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ASSESSMENT OF SOIL QUALITY AND AGRICULTURAL SUITABILITY IN THE PANCHGANGA BASIN

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Abstract:

This research paper presents a comprehensive analysis of soil quality and agricultural suitability in the Panchganga Basin, a region characterized by diverse soil types originating from the Deccan Trap. The significance of this study lies in its potential to inform sustainable land-use planning and agricultural practices in the basin. The primary objective is to assess the physio-chemical characteristics of different soil types and determine their suitability for various crops. With the detailed examination of soil properties, including color, depth, drainage, topography, erosion, and nutrient content. The key findings reveal a spatial distribution of soil types across tahsils, providing valuable insights for farmers and policymakers. This research contributes to the understanding of the region's soil diversity, aiding in informed decision-making for sustainable agricultural development.

Key Words: Agricultural Suitability, Panchganga Basin, Soil Types, Land Use Planning, Sustainable Agriculture, Nutrient Content.

Introduction:

The Panchganga Basin, characterized by its diverse soil composition derived from the Deccan Trap, holds immense significance for sustainable agriculture in the region. As the demand for food production rises, understanding the physio-chemical characteristics of soils becomes imperative for informed land-use planning and crop selection. Despite the region's agricultural importance, there exists a gap in the comprehensive study of soil quality and its suitability for different crops. Existing studies provide limited insights, necessitating a focused investigation into the diverse soil types present in the basin. At present, there is a lack of detailed analyses that integrate spatial distribution patterns, physio-chemical properties, and agricultural implications for each soil type. This research aims to bridge this gap by offering a holistic examination of the Panchganga Basin's soils, thereby providing valuable insights for farmers, policymakers, and researchers involved in the sustainable development of agricultural practices in the region.

The current status of soil studies in the Panchganga Basin reflects a fragmented understanding, with existing research primarily focusing on specific aspects such as soil types or nutrient content. This research paper seeks to build upon and synthesize existing knowledge, offering a comprehensive overview that integrates various levels of soil analysis. Geographically, the study is crucial for understanding the diverse topography of the basin and its implications for soil characteristics. Socially, the outcomes of this research are vital for enhancing agricultural productivity, contributing to food security, and promoting sustainable farming practices. The main objective is to assess the physio-chemical characteristics of different soil types and their suitability for various crops. The research outcomes are expected to guide land-use planning, inform policymakers, and empower local farmers with knowledge for sustainable agricultural practices. This study draws on a range of references, including works by Brady and Weil (2008) on soil science principles, Lal (2004) on sustainable agriculture, and studies on regional soil characteristics such as those by Singh et al. (2015) and Kumar et al. (2018). Additionally, government reports from the Soil Survey and Soil Testing Laboratory in Kolhapur provide valuable insights into the current state of soil knowledge in the region.

Objective:

1. To assess the physio-chemical characteristics of different soil types in the Panchganga Basin, aiming to provide insights into their agricultural suitability and inform sustainable land-use planning in the region.

Database and Methodology:

For collecting detailed soil data from authoritative sources, primarily utilizing soil sample analysed data from government soil survey and soil testing laboratory, Kolhapur. The information is used for physio-chemical characteristics, spatial distribution, and area percentages of different soil types in the Panchganga Basin. Soil types were classified and analyzed based on color, depth, drainage, topography, erosion, and nutrient content, forming the basis for a comparative assessment of agricultural suitability. Spatial maps were created to visually represent the distribution of soil types across tahsils. A literature review contextualized finding, and statistical tools were employed for quantitative analysis, integrating data from multiple sources. Cross-validation with established soil survey and testing laboratory data ensured reliability. The interdisciplinary approach combined geographical, geological, and agricultural perspectives. The methodology culminated in a comprehensive report summarizing key insights and

recommendations for informed decision-making in sustainable land-use planning and agriculture in the Panchganga Basin.

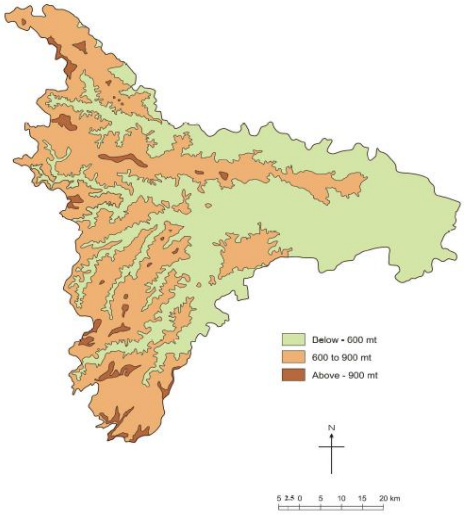
Study Region:

The selected region for the present investigation is the 'Panchganga Basin' of south Maharashtra state comprising seven tahsils of Kolhapur district namely Shahuwadi, Panhala, Gagan Bawada, Karveer, Hatkanangle, & Shirol. The triangular tract region lies between 16°13' and 17°11' north latitude, and 73°41' and 74º 42' east longitudes. It covers about 45752.2 sq.km area and supports 2611547 (2.6% of state) population. The river Panchganga is well- watered and agriculturally developed part of the state (Shinde, 1973 .(This region is topographically complex, having river valley flood plains to the east and hilly ranges to the west. Climatically this region have's temperate climate. The region located in rain shadow zone of Western Ghats receives a decreasing amount of rainfall from the west (6000 mm) to east (500mm).

Analysis:

Geographical Overview:

The Panchganga Basin, nestled in the Deccan Trap, features undulating topography influenced by the Western Ghats, resulting in varying slopes and a moderate to heavy annual rainfall. The western hilly tracks contribute to laterite soils, while residual coarse shallow soils dominate the uplands. This diverse geographical setting, coupled with unique climatic influences, shapes the region's vegetation cover, creating a landscape that holds significance for soil formation and agricultural practices. A concise understanding of these geographical features is essential for effective land-use planning in the Panchganga Basin.



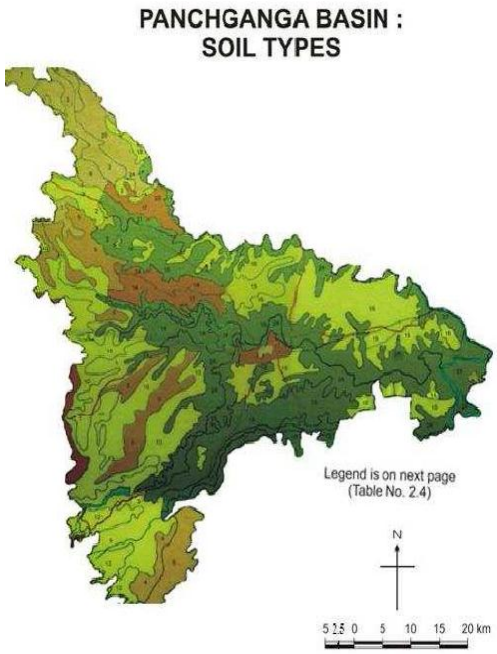
Soil Types, Classification and Spatial Distribution:

The Panchganga Basin showcases a diverse range of soil types originating from the Deccan Trap. These soils are broadly classified into five categories based on physio-chemical characteristics and spatial distribution:

- Laterite Soils (13.41%): Location- Western hilly tracks, Characteristics - High iron content, acidity, low water-holding capacity

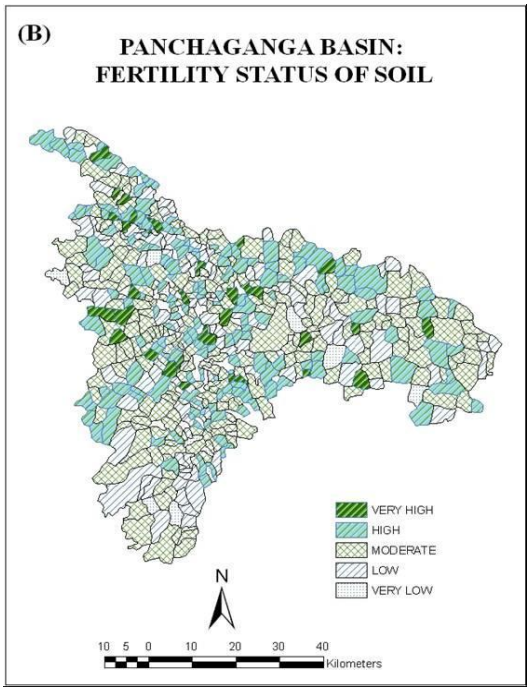
- Radish Brown Soils (30.77%): Location- Throughout the region, Characteristics- Dark brown color, moderate fertility
- Course Shallow Soils (22.10%): Location- Undulating uplands
- Characteristics- Compactness, low water-holding capacity
- Medium Black Soils (19.65%): Location- Uplands, Characteristics- Good moisture retention, neutral to alkaline reactions
- Deep Black Soils (14.00%): Location- Various parts of the region, Characteristics- High clay and organic matter content, high water-holding capacity

This spatial distribution of soil types across tahsils provides valuable insights for localized land-use planning and agricultural practices in the Panchganga Basin.



Soil Fertility and Nutrient Content:

The fertility analysis, based on the composite index of village-wise fertility data, reveals distinct categories within the region. A mere 2.36% falls under the "Very Low Fertile Areas," encompassing Radhanagri, Hatkanangle, Shirol, Panhala, Shahuwadi, and Karveer tahsils. Characterized by hilly barren lands and saline waterlogged areas, this classification is crucial, constituting only a small fraction of the entire region. Meanwhile, "Low Fertile Areas" cover 18.18%, including Hatkangale, Radhanagri, Shahuwadi, Shirol, Panhala, Karveer, and Gagan Bawada tahsils. These areas exhibit low fertility due to factors like immature soils in high drainage density and high rainfall zones. The majority, about 43.45%, falls into the "Moderate Fertile Areas," providing average agricultural production. Conversely, "High Fertile Areas" make up 30% of the total region, showcasing better fertility for agricultural practices. Lastly, the "Very High Fertile Areas," though minimal at 6.00%, stand out for their agricultural development potential, found in small quantities across Panhala, Karveer, Shahuwadi, Gagan Bawada, Hatkanangle, and Shirol tahsils. This detailed categorization, supported by specific percentages and tahsil-wise breakdowns, provides a comprehensive understanding of the region's fertility landscape.



Agricultural Suitability:

Agricultural suitability in the Panchganga Basin is intricately linked to the diverse soil types and fertility levels across the region. Laterite soils, covering 13.41% of the area, are suitable for crops like paddy, millets, rice, and fruits. Radish Brown soils, constituting 30.77%, are well-suited for rice, jowar, groundnut, sugarcane, and vegetables. Course Shallow soils, comprising 22.10%, are apt for groundnuts, jowar, pulses, and sugarcane. Medium Black soils, covering 19.65%, support paddy, sugarcane, soybean, and vegetables. Deep Black soils, occupying 14%, are suitable for jowar, groundnuts, pulses, cotton, wheat, sugarcane, and soybean. The evaluation extends beyond soil types to fertility levels, categorized into Very Low, Low, Moderate, High, and Very High. Areas with low fertility, such as Radhanagri, Hatkanangle, Shirol, Panhala, Shahuwadi, and Karveer tahsils, may require targeted agricultural practices. On the other hand, moderate to very high fertile areas, including Karveer, Shahuwadi, Gagan Bawada, Panhala, Shirol, Hatkangale, and Radhanagri tahsils, present favorable conditions for diverse crop production. This nuanced understanding of soil fertility and types facilitates precise crop selection and guides agricultural practices for optimal productivity in the Panchganga Basin.

Land Use Planning:

Land use planning in the Panchganga Basin is intricately linked to the fertility levels of its villages, as determined by a composite index. The region is classified into five groups based on fertility, guiding agricultural practices and sustainable development. Very Low fertile areas, covering 2.36% of the total region, include hilly barren lands in Radhanagri, Shahuwadi, Panhala, and some parts of Karveer, along with lowlands that are saline and waterlogged in Hatkanangle and Shirol tahsils. Low fertile areas, constituting 18.18% of the total regional area, encompass hilly and sloppy lands with immature soils in Radhanagri, Shahuwadi, Panhala, and some parts of Karveer, as well as saline, waterlogged, and overexploited areas in Hatkanangle and Shirol tahsils. Moderate fertile

areas, the majority at 43.45%, give average agricultural production and cover most parts of the region. High fertile areas, covering 30% of the total area, are well-suited for agricultural practices, and Very High fertile areas, though insignificant at 6.00%, are highly suitable for various crop production, contributing to the agriculturally well-developed parts of the region. This nuanced understanding of fertility zones is essential for effective land use planning, guiding decisions on agricultural practices and resource allocation in the Panchganga Basin.

Conclusion:

The comprehensive analysis of soil characteristics and agricultural suitability in the Panchganga Basin reveals valuable insights crucial for sustainable development and land management. The region's soil diversity, ranging from laterite to deep black soils, dictates the suitability for specific crops. Laterite soils, while prone to erosion, offer potential for paddy crops, millets, and fruit plantations. Radish Brown soils exhibit moderate fertility, making them suitable for rice, jowar, groundnut, sugarcane, and vegetables. Course Shallow soils, though moderately fertile, are suitable for groundnuts, jowar, pulses, and sugarcane. Medium Black soils, with good moisture retention, support paddy, sugarcane, soybean, and vegetables. Deep Black soils, highly fertile but deficient in nitrogen and phosphate, are suitable for various crops. Moreover, the fertility analysis classifies the region into categories, emphasizing the need for informed soil management practices. With only 2.36% falling under very low fertility, the majority of the area (43.45%) is in the moderate fertility zone, providing average agricultural production. The identification of high and very high fertile areas (36%) underscores opportunities for agricultural development. This nuanced understanding is vital for formulating land use plans that balance agricultural productivity and environmental conservation in the Panchganga Basin.

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