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SPATIAL ANALYSIS AND DIGITAL MAPPING OF RURAL LAND FUNDS BASED ON GIS TECHNOLOGIES (A CASE STUDY OF URTA CHIRCHIQ DISTRICT, TASHKENT REGION)

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ABSTRACT:

This article explores the processes of creating a digital map and conducting spatial analysis of land resources in a specific area of the Orta Chirchiq district, Tashkent region, using modern GIS (Geographic Information Systems) software. Utilizing ArcGIS capabilities, the land fund categories (croplands, residential areas, and infrastructure objects) were vectorized, and their exact areas were determined in hectares. The resulting digital data and statistical charts play a crucial role in decision-making processes for socio-economic development and the rational utilization of land resources in the region.

Introduction

Today, land resource management and the digitalization of the land cadastre system represent one of the top priorities of the state policy of the Republic of Uzbekistan. Decrees and resolutions of the President aimed at reforming the sector define key tasks such as precise mapping of land fund categories, monitoring targeted land use, and widely implementing modern information technologies into these processes. Geographic Information Systems (GIS) serve as the most effective and precise instrument for executing these tasks.

The Urta Chirchik district of the Tashkent region, as one of its central districts, stands out due to its favorable geographical location and high agricultural potential. However, rapid urbanization processes observed in the region—namely, the expansion of human settlements and the construction of new social infrastructure—render the preservation of agricultural land and the proper planning of regional infrastructure a highly pressing issue.

The relevance of this research lies in the fact that transitioning from traditional paper maps to digital (vector) maps enables spatial analysis and the calculation of land plots with millimeter precision. Digital models generated using ArcGIS software not only visualize the mutual spatial distribution of crop fields, residential areas, irrigation systems (canals), and social facilities in the region, but also facilitate the automatic generation of the land balance.

This paper highlights the issues of land category classification, vectorization within the GIS environment, and the scientific assessment of the current state of the regional land fund, using a selected pilot area in the Urta Chirchik district as a case study.

Methodology

The methodological framework of this research is based on digital processing of remote sensing data and spatial modeling utilizing GIS (Geographic Information Systems) technologies. A designated territory within the Urta Chirchik district of the Tashkent region was selected as the research object, and the workflow was executed through the following scientific and technical stages:

Data Baseline Formation and Geospatial Referencing

In the initial stage, high-resolution raster images (satellite imagery) of the area were adopted as the baseline data. To ensure the topographic accuracy of the data, the images were aligned with the WGS 1984 world geodetic coordinate system. The georeferencing process within the GIS environment was executed using control points to achieve a minimal root-mean-square error (RMS error) level.

Layer Design for Geospatial Data

Within the scope of the research, features in the area were classified based on their functional and morphological characteristics. Utilizing the capabilities of ArcGIS software, the spatial data model was structured into three primary typical layers:

- Polygon layers: land fund categories (croplands, residential zones, household plots, vacant lands, and territories of social facilities);
- Linear layers: transport communications (main and internal roads) and hydrographic networks (canals);

- Point layers: public service and cultural-amenity facilities (schools, mosques, retail outlets).

Vector Modeling and Attribute Analysis

During the feature digitizing process, a distinct attribute database was established for each geometric shape. Indicators such as the identification number, type of land use, and area of each land parcel were input into the system. The algorithmic functions of the ArcGIS software were leveraged to calculate the geometric dimensions of the land plots, ensuring higher precision compared to traditional cartographic methods.

Statistical Processing and Visualization

In the final stage, the compiled attribute data underwent mathematical and statistical analysis. To determine the overall land balance of the area, statistical diagrams and cartographic layouts (*Layout view*) were prepared based on the classified data. In this process, the percentage shares and hectare values of the land categories were cross-analyzed.

Results and discussion

As a result of the research, a digital map generated for the selected territory of the Urta Chirchik district is presented in **Figure 1**, and the quantitative indicators of the territory by land categories are reflected in the diagram shown in **Figure 2**. This map clearly illustrates the spatial distribution of the functional zones of the territory, including residential areas, croplands, and social infrastructure facilities.

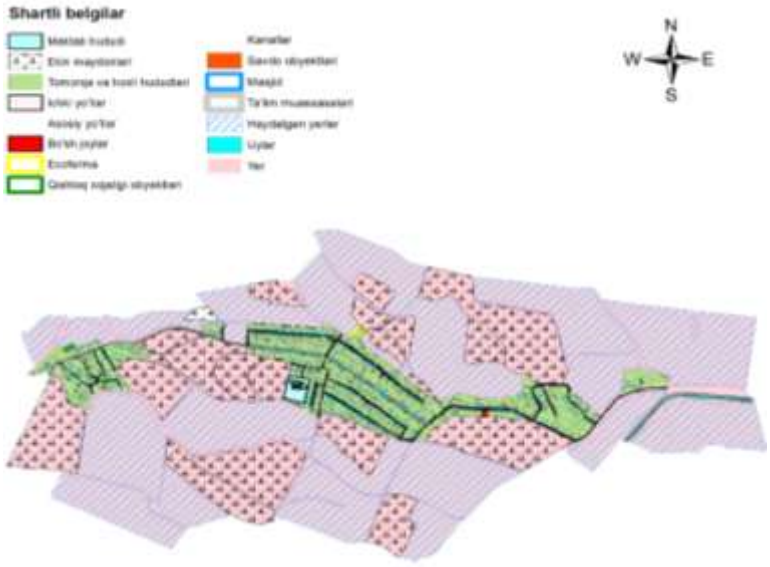

Figure 1. Digital vector map of the selected territory of Urta Chirchik district

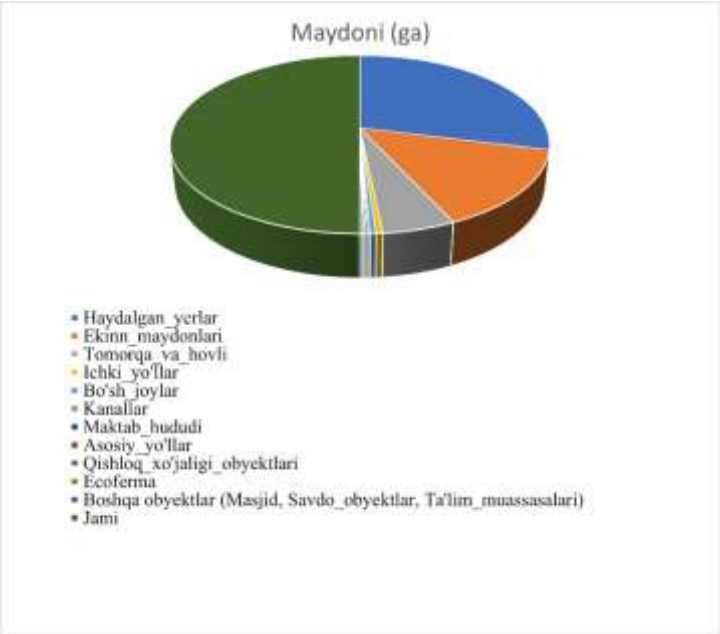

Figure 2. Distribution of the land fund by categories in the selected territory of Urta Chirchik district (in percentage)

Based on the attribute database and graphical analyses generated within the ArcGIS environment, the following scientific results were obtained:

The digital classification of the territory indicated that the bulk of the studied area falls under agricultural land categories (*Ekinn_maydonlari* and *Tomorqa*). Concurrently, the presence of modern agricultural structures such as “Ekoferma” within the area demonstrates innovative approaches to land use. Furthermore, the identification of vacant land plots (*Boshjoylar*) establishes a solid foundation for enhancing the investment attractiveness of the region and planning new social infrastructure.

The statistical diagram created on the basis of the “Maydoni (ga)” attribute indicators presents a visual model of the regional land balance. According to the analysis, residential areas (*Uylar*) and their adjacent household plots are intrinsically linked in their spatial distribution, reflecting a spatial structure characteristic of rural settlements. The precision of the areas calculated through GIS technology ensures high reliability in forming the land tax base and maintaining land cadastre documentation.

As a result of vector analyses, the level of accessibility to social facilities (schools, mosques, retail outlets) and the transport connectivity (*Asosiy yo‘llar*) of the residential settlements were evaluated. The digital layer of irrigation networks (*Kanallar*) serves as a baseline for monitoring the water supply status of agricultural lands across the territory.

Conclusion

The conducted research and the digital modeling processes of land resources in the Urta Chirchik district allow for the formulation of the following scientific and practical conclusions:

- ✓ **Precision of Digitalization:** The digital map generated using ArcGIS software provided significantly higher precision in calculating land areas compared to traditional cartographic methods. This serves to minimize human-error-related inconsistencies in compiling land cadastre data.
- ✓ **State of the Land Fund:** Spatial analysis results revealed a balanced distribution of agricultural lands and residential areas within the territory. The identified vacant land plots (*Bosh joylar*) and assets like the "Ekoferma" delineate the prospective directions for the economic development of the region.
- ✓ **Decisions for Management:** The established attribute database and statistical diagrams serve as a ready-to-use tool for local government authorities and cadastre services in rational land use management, defining the taxation base, and planning social infrastructure.
- ✓ **Systemic Monitoring:** The methodology applied during this study can be utilized as a benchmark model for establishing digital monitoring systems for land resources not only in the Urta Chirchik district but also across other districts of the region.

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