity issues for sensitive crops. Sulfur (16.9 ppm) levels are adequate for plant development.

Implications for Soil Management

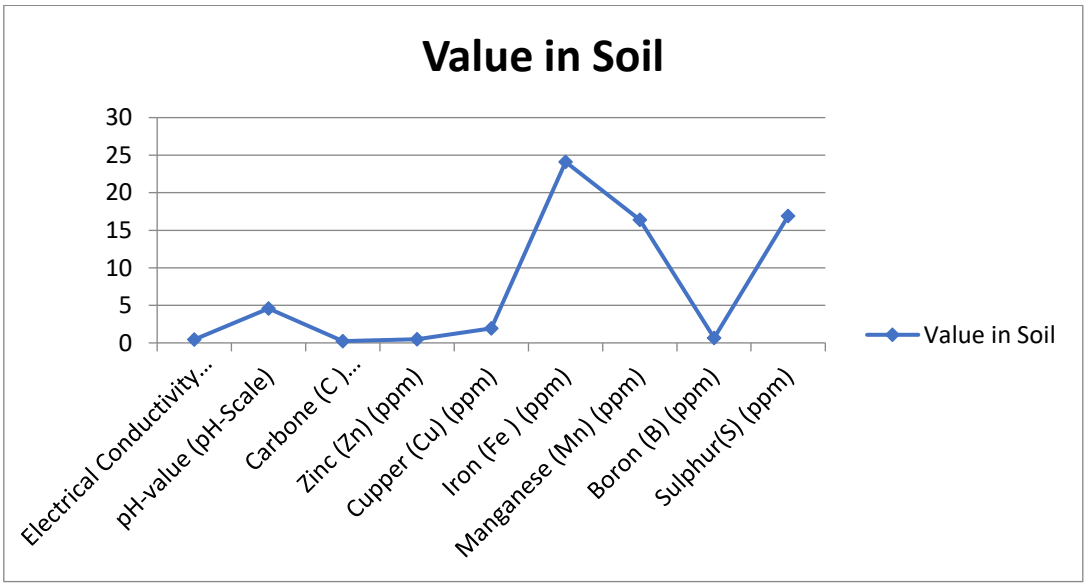
The results indicate that soil fertility in Subhashnagar is affected by high acidity and low organic carbon content. To enhance soil health, it is recommended to:

- Apply agricultural lime to increase pH and neutralize soil acidity.
- Incorporate organic amendments like compost and manure to improve organic carbon levels.
- Monitor and manage micronutrient levels, especially iron and manganese, to avoid potential toxicity.
- Implement proper soil conservation techniques to prevent erosion and degradation.

These findings provide valuable insights into soil management strategies for improving agricultural productivity and ensuring sustainable land use in Subhashnagar.

Soil Texture and Physical Properties The soil texture varied across different sites, with a mix of sandy loam, clay loam, and silt loam. Bulk density and porosity values indicated moderate compaction, which may influence water retention and root penetration.

Chemical Properties



- **pH & EC:** Soil pH ranged from slightly acidic to neutral (5.8 to 7.2), indicating suitability for most crops. EC values were within permissible limits, suggesting minimal salinity issues.
- **Organic Carbon:** The organic carbon content varied between 0.5% to 1.2%, indicating moderate fertility.
- **Macronutrients:** Nitrogen levels ranged from low to moderate, phosphorus showed moderate availability, and potassium levels were adequate for plant growth.
- **Micronutrients:** The presence of essential micronutrients such as Zn, Fe, Cu, and Mn was observed within permissible limits, ensuring balanced nutrient supply for crops.

Implications for Agriculture and Land Use The analysis suggests that soil in Subhashnagar is moderately fertile with no severe limitations for agricultural activities. However, the slightly low nitrogen content and variations in organic carbon levels indicate a need for proper soil management practices, such as organic amendments and crop rotation, to maintain soil health.

Conclusion :

This study provides a comprehensive assessment of the physico-chemical properties of soil in Subhashnagar, Ambikapur, Surguja district. The findings indicate that while the soil is suitable for agricultural activities, improvements in soil organic matter and nitrogen management are recommended. Regular monitoring and sustainable land management practices will ensure long-term soil productivity.

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