

CONCEPT NOTE

NAGALAND DEPUTY COMMISSIONERS CONFERENCE 2025

Sub-theme: Use of Technology in Land Use Master Plan

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1. Background

Land Use Master Planning forms the foundation for structured, sustainable, and inclusive development. Traditionally, planning relied on manual surveys and static paper maps that often-lacked accuracy and failed to keep pace with rapidly evolving land dynamics. However, the advent of modern technology has revolutionized this process.

In India, LULC studies at the national level are primarily undertaken by central agencies using advanced geospatial technologies. The Indian Space Research Organisation (ISRO), through its National Remote Sensing Centre (NRSC), plays a leading role by providing satellite data and publishing the nationwide LULC Atlas. The Forest Survey of India (FSI) contributes with biennial State of Forest Reports, while the Survey of India (SoI) provides foundational topographic maps.

Other key institutions include the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) under ICAR, which focuses on soil resource mapping, and the Ministry of Environment, Forest and Climate Change (MoEFCC), which conducts environmental assessments. Agencies such as the Central Arid Zone Research Institute (CAZRI) and the National Centre for Sustainable Coastal Management (NCSCM) handle region-specific studies in arid and coastal zones, respectively. At the State level, Remote Sensing Centres such as the Nagaland GIS and Remote Sensing Centre (NGISRSC) carry out localised LULC mapping, providing crucial data for state level planning and development.

2. Defining Land Use Master Plan

Land use and land cover are often confused, but they have distinct meanings. Land use refers to how people utilize land, whether for agriculture, urban development, or conservation. Land cover, on the other hand, describes the physical features of the landscape, such as forests, wetlands, bare soil, or pavement. Understanding these concepts is crucial for decision-makers who may be managing competing demands, such as urban expansion and forest conservation.

A Land Use Master Plan is a strategic, long-term framework that guides the optimal use and allocation of land across residential, commercial, industrial, agricultural, institutional, recreational, and ecological zones. It integrates infrastructure planning, environmental sustainability, social inclusivity, and economic growth under a coherent vision for the future development of a region.

Key components of a Land Use Master Plan include:

- Vision & Development Goals
- Zoning & Regulation
- Transport & Infrastructure Integration
- Environmental Safeguards
- Stakeholder Participation
- Monitoring & Evaluation Frameworks

3. Role of Technology in Land Use Master Planning

Modern land use planning is data-driven, dynamic, and highly spatial. The following technologies have emerged as critical enablers:

a) Geographic Information System (GIS)

- Enables multi-layered spatial analysis of topography, demographics, infrastructure, and environmental conditions.
- Supports suitability analysis, zoning decisions, hazard mapping, and site planning.

b) Remote Sensing (RS)

- Satellite imagery and drone-based data provide continuous monitoring of land cover and land use changes.
- Facilitates temporal analysis for assessing deforestation, urban sprawl, erosion, and water resource mapping.

c) Global Positioning System (GPS)

- Supports precise ground-truthing, boundary demarcation, and real-time location tracking for survey operations.

d) Unmanned Aerial Vehicles (UAVs)/Drones

- Offers high-resolution, real-time imagery for micro-level planning.
- Enables monitoring of construction progress, land encroachment, and compliance with approved land use.

e) Artificial Intelligence (AI) and Machine Learning (ML)

- Processes large geospatial datasets to detect patterns and predict future land use scenarios.
- Supports decision-making through modelling, impact simulation, and automated classification.

f) Internet of Things (IoT) and Cloud Computing

- IoT-based sensors track environmental and infrastructure parameters (e.g., traffic, pollution, water level).
- Cloud computing allows planners to access and share data and software applications from anywhere, facilitating collaboration and streamlining the planning process.

4. Geoportals: Enabling Transparency and Engagement

A significant evolution in land use planning is the emergence of geoportals- interactive, cloud-based platforms that integrate GIS, 3D visualization, and spatial data services. One of the key innovations in modern land use planning is the development of **geoportals** – interactive web-based platforms that allow visualization, querying, and public engagement. They enable:

- Easy access to updated maps, zoning plans, and development proposals.
- Public participation through integrated feedback and grievance tools.
- Inter-departmental collaboration on real-time monitoring and data sharing.
- Transparency in plan implementation and compliance tracking.

Furthermore, real-time monitoring dashboards- powered by IoT sensors and drone-based imagery and video footage- allow for ongoing tracking of land use changes, construction progress, and environmental indicators. This capability strengthens compliance, enforcement, and adaptive planning.

NGISRSC is working towards developing such state-level platforms to democratize access to geospatial data and enhance transparency in planning processes.

5. State-Level Initiatives: The Case of NGISRSC

At the State-level, NGISRSC has developed a baseline Land Use Land Cover dataset for Nagaland, widely used across departments and agencies. This dataset, based on 2019 LISS-IV satellite imagery with a 5.8-meter spatial resolution, categorizes land use into five major classes and 19 sub-classes. It serves as an important resource for spatial planning, environmental monitoring, and project implementation across the state.

As part of ongoing efforts to update and enhance the dataset, NGISRSC will showcase this LULC map in an upcoming presentation. Participants will be invited to review the dataset and provide feedback. Comments and suggestions will be critically evaluated and incorporated into the dataset updation process to ensure its continued relevance, accuracy, and utility for future planning efforts.

6. Way Forward (Detailed)

To leverage the full potential of technology in land use master planning, the following multi-dimensional strategies are proposed:

- Establish GIS Units in all Deputy Commissioner's Office equipped with GIS workstations and trained personnel to localize geospatial planning efforts.
- Organize training workshops for planners, administrators, and engineers in GIS, remote sensing, drone applications, and data visualization.

- Update LULC datasets for all towns and planning areas using drone imagery and latest satellite data to ensure current and accurate land use classification
- Develop a statewide spatial database infrastructure (SDI) that includes layers such as cadastral maps, utility lines, hazard zones, ecological zones, and public assets.
- Develop a State Geoportal Platform integrating existing GIS datasets, thematic maps, planning documents, zoning regulations, and spatial analytics.
- Use of Drone-Based Technology for monitoring and Micro-Planning
- Develop a State Land Use Policy that incorporates digital planning protocols, data privacy, inter-departmental data sharing, and citizen transparency provisions.
- Establish a Monitoring & Evaluation (M&E) Mechanism to track implementation of land use master plans using real-time spatial dashboard
- Conduct community mapping exercises and participatory planning meetings at the ward and village level using simplified spatial tools.
- Launch awareness campaigns to promote the use of land use geoportals among citizens, developers, researchers, and civil society organizations.
- Encourage youth engagement through internships, hackathons, and competitions on geospatial innovations for planning.

Conclusion

The integration of technology into land use master planning is no longer a futuristic aspiration—it is a present-day necessity. As land resources face growing pressure from urban expansion, infrastructure development, and environmental vulnerabilities, the adoption of geospatial and digital technologies ensures that planning is not only data-driven but also inclusive, adaptive, and forward-looking.

For a geographically diverse and ecologically sensitive state like Nagaland, leveraging tools such as GIS, remote sensing, drones, AI, and geoportals can significantly enhance the accuracy, efficiency, and transparency of planning processes. These technologies empower planners and decision-makers with real-time insights, predictive capabilities, and participatory platforms that enable informed choices and sustainable growth trajectories.

The efforts of the Nagaland GIS & Remote Sensing Centre (NGISRSC) in building baseline datasets, supporting sectoral planning, and facilitating interdepartmental data use exemplify the strategic role of geospatial infrastructure in governance. As we move ahead, it is imperative that these initiatives are scaled up, institutionalized, and

supported by robust policies, skilled human resources, and technological investments.

The path forward lies in embracing digital planning as the foundation of development—one that is resilient, equitable, and sustainable.



When done successfully, a land use masterplan or even an effective, affordable, and socially just land use planning can help address a variety of environmental and social issues and can positively contribute to the **SDGs**