

# DEVELOPMENT OF AN AUTOMATED SOFTWARE SYSTEM FOR TRANSFER OF AGRICULTURAL LAND TO OTHER LAND CATEGORIES

Turayev Ruhiddin Amirkulovich

Director General of the State Scientific Design Institute  
"Uzdavierloyiha", Doctor of Technical Sciences, Professor  
[0000-0002-3879-0875]

Safayev Sanjarbek Zafarbek oglu,  
Deputy Director of the Khorezm branch of the State Scientific  
Design Institute "Uzdavierloyiha",  
Doctor of Philosophy in Agricultural Sciences (Phd)  
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## Abstract

This article discusses the scientific and methodological foundations of developing an automated software system for digitizing and managing the process of converting agricultural land to other land categories. The issues of reducing the impact of the human factor, increasing transparency, and ensuring the efficient use of land resources by automating the stages of documentation, assessment, monitoring, and decision-making in the land conversion process are considered.

**Keywords:** Land conversion, automation, GIS, digital cadastre, land management, decision support system, monitoring.

## Introduction

In recent years, urbanization, expansion of industrial infrastructure, and an increase in investment projects have led to the acceleration of the process of converting agricultural land to other categories. This process requires complex legal, environmental, and economic assessments.

In traditional methods:

- documents are maintained manually;
- data is stored in various databases;
- decision-making is slow.

Therefore, creating an **automated software system** for managing land conversion is an urgent scientific and practical task.

## Basic concepts and tariffs.

The process of converting agricultural land to other land categories is one of the important directions of the modern land management system. This process is based on the principles of territorial planning, economic development, ecological balance and rational use of land resources. Since land conversion is a complex system that includes many legal, technical and economic



stages, for its effective management it is necessary to use a unified conceptual apparatus and clear scientific tariffs.

In modern conditions, the processes of changing land categories are closely related to digitization and automation, and geographic information systems (GIS), digital cadastre, databases, and software tools that support decision-making play a key role. Therefore, it is important to clarify the scientific content of concepts such as land conversion, spatial data management, monitoring, and analytical assessment when developing an automated software system.

The basic concepts and their precise definitions serve to standardize the process, simplify information exchange, and ensure the objectivity of decisions made by state bodies. In this regard, the concepts presented below form the theoretical and methodological basis of an automated land management system[4,5].

**Table 1**

Concept	Tariff
<b>Land conversion</b>	The process of changing the current category of a land plot to another functional purpose
<b>Automated system</b>	A system that performs data collection, processing, and decision-making through software tools
<b>GIS technology</b>	Spatial data analysis and visualization system
<b>Digital cadastre</b>	Electronic database of information about land plots
<b>DSS (Decision Support System)</b>	Analytical system supporting decision-making

**The need to create an automated system.**

The process of transferring agricultural land to other land categories is a multi-stage and complex management process, in which legal permits, cadastral information, environmental assessment, economic calculations, and territorial planning factors are interrelated. In practice, most of these processes are carried out separately by different organizations, which leads to duplication of information, loss of time, and subjectivity in decision-making.

In traditional management methods, the exchange of documents is largely manual, spatial data is not consolidated into a single database, and the monitoring system is not sufficiently developed, which hinders the effective use of land resources. As a result, environmental risks, economic losses, and illegal land allocations can occur during the land conversion process[6].

Therefore, there is a need to digitize the process of changing land categories, integrate all data into a single platform, and create an automated software system that automatically performs analytical calculations. Such a system will serve to speed up the decision-making process, increase transparency, and ensure the efficiency of land management.

There are the following problems with changing the land category:



**Figure 1. Problems with changing land classification.**

Let's look at a comparison of the traditional and automated systems (Table 2).

**Table 2**

Indicator	Traditional method	Automated system
Document circulation	In paper form	Electronic
Decision making	Subjective	Analytical
Monitoring	Limited	Real-time mode
Transparency	Low	High
Time consumption	Long	Short

**Conceptual model of the system.**

To effectively manage the process of transferring agricultural land to other land categories, the automated software system being developed must be based on a clearly structured conceptual model. The conceptual model scientifically defines the general structure of the system, the interconnections between its functional modules, and the flow of data.

This model serves to integrate all stages of the land conversion process - data collection, spatial analysis, environmental and economic assessment, decision-making and monitoring - into a single information environment. Through a conceptual approach, the system's operating algorithm is planned in advance and information exchange between various government organizations is carried out in an integrated manner [7,8].

The conceptual model also ensures the flexibility of the automated system, allowing for future integration with new data sources, GIS technologies, and digital management platforms. Therefore, the conceptual model forms the theoretical basis for the development of the system and is an important stage in determining its effective operation.

It is proposed that the automated software system consist of the following modules:

1. Data collection module;
2. GIS analysis module;
3. Ecological assessment module;
4. Economic calculation module;



5. Decision-making module;
  6. Monitoring and control module.
- Functions of system modules (Table 3).

**Table 3**

Module	Main task
<b>Cadastral integration</b>	Obtaining land plot information
<b>GIS analysis</b>	Soil, terrain and infrastructure assessment
<b>Ecological module</b>	Determining the impact on the ecosystem
<b>Economic module</b>	Compensation and damage calculation
<b>DSS module</b>	Formulating an optimal decision
<b>Monitoring</b>	Monitoring changes

**Software system architecture.**

Software system architecture plays an important role in automating the process of transferring agricultural land to other land categories. System architecture is a technological framework that defines the components of the software, their interaction and the principles of data exchange. A properly designed architecture ensures the stable operation, security and scalability of the system[9,10].

Due to the large amount of cadastral, spatial and analytical data processed in land conversion processes, the system must be organized on the basis of a multi-layer architecture. In this case, data storage, analytical calculations and user interface are separated into separate layers, and a single management environment is created through their mutual integration.

This approach allows for the creation of a convenient electronic platform for government agencies, specialists and investors, real-time monitoring, and fast and accurate decision-making. Therefore, the software system architecture is the technological foundation of the automated land management system.

The system is developed based on a three-tier architecture:

- **Data level - cadastral and spatial databases;**
- **Logical level - analysis algorithms;**
- **User interface - portal for government agencies and investors.**

Also technological components (Table 4).

**Table 4**

Component	Texnologiya
<b>Database</b>	PostgreSQL/PostGIS
<b>GIS platform</b>	QGIS / ArcGIS
<b>Backend</b>	Python / Java
<b>Web interface</b>	React / WebGIS
<b>API integration</b>	REST API

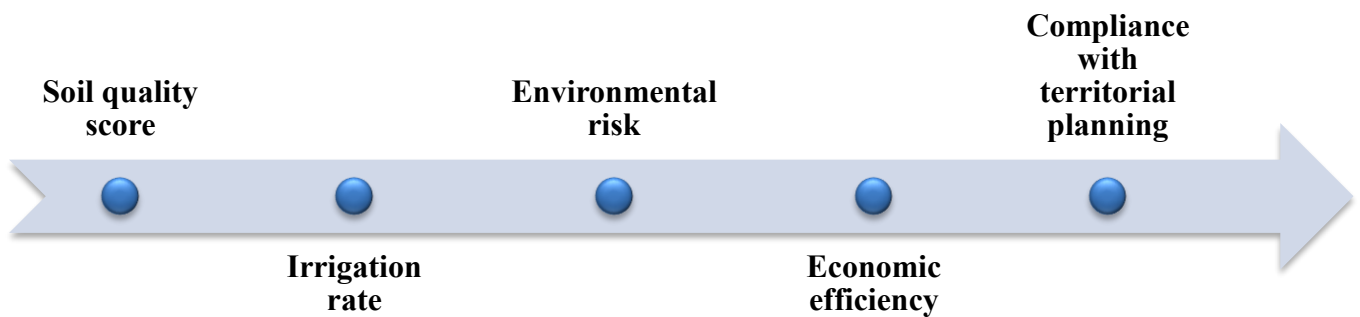
**Evaluation algorithm (proposed model).**

One of the main stages in the process of transferring agricultural land to other land categories is a comprehensive assessment of the land plot. In this process, it is impossible to make a sound decision without comprehensive consideration of environmental, economic, social and territorial factors. Therefore, it is important to develop an algorithm that standardizes the assessment process in an automated software system and provides objective results [4,7].

The proposed assessment model allows for the analysis of various indicators based on a single indicator system. The algorithm determines the agricultural value of land, environmental sustainability, proximity to infrastructure, economic efficiency and social impact through a scoring method. As a result, dependence on the human factor is reduced and the decision-making process is carried out scientifically.

This model serves to quickly perform analytical calculations in an automated system, formulate recommendations for conversion, and ensure the sustainable use of land resources.

Land conversion permits are assessed based on the following indicators:



**Figure 2. Indicator-based assessment of land conversion permits.**

Evaluation indicators (Table 5).

**Table 5**

Indicator	Weight (%)
Agricultural value	30
Environmental sustainability	25
Investment efficiency	20
Infrastructure proximity	15
Social impact	10

The assessment indicators used in the process of transferring land to other land categories ensure that decision-making is scientifically based and objective. These indicators allow for a comprehensive assessment of the agricultural value, ecological status, economic efficiency, infrastructure provision, and social impact of a land plot[8,10].

Through the indicator system, each factor is determined by specific criteria with points or weighted indicators, and the feasibility of land conversion is analyzed. As a result, subjective decisions are reduced, the efficiency of land resource use increases, and environmental risks are prevented.

Thus, assessment indicators are the main analytical element of the automated software system, which serves to ensure balanced, transparent and sustainable management in the process of changing the land category.



### Advantages of automation.

Automation of the process of transferring agricultural land to other land categories is one of the modern approaches to land resource management. In traditional methods, many processes are performed manually, which leads to increased time consumption, data errors, and insufficient transparency in the decision-making process. Automated systems eliminate these shortcomings and allow managing processes in a single digital environment.

Automation enables rapid data collection, processing, and analysis, and makes decisions on land conversion more scientifically sound. In addition, real-time monitoring, reduced human intervention, and simplified information exchange significantly improve the efficiency of land management. Therefore, automation is considered an important factor in ensuring the rational and sustainable use of land resources[7,9].

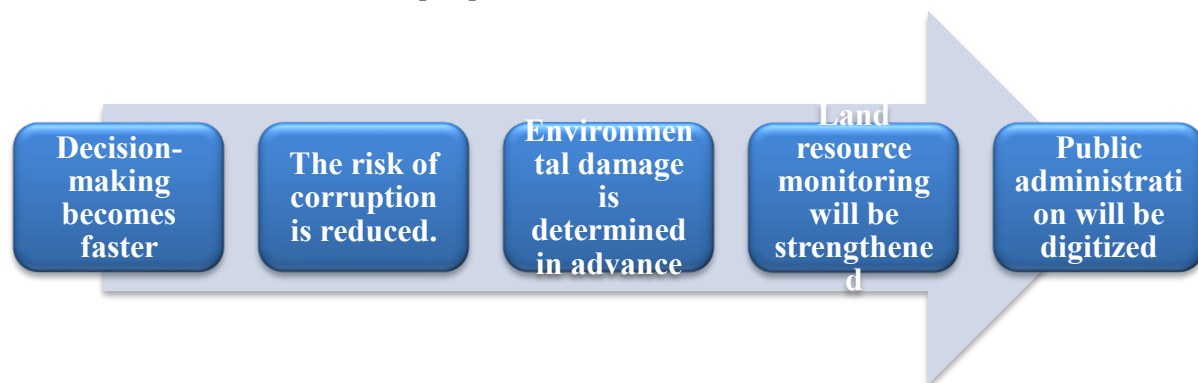


Figure 3. Benefits of automation.

### Prospects for implementation in Uzbekistan

Reforms in Uzbekistan aimed at effective management of land resources and digitalization of public services require the organization of the processes of transferring agricultural land to other land categories based on modern information technologies. Population growth, accelerated urbanization processes, and an increase in investment projects require the management of land conversion on a rapid, transparent, and scientific basis.

The introduction of an automated software system will allow the creation of a single digital management environment through integration with the national land cadastre, e-government platforms, and GIS technologies. This will simplify land allocation processes, strengthen control, and provide for a preliminary assessment of environmental risks.

In this regard, the introduction of automated systems in Uzbekistan is one of the promising areas for modernizing the land management system, increasing investment attractiveness, and ensuring sustainable use of land resources.

In Uzbekistan, the system can be integrated with the following platforms:

- National Land Cadastre;
- Digital Government System;
- Satellite Monitoring;
- Agrotechnical Database.

As a result, a single “**Land Conversion Digital Platform**” will be formed.

**In conclusion**, the process of converting agricultural land to other land categories is of great

importance in modern conditions for ensuring economic development, territorial planning and rational use of land resources. The complexity, multi-stage nature of this process, and the need for the participation of various organizations make it difficult to effectively organize it through traditional management methods. Therefore, the introduction of automated software systems for managing land conversion is scientifically and practically relevant.

The results of the study show that the automated system allows for the consolidation of data in a single database, GIS-based analysis, automatic implementation of environmental and economic assessments, and scientific substantiation of decision-making during the land conversion process. The use of assessment indicators and algorithmic models reduces dependence on the human factor, increases the level of transparency and control, and ensures the efficiency of land resource use.

In the conditions of Uzbekistan, the introduction of such a system will serve to digitize land management processes, reduce cases of illegal land allocation, expedite the review of investment projects, and maintain environmental sustainability. In general, the development and implementation of an automated software system is an important factor in modern, transparent, and sustainable management of the land conversion process.

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