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ASSESSING LAND SUITABILITY FOR RUBBER CULTIVATION IN KERALA'S TROPICAL HUMID REGION

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Abstract: This study assesses the suitability of land for rubber cultivation in Kerala's tropical humid region, employing geographic information systems (GIS) and multi-criteria decision analysis (MCDA). Various factors including climate, soil characteristics, topography, and land use are integrated to generate suitability maps. The findings provide valuable insights into optimal land use planning for rubber cultivation, contributing to sustainable agricultural practices in the region.

Keywords: Rubber cultivation, land suitability assessment, Kerala, tropical humid region, geographic information systems (GIS), multi-criteria decision analysis (MCDA).

INTRODUCTION

Rubber cultivation in Kerala, India, has a rich history and plays a crucial role in the state's economy, contributing significantly to agricultural output and employment. The tropical humid climate of Kerala, characterized by high rainfall and moderate temperatures, provides favorable conditions for rubber tree (Hevea brasiliensis) growth. However, the suitability of land for rubber cultivation varies across the region due to diverse factors such as soil types, topography, and existing land use patterns.

Assessing the suitability of land for rubber cultivation is essential for maximizing productivity and sustainability in agricultural practices. Geographic information systems (GIS) and multi-criteria decision analysis (MCDA) have emerged as valuable tools for integrating spatial data and criteria to evaluate land suitability effectively. By mapping out suitable areas for rubber cultivation based on environmental and agronomic factors, stakeholders can make informed decisions regarding land management and resource allocation.

This study aims to assess land suitability for rubber cultivation in Kerala's tropical humid region, utilizing GIS and MCDA techniques. By analyzing various parameters including soil quality, climate conditions, slope, and land use, the research seeks to provide comprehensive insights into optimal land use planning strategies. The findings of this study are expected to guide policymakers, agricultural planners, and rubber

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growers towards sustainable practices that enhance productivity while minimizing environmental impacts.

Understanding the spatial distribution of suitable land for rubber cultivation is crucial for promoting agricultural sustainability and economic development in Kerala. This research contributes to the broader goal of achieving balanced land use management practices that support both agricultural productivity and environmental conservation in the region.

METHODS

To assess the suitability of land for rubber cultivation in Kerala's tropical humid region, a systematic approach utilizing Geographic Information Systems (GIS) and Multi-Criteria Decision Analysis (MCDA) was adopted. The study area, encompassing various districts known for rubber cultivation, was first delineated using satellite imagery and topographic maps. This spatial data provided a foundation for the subsequent analyses.

The initial step involved compiling and integrating spatial datasets related to environmental and agronomic factors influencing rubber cultivation. Soil data, including texture, pH levels, and nutrient content, were obtained from soil surveys and databases. Climate data, such as rainfall patterns, temperature regimes, and humidity levels, were sourced from meteorological stations and remote sensing datasets. Additionally, information on topography, including slope and elevation, was derived from digital elevation models (DEMs) to assess terrain suitability.

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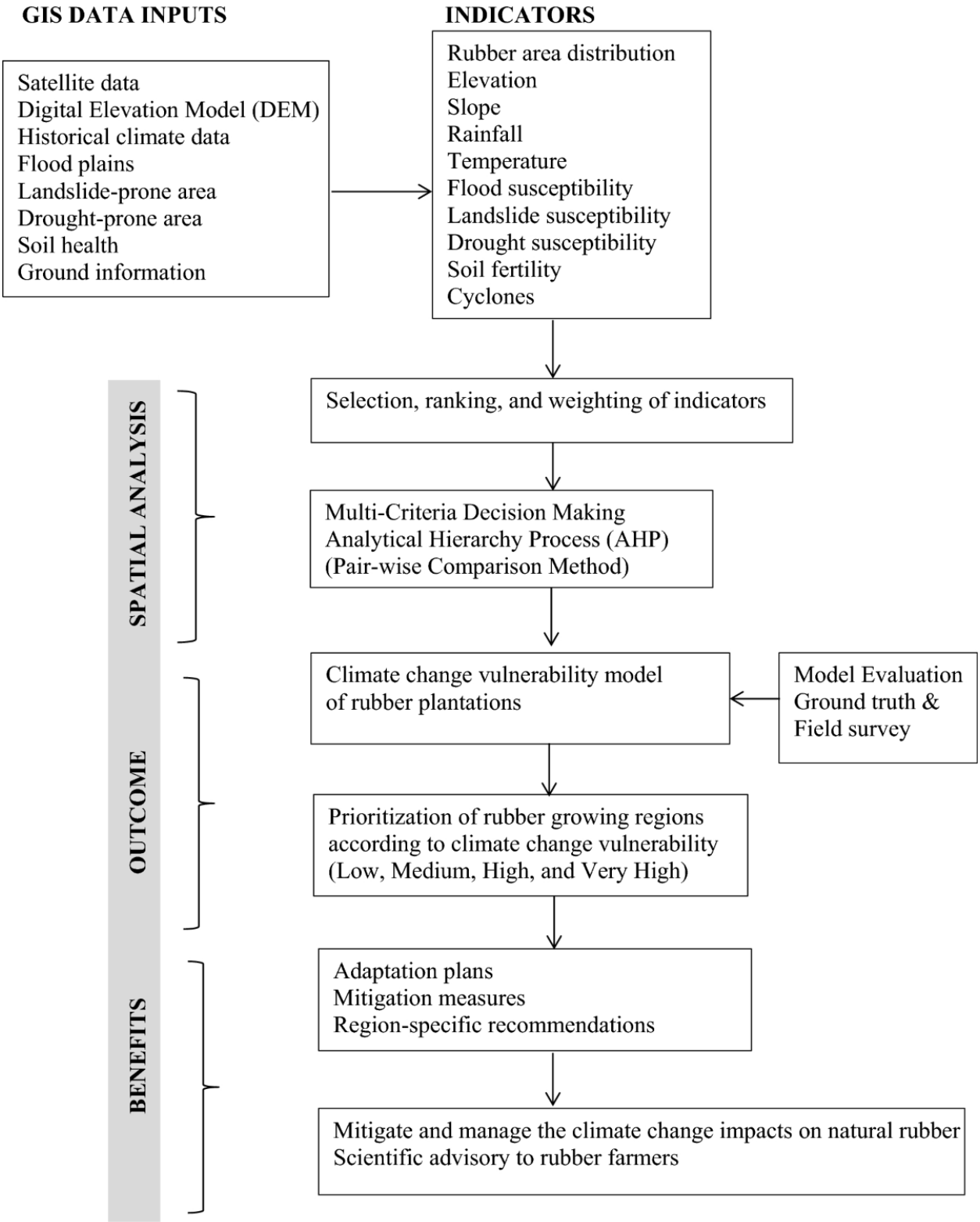

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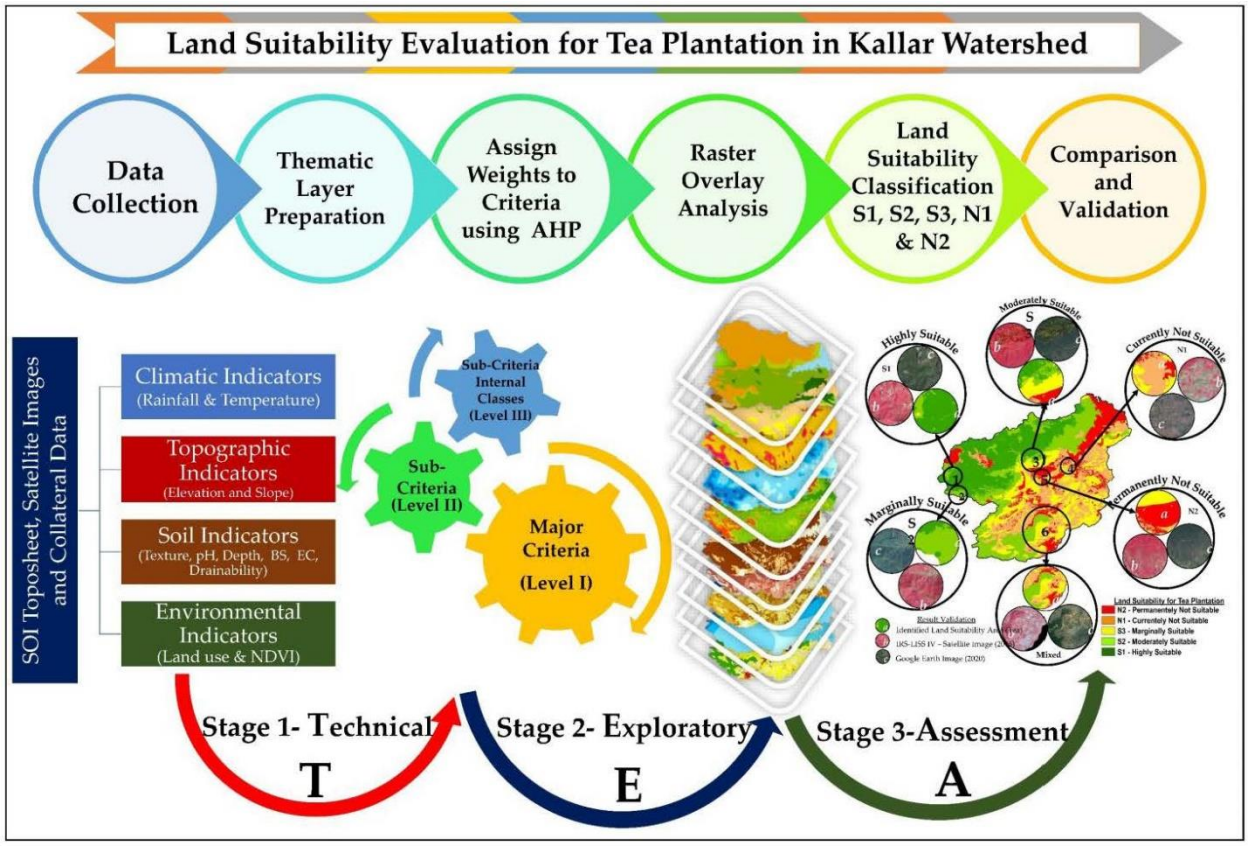
Next, criteria weights were assigned to each factor based on their relative importance in determining land suitability for rubber cultivation. This step involved stakeholder consultations and expert opinions to ensure comprehensive consideration of local agricultural practices and environmental conditions. The MCDA framework facilitated the integration of these criteria into a unified suitability model, allowing for spatial analysis and decision-making.

GIS techniques were employed to overlay and analyze the integrated datasets within a spatial framework. Spatial analysis involved overlay operations, where layers representing soil, climate, and topography factors were combined to generate a comprehensive suitability map. This map delineated areas ranging from highly suitable to unsuitable for rubber cultivation based on predefined criteria thresholds.



Validation of the suitability model was conducted through field surveys and ground truthing exercises. Sample plots were selected across the study area to assess the accuracy of model predictions against actual conditions observed on the ground. This validation process ensured the reliability and robustness of the suitability maps generated through GIS and MCDA methodologies.

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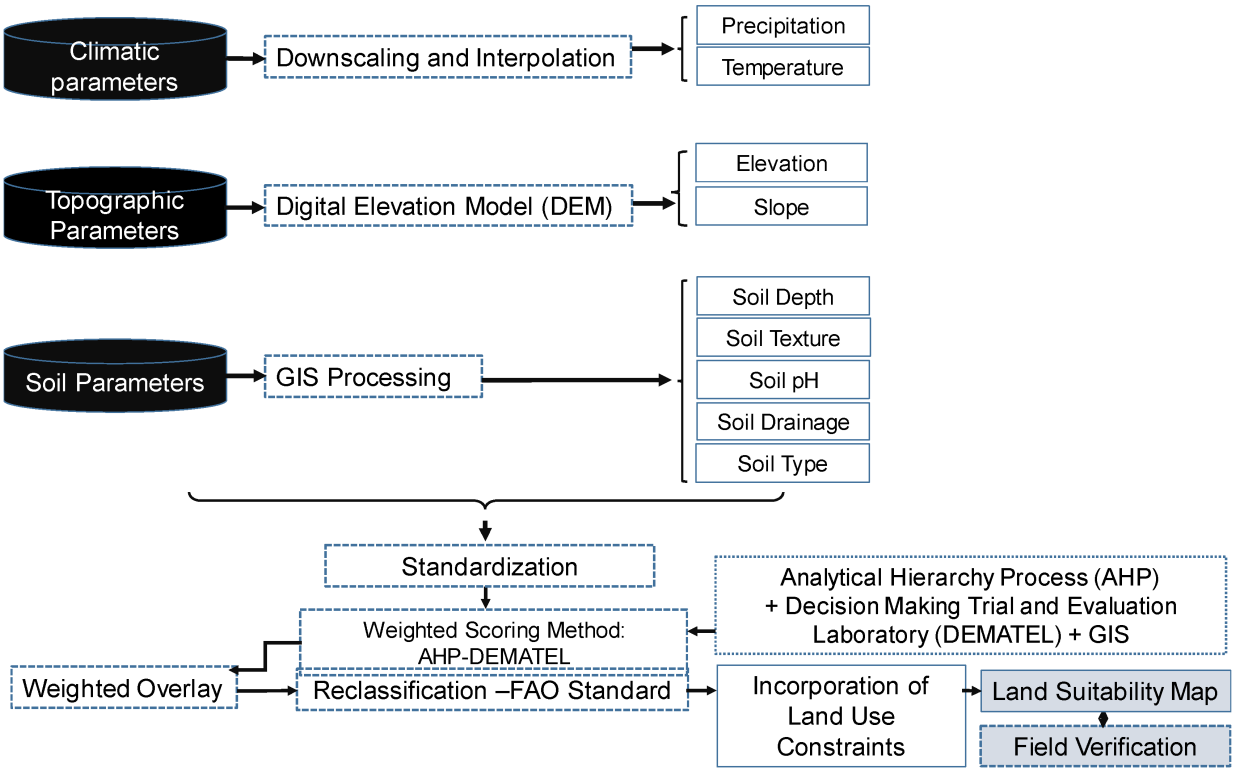

Overall, the methodological approach employed in this study integrated spatial data analysis, criteria weighting using MCDA, and validation through field surveys to assess land suitability for rubber cultivation in Kerala's tropical humid region. The findings provide valuable insights into optimal land use planning strategies, supporting sustainable agricultural practices and informed decision-making among stakeholders in the rubber industry.

RESULTS

The assessment of land suitability for rubber cultivation in Kerala's tropical humid region revealed varying degrees of suitability across different districts. Based on the integrated analysis of soil quality, climate conditions, and topographic factors using GIS and MCDA techniques, suitability maps were generated. These maps categorized areas into highly suitable, moderately suitable, marginally suitable, and unsuitable zones for rubber cultivation. Highly suitable areas typically exhibited favorable soil characteristics (well-drained soils with good fertility), optimal climate conditions (moderate temperature, high humidity, and adequate rainfall), and gentle slopes conducive to rubber tree growth.

DISCUSSION

The results highlight the importance of considering multiple criteria in assessing land suitability for rubber cultivation. Soil quality emerged as a critical factor, with well-drained soils rich in organic matter and nutrients proving optimal for rubber tree growth. Climate conditions, particularly rainfall distribution and

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humidity levels, significantly influenced suitability, with areas experiencing high and evenly distributed rainfall deemed more suitable. Topographic factors such as slope gradient also played a role, as gentle slopes were preferred to minimize soil erosion and facilitate management practices.

The spatially explicit nature of GIS allowed for a detailed assessment of land suitability, enabling stakeholders to prioritize areas for rubber expansion or intensification based on their specific requirements. The MCDA approach facilitated the integration of diverse criteria and stakeholder preferences, providing a systematic framework for decision-making in land use planning.

CONCLUSION

In conclusion, the assessment of land suitability for rubber cultivation in Kerala's tropical humid region underscores the importance of employing GIS and MCDA methodologies for informed decision-making in agricultural planning. The study identified and mapped areas with varying degrees of suitability for rubber cultivation based on environmental and agronomic criteria. This information is invaluable for policymakers, agricultural planners, and rubber growers aiming to optimize land use practices, enhance productivity, and promote sustainable development in the region.

Moving forward, continued monitoring and adaptation of the suitability model will be essential to account for changing environmental conditions and evolving agricultural practices. By integrating scientific analysis with local knowledge and stakeholder engagement, Kerala can sustainably manage its rubber cultivation sector while safeguarding environmental integrity and supporting economic growth in the long term.

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