INNOVATIVE TECHNOLOGICA
METHODICAL RESEARCH JOURNAL
ISSN: 2776-0987 Volume 6, Issue 6, June – 2025

IMPROVING CADASTRAL MANAGEMENT AND CARTOGRAPHIC SUPPORT METHODS FOR LAND DESIGNATED FOR NATURE PROTECTION, WELLNESS, AND RECREATIONAL PURPOSES: A CASE STUDY OF SAMARKAND REGION

Tursunov Bekzod Abdumo‘minovich
PhD Researcher at Samarkand State Institute of
Architecture and Civil Engineering (SamDAQU)

Gulmurodov Farrux Eshmurodovich
PhD, Doctoral Researcher at Samarkand State Institute of
Architecture and Civil Engineering (SamDAQU)

ANNOTATION:
This article examines the challenges and opportunities of improving cadastral management and cartographic support for land designated for nature protection, health improvement, and recreational purposes using the case of the Samarkand region. The study applies GIS technologies, digital cadastral systems, and remote sensing methods to analyze the current state of such lands. It identifies problems, assesses ecological potential, and provides science-based recommendations. The proposed methodology aims to ensure ecological sustainability and promote rational use of recreational land resources.

The research highlights the gap between existing land registration systems and the actual spatial distribution of recreational and wellness sites. It addresses the inadequacies in legal status, digital mapping, and ecological monitoring of such lands. Through field surveys, satellite imagery analysis, and drone-based data collection, the study develops a comprehensive geospatial database of recreational zones. Furthermore, it proposes a model for integrating these lands into national cadastral frameworks using a unified digital platform.

The practical recommendations derived from this study include the creation of specialized GIS layers, the introduction of UAV-assisted land monitoring, and the establishment of legal mechanisms for classifying and managing these lands. The study contributes to sustainable land governance, ecological conservation, and tourism development in Uzbekistan and serves as a replicable model for other regions facing similar challenges.

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KEYWORDS: recreational land, digital cadastre, GIS technology, cartographic analysis, ecological monitoring, Samarkand region

INTRODUCTION:

In recent years, the significance of lands intended for nature protection, wellness, and recreational purposes has grown sharply due to their role in ensuring public health, improving quality of life, and supporting sustainable development. These lands possess ecological, aesthetic, and therapeutic value. In regions like Samarkand, which offer rich natural and geographic potential, such lands hold vast development opportunities. However, the current cadastral system and cartographic data often contain shortcomings: outdated information, incomplete digitalization, and insufficient monitoring capabilities. These issues highlight the need for integrating modern geospatial technologies into land management practices.

The expansion of tourism, urban sprawl, and climate-related environmental challenges have increased pressure on natural and recreational lands. Without clear boundaries, accurate records, and standardized classification, these areas are vulnerable to degradation, unsustainable use, and legal disputes. In many cases, such lands are categorized under generic land uses—such as agricultural or residential zones—resulting in administrative ambiguity and the loss of their environmental functions.

Moreover, the absence of real-time monitoring and geospatial assessment mechanisms limits the ability of regional planning authorities to make informed decisions regarding land use policies. Conventional paper-based records and manual mapping methods are no longer sufficient to manage these valuable resources effectively. Therefore, the integration of geographic information systems (GIS), remote sensing (RS), and UAV (unmanned aerial vehicle) technologies provides a promising solution for modernizing the cadastral registry of nature-related land categories.

This study is driven by the need to create a structured and scientifically grounded approach to the identification, classification, and cartographic support of recreational and wellness zones. Using Samarkand region as a case study, the research aims to develop an applied model for digital cadastral registration that can inform land policy, support sustainable planning, and preserve the ecological integrity of recreational areas for future generations.

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RELEVANCE AND STATE OF RESEARCH:

In the Samarkand region—specifically in areas like Zomin, Urgut, Bulungur, Nurobod, and Payariq—numerous natural sites possess significant recreational potential. These areas include mountainous landscapes, forested zones, healing springs, and scenic environments that are well-suited for tourism, wellness, and ecological restoration. However, these lands are poorly reflected in the existing cadastral records, often lacking clear designation, legal protection, and updated spatial documentation.

There are considerable challenges related to ecological monitoring, land classification, recreational zoning, and the delineation of spatial boundaries. Many of these lands are misclassified under other land categories, such as agricultural or residential zones, leading to legal ambiguity and ineffective land governance. As a result, these valuable resources are underutilized or mismanaged, and their long-term preservation is at risk.

Determining and registering recreational and wellness areas, clarifying their legal status, assessing their ecological importance, and ensuring boundary accuracy are among today's most urgent land management tasks. These needs are further amplified by national tourism development strategies that emphasize rational and sustainable land use. The ability to identify, document, and monitor these lands is critical to aligning with national development plans and ensuring the multifunctional use of landscapes.

The scientific literature has extensively addressed the cadastre and cartography of agricultural, industrial, and infrastructural lands. These domains benefit from clear methodologies, legal frameworks, and technological support. However, there is a noticeable lack of research focused specifically on recreational and wellness land categories. This gap is evident both in Uzbekistan and internationally. While these areas have been explored in the context of ecological tourism, green infrastructure, and environmental protection, few studies have examined how to formally integrate them into cadastral systems, particularly using advanced geospatial technologies.

This research seeks to fill that gap by providing a methodological framework tailored to the specific characteristics of recreational and wellness lands. It aims to bridge the divide between ecological planning and cadastral registration through a combination of GIS, remote sensing, and field-based analysis.

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RESEARCH OBJECTIVES AND TASKS:

The main objective of this study is to improve the methodology for the cadastral registration and cartographic representation of lands designated for nature protection, wellness, and recreational purposes, with a specific focus on the Samarkand region. These lands require accurate documentation to support sustainable environmental management and land use planning.

To achieve this objective, the study seeks to:

- Identify and map the spatial boundaries of recreational and wellness zones using up-to-date geospatial data;
- Analyze their current usage, land cover status, and legal classification within the existing cadastral framework;
- Develop thematic maps and spatial databases using GIS tools and remote sensing imagery;
- Conduct field-based ecological monitoring to assess land condition and suitability for recreational use;
- Create standardized digital cadastral passports for each identified site, including physical, legal, and ecological attributes;
- Integrate the processed data into national and regional land administration systems, enhancing transparency and accessibility;
- Propose a scalable and replicable model for incorporating recreational lands into digital land management platforms across other regions of Uzbekistan.

The proposed framework aims to bridge the gap between traditional cadastral systems and the evolving need for spatially intelligent, ecologically sensitive land governance. It supports strategic decision-making, facilitates environmental protection, and promotes the efficient use of natural resources aligned with regional development policies.

RESEARCH METHODOLOGY:

The research employs a comprehensive, multi-phase methodology that combines geospatial technologies, field observations, and data integration techniques. This hybrid approach ensures high accuracy in identifying, classifying, and managing lands designated for recreation, wellness, and environmental protection.

The initial phase involved identifying potential recreational sites using topographic, climatic, soil, and hydrological data. Key baseline information was sourced from the Geocadastre Committee, the Committee for Ecology and Environmental Protection, and other relevant government agencies. Criteria for site selection

ISSN: 2776-0987 Volume 6, Issue 6, June – 2025

included accessibility, landscape diversity, ecological integrity, and existing land use classifications.

In the geospatial processing phase, GIS platforms such as ArcGIS and QGIS were used to compile and manage spatial data. Vector datasets included administrative boundaries, infrastructure layers, and land use maps, while raster layers were derived from satellite imagery. Remote sensing (RS) data from Landsat 8 and Sentinel-2 satellites were utilized to assess vegetation health, anthropogenic impact, and seasonal dynamics using indices like NDVI (Normalized Difference Vegetation Index) and SAVI (Soil Adjusted Vegetation Index).

High-resolution orthophotos were obtained through UAV (drone) surveys, enabling detailed landscape visualization and accurate boundary delineation. UAV imagery also facilitated the detection of unauthorized activities, land degradation, and land cover transitions in real-time.

Ground truthing through field expeditions was essential to verify remote sensing interpretations and to gather GPS-tagged ecological data, land use observations, and photographic documentation. This information was used to calibrate spatial models and refine thematic maps.

Each identified recreational site was documented through the creation of a digital cadastral passport. These passports included detailed information such as parcel area, type of recreational use, vegetation status, ecological threats, infrastructure availability, and legal status. All data were standardized and prepared for integration into the national geospatial cadastre system.

Additionally, spatial analysis tools were used to prioritize areas based on ecological value, suitability for tourism, and risk exposure. Heat maps and zonal statistics were generated to support policy decisions and land planning strategies.

This methodology enabled the generation of an accurate, scalable, and update-ready geospatial database. It not only improves data quality and decision-making but also establishes a replicable framework for other regions seeking to modernize recreational land management through advanced geotechnologies.

MAIN RESULTS:

The research revealed that while Samarkand region possesses numerous recreational resources, about 60% of such sites are misclassified under unrelated land categories. This legal ambiguity hampers environmental protection and limits their use for tourism and health purposes.

ISSN: 2776-0987 Volume 6, Issue 6, June – 2025

Spatial analyses and digital maps enabled the classification of zones based on terrain, ecological condition, accessibility, and anthropogenic impact. NDVI-based assessments highlighted the natural richness or degradation of vegetation, helping to prioritize conservation efforts.

Drone imagery helped identify real-time changes and inconsistencies between on-site observations and official cadastral records. These observations were compiled into GIS databases with detailed object-level attributes. As a result, local governments now have access to structured digital profiles for each recreational site.

A model for integrating recreational lands into the official cadastre was developed. It includes assigning unique ID codes, linking attribute and spatial data, and defining technical and legal requirements for system-wide inclusion.

RECOMMENDATIONS:

1. Develop dedicated GIS-based cadastral layers for all recreational and wellness sites.
2. Regularly monitor land use and ecological dynamics using drones and satellite imagery.
3. Establish an open-access geoportal for sharing real-time spatial information.
4. Formally designate recreational lands as a separate legal category in national legislation.
5. Launch training programs for specialists in GIS, RS, and environmental land management.
6. Institutionalize annual field assessments and link the results to digital maps.
7. Adapt international models of recreational land management to local conditions.
8. Integrate recreational land zones into regional spatial planning documents.

CONCLUSION:

This study demonstrates that the current state of recreational and wellness lands in Samarkand requires significant improvement in terms of spatial clarity and legal recognition. The application of geospatial technologies, digital mapping, and integrated field-GIS workflows provides an effective solution to these challenges.

The developed methodology offers a replicable model for other regions. Institutional and legal reforms, alongside capacity building and the creation of open geospatial systems, are necessary to support long-term sustainability.

ISSN: 2776-0987 Volume 6, Issue 6, June – 2025

Modernizing cadastral practices for these types of land will not only improve environmental governance but also unlock the full potential of Uzbekistan's recreational resources for sustainable development and tourism.

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