

# Integrating geospatial technologies in land surveying can support sustainable development

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**Abstract:** The rapid growth of geospatial technologies has changed land surveying. It offers new solutions to various environmental, engineering, and development challenges. This study looks at how Geographic Information Systems (GIS), Global Positioning System (GPS), and Remote Sensing are used in modern surveying practices. It examines how these technologies improve accuracy, efficiency, and decision-making in engineering surveying, renewable energy planning, and climate change response. The research uses both conceptual and analytical methods, reviewing existing literature and practical applications to assess the role of geospatial tools in sustainable development. The findings show that combining these technologies greatly enhances spatial data management, aids infrastructure development, and supports environmental monitoring. However, challenges like limited technical knowledge, high costs, and poor infrastructure still pose significant obstacles. The study concludes that investing in training, policy support, and technological infrastructure is crucial to maximizing the advantages of geospatial technologies in developing areas.

**Keywords:** Land Surveying, GIS, GPS, Remote Sensing, Renewable Energy, Climate Change.

## Introduction

Land surveying is a key area in engineering, urban planning, and environmental management. It involves measuring, mapping, and analyzing the earth's surface to identify spatial relationships and boundaries. In the past, surveying depended on manual techniques and instruments like chains, compasses, and theodolites. Although these methods worked well, they were often slow and susceptible to human error.

The arrival of geospatial technologies has changed surveying practices for the better. Tools like GIS, GPS, and remote sensing offer precise, efficient, and scalable ways to collect and analyze spatial data. These technologies have broadened surveying's purpose beyond just marking boundaries to include environmental monitoring, disaster management, and planning for sustainable development.

In developing countries, using geospatial technologies is especially important. Rapid urban growth, environmental damage, and climate change create major challenges that need better tools for spatial analysis and decision-making. This study examines how geospatial technologies are used in modern surveying, focusing on their roles in engineering, renewable energy, and addressing climate change.

## Literature Review

### Evolution of Land Surveying

The history of land surveying reflects wider technological advancements. Early methods relied on basic geometric principles and manual measurements. The creation of electronic distance measurement (EDM) devices and total stations greatly improved accuracy and efficiency.

In recent years, satellite-based technologies have reshaped surveying practices. GPS provides exact positioning, while GIS allows for the integration and analysis of spatial data. Remote sensing offers large-scale data on environmental conditions, enabling the monitoring of changes over time.

### Geographic Information Systems (GIS)

GIS is a powerful tool for managing and analyzing spatial data. It enables users to create, store, and manipulate geographic information digitally. GIS is widely used in urban planning, environmental management, and infrastructure development.

### Key functions of GIS include:

- Spatial analysis
- Data visualization
- Decision support

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## Global Positioning System (GPS)

GPS is a satellite-based navigation system offering accurate location data. It is commonly used in surveying for:

- Boundary determination
- Topographic mapping
- Engineering measurements

GPS boosts accuracy and cuts down on the time needed for fieldwork.

## Remote Sensing

Remote sensing involves collecting data from satellites or aerial platforms. It is used for:

- Land use analysis
- Environmental monitoring
- Climate change studies

Remote sensing provides extensive data that is crucial for regional and global analysis.

## Geospatial Technologies and Sustainable Development

Geospatial technologies are vital for sustainable development by:

- Supporting resource management
- Improving environmental protection
- Aiding infrastructure planning

## Methodology

### Research Design

This study follows a qualitative and analytical research design. It includes:

- Literature review
- Case analysis
- Conceptual modeling

### Data Sources

Data for this study were sourced from:

- Academic journals

- Books
- Technical reports

## Analytical Approach

The study examines the role of geospatial technologies in:

- Surveying accuracy
- Environmental monitoring
- Infrastructure development

## Geospatial Technologies in Land Surveying

### GIS Applications

GIS is applied in:

- Land use planning
- Urban development
- Environmental management

**Table 1: GIS Applications in Surveying**

Application	Description
Urban Planning	Mapping and zoning
Environmental Monitoring	Tracking changes
Infrastructure Planning	Road and utility design

## GPS Applications

GPS boosts:

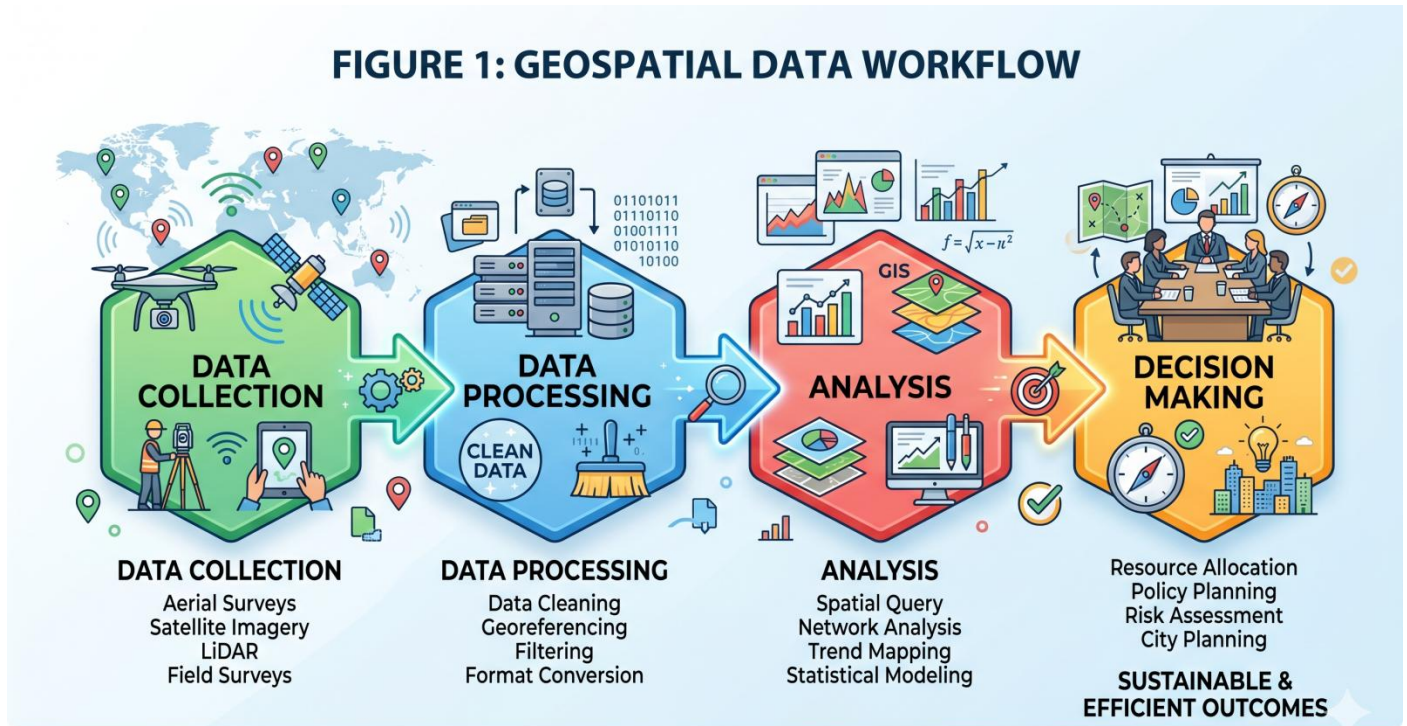
- Measurement accuracy
- Fieldwork efficiency
- Data reliability

## Remote Sensing Applications

Remote sensing aids:

- Land cover analysis
- Disaster management
- Climate monitoring

Figure 1: Geospatial Data Workflow



A visual guide to the complete cycle of handling geospatial information

**Role in Engineering Surveying**

Geospatial technologies are essential in engineering surveying. They are used for:

- Construction planning
- Structural design
- Project management

These tools ensure precision and cut project costs.

**Renewable Energy Applications**

Geospatial technologies help with renewable energy development by:

- Finding suitable locations
- Analyzing environmental impacts
- Optimizing resource use

**Table 2: Geospatial Tools in Renewable Energy**

Technology	Application
GIS	Site selection
Remote Sensing	Solar radiation analysis
GPS	Location mapping

**Climate Change and Environmental Monitoring**

Geospatial technologies are critical in tackling climate change. They assist in:

- Monitoring deforestation
- Tracking temperature shifts
- Analyzing rising sea levels

**Challenges**

Even with their advantages, geospatial technologies face some challenges:

- High equipment costs
- Limited technical skills
- Inadequate infrastructure
- Lack of policy backing

**Discussion**

Combining GIS, GPS, and remote sensing has greatly improved surveying practices. These technologies enhance accuracy, efficiency, and decision-making. However, economic and technical barriers restrict their use in developing regions.

**Recommendations**

1. Invest in education and training

2. Provide government support and policies
3. Collaborate with international organizations
4. Adopt modern technologies

## **Conclusion**

Geospatial technologies have reshaped land surveying into a dynamic and multi-faceted field. Their integration fosters sustainable development, improves infrastructure planning, and enhances environmental management. To fully unlock their potential, we must tackle challenges related to cost, expertise, and infrastructure.

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