

Remote Sensing And GIS-Based Land Suitability Analysis For Sustainable Development

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ABSTRACT

Remote sensing and Geographic Information System (GIS) technologies have revolutionized land suitability analysis, enabling sustainable development planning that integrates environmental, social, and economic factors. This paper examines the methodology, applications, and benefits of using remote sensing and GIS for land suitability assessment. It outlines how spatial data acquisition, thematic mapping, and multi-criteria decision-making models are integrated to evaluate the optimal use of land resources while minimizing ecological impacts. Case studies demonstrate the effectiveness of this approach in agriculture, urban planning, and natural resource management, offering pathways for policymakers to achieve balanced growth and environmental conservation.

Keywords: *Remote Sensing, GIS, Land Suitability, Sustainable Development, Spatial Analysis, Multi-Criteria Decision Making*

INTRODUCTION

Sustainable development requires optimal utilization of land resources without compromising ecological integrity. Land suitability analysis (LSA) is a systematic process of evaluating the potential of land for specific uses. Remote sensing provides timely, accurate, and cost-effective spatial data, while GIS offers analytical tools for integrating diverse datasets. The combination enhances precision in decision-making for land allocation across agriculture, industry, and urban development.

ROLE OF REMOTE SENSING

Remote sensing captures multispectral and hyperspectral data that can be processed to generate thematic maps of soil type, vegetation cover, water resources, and land use. Satellite imagery, including Landsat, Sentinel, and MODIS data, enables periodic monitoring of land changes, which is critical for assessing suitability over time.

GIS IN LAND SUITABILITY ANALYSIS

GIS facilitates spatial analysis by overlaying multiple thematic layers, such as topography, soil fertility, and proximity to infrastructure. It also supports multi-criteria decision analysis (MCDA) techniques, including Analytical Hierarchy Process (AHP), to assign weights to each criterion and generate composite suitability maps.

METHODOLOGY

The land suitability analysis process generally involves:

1. Data Acquisition – Remote sensing imagery and ancillary datasets (soil maps, DEMs, climate data).
2. Data Preprocessing – Georeferencing, atmospheric correction, and image classification.
3. Criteria Selection – Factors affecting suitability, e.g., slope, soil type, rainfall.
4. Weight Assignment – Using MCDA techniques to prioritize criteria.
5. Suitability Mapping – GIS-based overlay analysis to produce final maps.

CASE STUDIES

In Andhra Pradesh, India, remote sensing and GIS were used to identify suitable zones for mango cultivation, considering soil pH, temperature, and water availability. In Nairobi, Kenya, GIS-based analysis helped determine optimal zones for low-cost housing by integrating land slope, flood risk, and proximity to services.

BENEFITS

The integration of remote sensing and GIS for LSA improves accuracy, saves time, and reduces costs compared to traditional surveys. It supports evidence-based decision-making, ensures transparency in land allocation, and promotes sustainable resource management.

CHALLENGES

Challenges include high costs of high-resolution imagery, lack of technical expertise in rural areas, and the need for consistent data standards. Cloud cover and image resolution limitations can also affect accuracy.

CONCLUSION

Remote sensing and GIS-based land suitability analysis is a powerful tool for achieving sustainable development. Future advancements in AI-driven analytics, cloud computing, and real-time monitoring will further enhance its applicability, enabling proactive and adaptive land management strategies.

Criterion	Remote Sensing Data Source	GIS Application
Soil Type	Landsat multispectral imagery	Overlay with soil fertility maps
Slope	ASTER DEM	Slope analysis for construction suitability
Water Availability	MODIS evapotranspiration data	Proximity analysis to water sources

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