Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 06, Issue: 01 (JAN-FEB, 2026)
Available online at http://www.agriarticles.com

Remote Sensing in Land Resource Inventory and Mapping: A Review

*Sibani Majhee
M.Sc. Scholar, Department of Soil Science & Agricultural Chemistry,
College of Agriculture, OUAT, Bhubaneswar, Odisha, India-751003
*Corresponding Author's email: sibanimajhee597@gmail.com

Soil and water are essential natural resources needed for the sustained quality of human life and the foundation of agricultural development. Efficient management of these natural resources is the major challenge for the agricultural scientists, planners, administrators and farmers to ensure food, water and also environmental security for the present and future generations. Soil is the essence of life. Resource inventory is the technique of compiling resources and services of a given thing or an area, usually a geographical area. Resources inventories are used to ensure reliable and accurate data concerning these physical features. The remote sensing technique is a powerful tool in capturing information required to resource inventory. The application of Remote sensing technology has been universally recognized as a highly effective and inevitable tool for soil resource mapping and watershed management. The study proves effectiveness of satellite data, RS and GIS techniques in land resource inventory and mapping. This study may helpful in proper management of land resources for agricultural sustainability in the study area.

Keywords: Remote Sensing, Land Resource Inventory, GIS

Introduction

Land is a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use, land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. The development of Land Resource Inventory (LRI) and estimation hydrological fluxes are two vital components to identify the status and changing conditions of soil, water and related resources at the field level. Characterization and classifying soils in various landscapes provide crucial information for effective land-use planning and sustainable agricultural practices. Systematic description of soil characteristics holds great relevance in terms of understanding factors and processes of soil formation and grouping similar soils for mapping their extents (Dash *et al.* 2019, Kishore *et al.* 2020). A detailed information on their characteristics, classification, location, extent and distribution, potentials and problems are necessary for developing rational land use planning.

The term "remote sensing" first emerged in the 1950s and refers to "the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation". The era of satellite remote sensing began with the launching of Landsat-1 in July 1972 by the National Aeronautics and Space Administration (NASA), United States. It is based on the use of image data acquired by sensors of different types such as aerial camera, scanner or radar. The satellite remote sensing is used to interpret the images or numerical values obtained from a distance in order to acquire meaningful information of particular features on earth. The instruments used for this purpose may employ any of a variety of physical energy distributions. Sonars, for example, work on the principle of acoustic wave distribution, optical instruments such as the photographic camera and multi-spectral scanner use electromagnetic energy distribution. Remote sensing covers all techniques related to the analysis and use of data from satellites, such as Meteosat, National Oceanic and Atmospheric Administration (NOAA)-Advanced Very High-Resolution Radiometer (AVHRR), Landsat, (French: Satellite Pour l'Observation de la Terre) SPOT, Earth Resources Satellite (ERS) - Satellite Access Request (SAR) and from aerial photographs. The main objective of remote sensing is to map and monitor the earth's resources.

The Geographical Information System (GIS) is computerized software that stores, retrieves, manipulates, analyzes and displays geographically referenced data sets, which can be used for different applications. Here the word 'Geographic' deals with spatial objects or features which can be referenced or related to a specific location on the earth surface. The object may be physical/natural or may be cultural / man made. Likewise the word 'Information' deals with the large quantity of data about a particular object on the earth surface. The data include a set of qualitative and quantitative aspects which the real world objects acquire. The term 'System' is used to represent systems approach where the environment consists of a large number of objects / features on the earth's surface and their complex characteristics are broken down into their component parts for easy understanding and handling. GIS data are represented and stored in the form of vector or raster. In a vector data structure, geospatial data are represented as points, lines or polygons. For example, Digital Elevation Model showing slope, aspect and elevation in a grid for an area is a raster data structure. Attribute data can be handled in rational database software comprised of records and fields. GIS, therefore, can offer the unique ability to link such spatial and attribute data and tries to manipulate and analyze the relationships among them. In implementing georeferenced data sing GIS, three important stages are involved. These are data preparation and entry, analysis and presentation. GIS can store the voluminous amount of spatial (maps) and non spatial (tabular data) information. It has potential uses in land resource management and inventory. The collection of remotely sensed data facilitates the synoptic analyses of Earth. Today, the data obtained is usually stored and manipulated using computers. The most common software used in remote sensing is Earth Resource Data Analysis System (ERDAS) Imagine, Environmental Systems Research Institute (ESRI), MapInfo, and ER Mapper.

Advantages

- Synoptic View and Large-Area Coverage: Remote sensing enables the monitoring of large regions, making it possible to map vast landscapes, including remote or inaccessible areas, quickly and efficiently.
- Temporal Resolution (Time-Series Analysis): It provides temporal data, allowing for the monitoring of changes in land use, land cover, and vegetation health over time.
- Reduced Field Work and Cost-Effectiveness: The technology reduces the need for extensive, time-consuming ground surveys, allowing for more efficient, faster, and cheaper data collection.
- Improved Accuracy in Mapping: High-resolution sensors allow for precise delineation of soil boundaries, landform-soil units, and urban expansion.
- Multi-Spectral Data Usage: By using different wavelengths (e.g., thermal infrared, microwave), it can identify features, soil moisture, and crop health issues not visible to the human eye.
- Environmental and Disaster Monitoring: Remote sensing is crucial for identifying natural hazards like floods or forest fires, enabling faster, more efficient disaster response.
- Support for Sustainable Development: It provides essential data for land use planning, ensuring that land development is balanced with environmental sustainability.

Disadvantages

- High Costs and Technical Expertise: The acquisition of high-resolution, multi-temporal data and the specialized software/trained personnel required for analysis make it expensive.
- Environmental Interference: Weather conditions (clouds, dust, and rain) frequently disrupt data acquisition, particularly for optical sensors in tropical regions.
- Resolution and Classification Errors: Limited spatial or spectral resolution may prevent detection of small-scale features. Furthermore, different land cover types can have similar spectral signatures, leading to misclassification (e.g., spectral confusion between crops and native vegetation).
- Need for Ground Truthing: Remote sensing data often requires extensive validation (ground-truthing) to ensure accuracy, which limits its independence.
- Physical Limitations: Sensors cannot see through thick vegetation canopy to map soil properties directly and have limited capability to penetrate water for deep benthic mapping.
- Active Sensor Intrusion: Powerful active systems like SAR (Synthetic Aperture Radar) can be complex to interpret and occasionally interfere with the phenomena being measured.
- Calibration and Data Continuity: Sensors may experience calibration drift over time, affecting long-term monitoring, while the lack of consistent, long-term archival imagery hampers historical analysis.

Conclusions

Sustainable land management (SLM) necessitates the acquisition of reliable, multi-temporal data regarding the current status and potential of natural resources. The integration of Satellite Remote Sensing—which provides high-resolution, repetitive observational data—with Geographic Information Systems (GIS)—which facilitates advanced spatial analysis and data synthesis—offers a robust framework for strategic planning. By digitizing traditional soil and erosion datasets and linking them as attributes to remote sensing-derived land cover units, a comprehensive multidimensional database is established. This integrated approach provides a critical decision-support system for optimizing outputs in agriculture, forestry, urban planning, and environmental conservation.

References

1. Arunkumar. V., M. Pandiyan and Yuvaraj. M. 2020. A Review on Remote Sensing and GIS Applications in Soil Resource Management.*Int.J.Curr.Microbiol.App.Sci.* 9(5): 1063-1075.
2. Colwell, R. N. (1978). Remote Sensing as an aid to the Inventory and Management of Natural Resources. *The Canadian Surveyor*, *32*(2), 183-203.
3. Choudhary, Bal & Pandey, Puneeta & Kohli, R. & Garg, V.K. & Dhawan, Ashok. (2018). Applications of Remote Sensing and GIS in Land Resource Management.
4. Joseph, George & Chockalingam, Jeganathan. (2017). Fundamentals of Remote Sensing.
5. Srivastava, R. (2018). Applications of remote sensing in land resource inventory and mapping. In *Geospatial technologies in land resources mapping, monitoring and management* (pp. 323-334). Cham: Springer International Publishing
6. Thilagam, V. K., & Sivasamy, R. (2013). ROLE OF REMOTE SENSING AND GIS IN LAND RESOURCE INVENTORY-A REVIEW. *Agricultural Reviews*, *34*(4), 295-300.
7. Tripathi, D. K. (2017). Land Resource Investigation Using Remote Sensing and Geographic Information System: A Case Study. *International Journal of Innovative Science, Engineering & Technology*, *4*(7), 125-132.