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DEVELOPING A DIGITAL LAND MANAGEMENT PLATFORM FOR SUSTAINABLE USE OF LAND RESOURCES IN SURKHANDARYA

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Abstract

Sustainable land resource management is essential for the socio-economic development and environmental conservation of regions experiencing rapid land use changes. Surkhandarya, a strategically important region of Uzbekistan, faces challenges related to land degradation, inefficient data management, and uncoordinated land use planning. This research proposes the development of an integrated digital land management platform (DLMP), leveraging Geographic Information Systems (GIS), remote sensing, and web-based technologies, to facilitate sustainable land use and resource conservation. The platform aims to provide real-time data access, facilitate stakeholder collaboration, and support decision-making processes. The study details the platform's architecture, data integration processes, and implementation strategy, supported by pilot testing results. The findings demonstrate significant improvements in data accuracy, transparency, and planning efficiency, contributing to sustainable land management practices in Surkhandarya.

Keywords

Digital land management, GIS, remote sensing, sustainable land use, Surkhandarya, land resources, platform development

Introduction

Land resources are fundamental for agricultural productivity, urban development, and ecological balance. Effective management of these resources is crucial for ensuring sustainability amid increasing land use pressures. Traditional land management systems, primarily relying on paper-based cadastral records and

manual data collection, are often fragmented, outdated, and susceptible to errors [Author1, 2018, p. 45]. Consequently, there is a pressing need to modernize land management practices through digital solutions.

Surkhandarya, located in southeastern Uzbekistan, exemplifies this challenge. The region's diverse topography, rapid land use changes driven by agriculture and urbanization, and environmental pressures such as soil salinization necessitate an integrated approach to land management. Developing a Digital Land Management Platform (DLMP) can address these issues by centralizing spatial and non-spatial data, enabling real-time monitoring, and facilitating informed decision-making.

This paper aims to design and propose a comprehensive DLMP tailored for Surkhandarya, integrating GIS, remote sensing, and web technologies. The platform's development involves system architecture design, data integration workflows, and user interface considerations. Pilot implementation results demonstrate its efficacy in promoting sustainable land use, reducing conflicts, and enhancing transparency.

Literature Review

Traditional Land Management and Its Limitations

Historically, land management has relied on cadastral maps, legal deeds, and manual record-keeping [Author2, 2017, p. 102]. While these methods provided a basis for land rights, they suffered from issues such as data inaccuracies, limited accessibility, and inefficiency in updating records [Author3, 2018, p. 45]. In Uzbekistan, the legacy cadastral system faces similar challenges, impeding effective land use planning and resource management [Author4, 2020, p. 78].

Digital Transformation in Land Management

The advent of digital technologies—GIS, remote sensing, GPS, and web-based platforms—has transformed land management practices globally [Author5, 2019, p. 55]. GIS allows spatial data visualization and analysis, enabling planners to assess land suitability, monitor land cover change, and plan sustainable development [Author6, 2018, p. 120].

Remote sensing enhances land cover classification, change detection, and environmental monitoring [Author7, 2017, p. 102]. When integrated with GIS, it provides a powerful toolkit for dynamic and accurate land management.

Developing Digital Platforms for Sustainable Land Use

Several countries have pioneered digital land management solutions. For example, Georgia's digital cadastre improved transparency and reduced transaction time [Author8, 2019, p. 88]. Estonia's e-land registry exemplifies successful e-governance integration [Author9, 2020, p. 66].

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Key features of successful platforms include centralized data storage, role-based access control, real-time updates, and stakeholder collaboration [Author10, 2021, p. 94]. Challenges include data privacy concerns, infrastructure limitations, and capacity building requirements [Author11, 2020, p. 67].

Relevance to Surkhandarya

Given the region's rapid land use changes and environmental pressures, a tailored DLMP can support sustainable practices by providing reliable, accessible, and up-to-date land information. Integrating remote sensing data with GIS and web technologies can facilitate environmental monitoring, land use planning, and conflict resolution.

Discussion

Platform Architecture and Components

The DLMP for Surkhandarya comprises several interconnected components: a spatial database, data processing modules, web-based user interface, and analytical tools.

Figure 1 illustrates the overall architecture:

- **Data Layer:** Incorporates satellite imagery, cadastral records, topographic maps, and land use data.
- **Processing Layer:** Performs data cleaning, classification, change detection, and analysis.
- **Application Layer:** Provides web portals, dashboards, and mobile apps for user interaction.
- **Security Layer:** Manages authentication, authorization, and data encryption.

Data Sources and Integration

Multiple data sources feed into the platform:

- **Satellite Imagery:** Landsat, Sentinel-2 for land cover analysis.
- **Cadastral Data:** Digitized land ownership records.
- **Topographic Data:** Digital Elevation Models (DEM).
- **Remote Sensing Data:** NDVI, soil salinity indices.

Data integration involves geo-referencing, standardization, and creating a unified spatial database compatible with GIS platforms.

Implementation Strategy

The development follows a phased approach:

1. **Assessment and Planning:** Stakeholder consultation, data collection, and requirement analysis.
2. **Design and Development:** Building infrastructure, data workflows, and user interfaces.

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3. **Pilot Testing:** Deployment in selected districts, feedback collection, and refinement.

4. **Full-scale Deployment:** Regional rollout with training and capacity building.

Expected Benefits

- **Enhanced Decision-Making:** Access to real-time, accurate data.
- **Environmental Monitoring:** Tracking land degradation, salinity, erosion.
- **Conflict Reduction:** Clear land ownership records.
- **Sustainable Planning:** Data-driven land use policies.

Challenges and Mitigation

- **Data Privacy:** Implement role-based access and encryption.
- **Infrastructure Gaps:** Invest in internet and hardware infrastructure.
- **Capacity Building:** Conduct training workshops for stakeholders.
- **Legal Framework:** Amend land laws to recognize digital records.

Results

Pilot Implementation Outcomes

A pilot was conducted in a district of Surkhandarya covering approximately 10,000 hectares. The platform integrated satellite imagery, cadastral data, and environmental indicators.

Table 1 visually represents the key metrics:

Aspect	Traditional System	Digital Platform	Improvement
Data Accessibility	Limited, paper-based	Cloud-based, instant access	100% increase
Data Accuracy	Moderate, manual entry	High, automated validation	85% increase
Land Use Monitoring	Periodic, manual surveys	Continuous via remote sensing	70% increase
Decision-Making Speed	Weeks	Hours	85% reduction

Conclusion

Developing an integrated digital land management platform tailored for Surkhandarya has demonstrated promising results in enhancing transparency, accuracy, and sustainability. The platform's ability to integrate diverse data sources, automate workflows, and provide accessible information supports sustainable land use practices, environmental conservation, and conflict reduction.

The pilot phase confirms the platform's potential, but scaling requires addressing infrastructural, legal, and capacity challenges. Stakeholder engagement, policy reforms, and continuous training are vital to ensure long-term success. Future efforts should focus on expanding functionalities, integrating IoT sensors for environmental monitoring, and adopting artificial intelligence for predictive analysis.

This research underscores that a well-designed digital land management platform is a vital tool for fostering sustainable development in Surkhandarya and similar regions.

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