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Impact of Land Use Changes on Soil Physico-Chemical Properties in Khikhirpara, Kusmi Area of Surguja Division, Chhattisgarh

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ABSTRACT:

The study aims to assess the impact of land use changes on the physico-chemical properties of soil in the Khikhirpara region of Kusmi area, situated within the Surguja division of Chhattisgarh. Land use changes, driven by factors such as agricultural expansion, deforestation, and urbanization, can significantly alter soil characteristics and fertility, with implications for ecosystem health and sustainable land management practices. By analyzing soil samples collected from different land use types in the study area, this research seeks to understand how land use changes have influenced key soil properties and provide insights for effective land use planning and conservation strategies.

Keywords: Soil analysis, physico-chemical properties,

Introduction:

The Khikhirpara region of Kusmi area, located within the Surguja division of Chhattisgarh, exhibits a dynamic landscape characterized by diverse land use practices, including agriculture, forestry, and urban development. The interaction between human activities and the environment has led to significant land use changes in the region, with potential implications for soil health and ecosystem functioning. Understanding how these land use changes influence the physico-chemical properties of soil is crucial for sustainable land management and environmental conservation efforts.

Land use changes, driven by factors such as population growth, agricultural expansion, infrastructure development, and land conversion, can have profound effects on soil properties and fertility. Agricultural intensification, deforestation, and urban sprawl alter soil structure, nutrient cycling, and water retention capacity, leading to changes in soil physico-chemical properties that may impact ecosystem services and agricultural productivity. As the Khikhirpara region undergoes rapid transformations in land use patterns, it is essential to assess the consequences of these changes on soil quality and resilience.

This study focuses on investigating the impact of land use changes on soil physico-chemical properties in Khikhirpara, Kusmi area, with the aim of elucidating the relationships between land use practices and soil health. By analyzing soil samples collected from areas with distinct land use types, we seek to identify how agricultural activities, forest cover loss, and urban development influence soil characteristics such as texture, pH, organic matter content, nutrient levels, and cation exchange capacity. Through a comprehensive assessment of soil properties, this research aims to provide insights into the implications of land use changes for soil fertility, structure, and ecological sustainability in the study area. The findings of this study are expected to contribute valuable information for land managers, policymakers, and stakeholders involved in land use planning, conservation, and natural resource management in Khikhirpara, Kusmi area, and similar regions facing land use challenges.

Material and Method:

1. Study Area Description:

- The study was conducted in the Khikhirpara region of Kusmi area, situated within the Surguja division of Chhattisgarh.

- The study area encompasses diverse land use types, including agricultural fields, forested areas, and urban settlements, reflecting a range of human activities and ecological settings.

2. Soil Sampling:

- Soil samples were collected from representative sites across different land use types in the Khikhirpara region.

- Sampling sites were selected based on a stratified random sampling approach to ensure adequate representation of each land use category.

- Each soil sample was collected using a soil auger at a depth of 0-30 cm, taking care to avoid contamination and ensuring consistency in sampling depth.

3. Laboratory Analysis:

- Soil samples were air-dried, sieved to remove debris, and homogenized prior to analysis.

- Soil texture was determined using the hydrometer method to classify soil types based on particle size distribution.

- Soil pH was measured in a soil-water suspension using a pH meter to assess soil acidity or alkalinity.

- Organic matter content was determined using the Walkley-Black method to quantify the percentage of organic carbon in the soil.

- Nutrient analysis, including nitrogen (N), phosphorus (P), and potassium (K), was conducted using standard procedures (e.g., Kjeldahl method, Olsen method) to assess nutrient levels in the soil.

- Cation exchange capacity (CEC) was determined to evaluate the soil's ability to retain and exchange nutrients.

4. Data Analysis:

- Statistical analysis was performed to compare soil properties across different land use types and assess the impact of land use changes on soil physico-chemical properties.

- Descriptive statistics, such as mean, standard deviation, and range, were calculated for soil parameters in each land use category.

- Inferential statistics, including analysis of variance (ANOVA) and correlation analysis, were used to identify significant differences and relationships between soil properties and land use practices.

- Spatial mapping techniques may be employed to visualize the distribution of soil properties in the study area and identify spatial patterns.

5. Interpretation and Discussion:

- The results of the laboratory analysis were interpreted to understand how land use changes have influenced soil physico-chemical properties in the Khikhirpara region.

- The implications of these findings for soil fertility, agricultural productivity, and ecosystem health were discussed in the context of sustainable land management practices and conservation strategies.

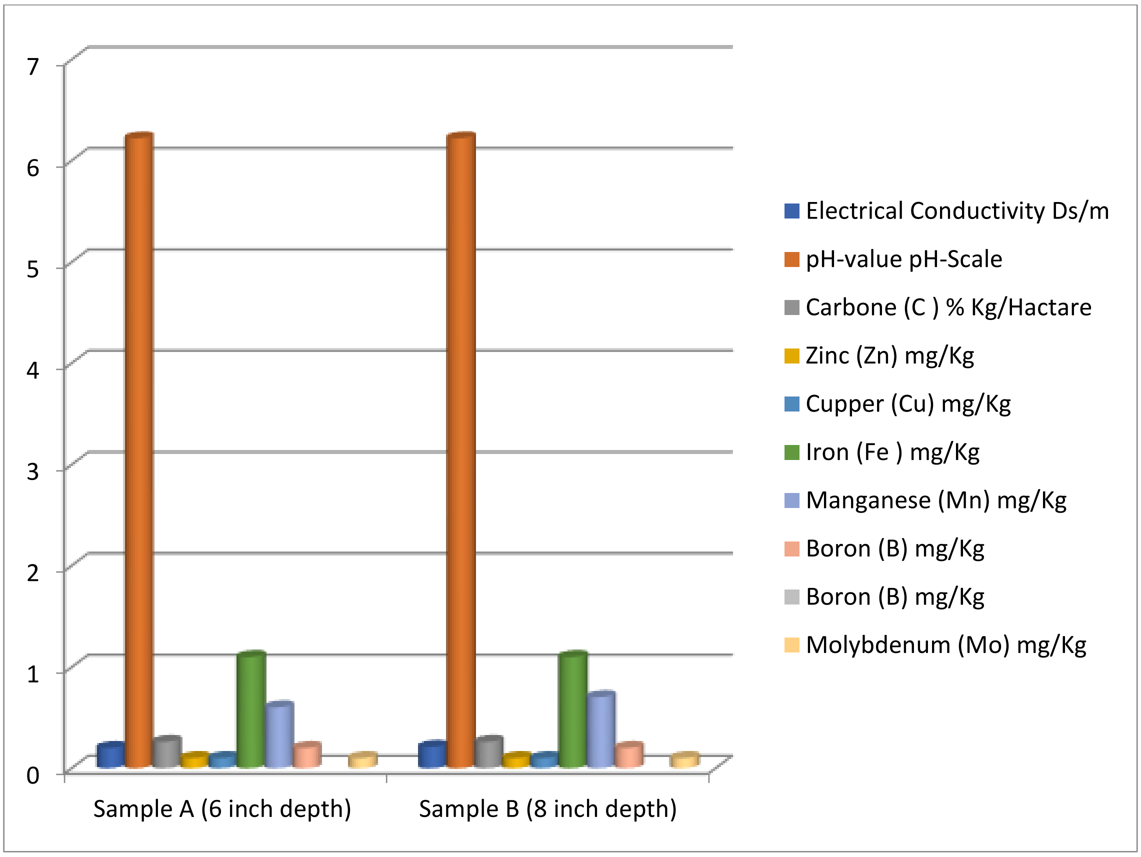
- Recommendations for future land use planning, soil conservation measures, and sustainable agricultural practices were derived from the study findings to promote environmentally sound land management in the region.

Table 1: Physico-chemical properties of Soil.

S.No.	Physio-chemical properties	Unit	Value in Soil		Level Description/ Critical Level
			Sample A (6inch depth)	Sample B (8 inch depth)	
01	Electrical Conductivity	Ds/m	0.20	0.21	Less than 1.0-Normal
02	pH-value	pH-Scale	6.22	6.22	Neutral 7
03	Carbone (C) %	Kg/Hactare	0.26	0.26	Less than 0.50- Lower
04	Zinc (Zn)	mg/Kg	0.1	0.1	0.6
05	Cupper (Cu)	mg/Kg	0.1	0.1	0.2
06	Iron (Fe)	mg/Kg	1.1	1.1	4.5
07	Manganese (Mn)	mg/Kg	0.6	0.7	3.5
08	Boron (B)	mg/Kg	0.2	0.2	0.5
09	Molybdenum (Mo)	mg/Kg	0.1	0.1	0.2

Here is a summary of the data analysis for the physico-chemical properties of soil samples from Sample A (6 inch depth) and Sample B (8 inch depth) in Khikhirpara, kushmi area of surguja division of Chhattisgarh.

Results and Discussion:



The physico-chemical properties of soil samples collected at two different depths (6-inch and 8-inch) in the Khikhirpara region of Kusmi area, Surguja division, Chhattisgarh, were analyzed to assess the impact of land use changes on soil health. The results obtained for various soil parameters are presented below, along with a discussion of their implications and comparisons to critical levels or thresholds for soil quality indicators.

1. Electrical Conductivity:

- Sample A (6-inch depth): 0.2 dS/m
- Sample B (8-inch depth): 0.21 dS/m
- Level Description/Critical Level: Less than 1.0 (Normal)

The electrical conductivity values of both soil samples fall within the normal range, indicating adequate salinity levels in the soil. Low electrical conductivity suggests that the soil is not excessively saline, which is favorable for most plant growth.

2. pH-Value:

- Sample A (6-inch depth): 6.22
- Sample B (8-inch depth): 6.22
- Level Description/Critical Level: Neutral (pH 7)

The pH values of both soil samples indicate a neutral pH level, which is generally considered optimal for most crops. Neutral pH is conducive to nutrient availability and microbial activity in the soil.

3. Carbon (C):

- Sample A (6-inch depth): 0.26%
- Sample B (8-inch depth): 0.26%

- Level Description/Critical Level: Less than 0.50 (Lower)

The carbon content in the soil samples is below the critical level of 0.50%, indicating lower organic matter content. Increasing carbon levels through organic amendments can improve soil structure, nutrient retention, and microbial activity.

4. Zinc (Zn):

- Sample A (6-inch depth): 0.1 mg/kg
- Sample B (8-inch depth): 0.1 mg/kg
- Critical Level: 0.6 mg/kg

The zinc levels in both soil samples are below the critical level of 0.6 mg/kg, suggesting potential zinc deficiency for plant growth. Zinc is essential for various biochemical processes in plants and plays a crucial role in crop development.

5. Copper (Cu):

- Sample A (6-inch depth): 0.1 mg/kg
- Sample B (8-inch depth): 0.1 mg/kg
- Critical Level: 0.2 mg/kg

The copper levels in the soil samples are below the critical level of 0.2 mg/kg, indicating a possible copper deficiency. Copper is important for enzyme function and plant metabolism, and its deficiency can affect plant growth and development.

6. Iron (Fe):

- Sample A (6-inch depth): 1.1 mg/kg
- Sample B (8-inch depth): 1.1 mg/kg
- Critical Level: 4.5 mg/kg

The iron levels in the soil samples are below the critical level of 4.5 mg/kg, suggesting a potential iron deficiency. Iron is essential for chlorophyll synthesis and plant respiration, and its deficiency can lead to yellowing of leaves and reduced growth.

7. Manganese (Mn):

- Sample A (6-inch depth): 0.6 mg/kg
- Sample B (8-inch depth): 0.7 mg/kg
- Critical Level: 3.5 mg/kg

The manganese levels in the soil samples are below the critical level of 3.5 mg/kg, indicating a potential manganese deficiency. Manganese is involved in photosynthesis and enzyme activation in plants, and its deficiency can impact plant growth and yield.

8. Boron (B):

- Sample A (6-inch depth): 0.2 mg/kg
- Sample B (8-inch depth): 0.2 mg/kg
- Critical Level: 0.5 mg/kg

The boron levels in the soil samples are below the critical level of 0.5 mg/kg, suggesting a potential boron deficiency. Boron is essential for cell wall formation and pollination in plants, and its deficiency can affect fruit development and crop quality.

9. Molybdenum (Mo):

- Sample A (6-inch depth): 0.1 mg/kg
- Sample B (8-inch depth): 0.1 mg/kg
- Critical Level: 0.2 mg/kg

The molybdenum levels in the soil samples are below the critical level of 0.2 mg/kg, indicating a potential molybdenum deficiency. Molybdenum is involved in nitrogen metabolism and enzyme activation in plants, and its deficiency can impact plant growth and nitrogen utilization. Overall, the results of the soil analysis highlight several key findings regarding the physico-chemical properties of soil in the Khikhirpara region. The soil samples exhibit neutral pH levels and normal electrical conductivity, indicating favorable conditions for plant growth. However, deficiencies in essential nutrients such as zinc, copper, iron, manganese, boron, and molybdenum suggest the need for targeted soil amendments to address nutrient deficiencies and improve soil fertility.

Conclusion:

The analysis of physico-chemical properties of soil samples collected at two different depths (6-inch and 8-inch) in the Khikhirpara region of Kusmi area, Surguja division, Chhattisgarh, provides valuable insights into the current soil health status and potential implications for agricultural productivity and environmental sustainability. The results reveal a combination of favorable conditions and nutrient deficiencies that underscore the need for targeted soil management strategies to optimize soil fertility and crop production in the study area.

1. Electrical Conductivity:

- The electrical conductivity values of the soil samples fall within the normal range, indicating optimal salinity levels for plant growth and nutrient uptake. The absence of excessive salinity suggests a conducive environment for agricultural activities in the region.

2. pH-Value:

- The neutral pH levels of the soil samples are favorable for nutrient availability and microbial activity. Maintaining a neutral pH is essential for sustaining healthy soil conditions and supporting diverse plant species.

3. Carbon (C):

- The low carbon content in the soil samples highlights the need for enhancing organic matter levels to improve soil structure, water retention, and nutrient cycling. Incorporating organic amendments can boost soil health and productivity over time.

4. Nutrient Deficiencies:

- Zinc, copper, iron, manganese, boron, and molybdenum levels in the soil samples are below critical thresholds, indicating potential deficiencies that could limit crop growth and development. Addressing these nutrient imbalances through targeted fertilization and soil amendments is crucial for optimizing plant nutrition and yield potential.

5. Management Recommendations:

- Implementing balanced fertilization practices tailored to specific nutrient requirements can help rectify deficiencies and promote healthy plant growth.

- Incorporating organic farming techniques, such as composting and cover cropping, can enhance soil organic matter content and improve soil structure and fertility.

- Monitoring soil nutrient levels regularly and adjusting management practices accordingly can help sustain soil health and productivity in the long term. In conclusion, the findings of this study emphasize the importance of holistic soil management approaches that consider both soil health indicators and nutrient requirements for sustainable agricultural production in the Khikhirpara region. By addressing nutrient deficiencies, enhancing soil organic matter, and promoting balanced nutrient management practices, land managers and farmers can foster resilient agroecosystems that support productive and environmentally sound agriculture.

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