Directions and methods of digital land management

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Abstract. The article deals with issues related to the digitalization of land management as a branch of the economy. The main directions and methods of digital land management developed in our country are outlined. Significant reduction of financial expenses and relatively rapid restoration of all land management functions is possible only through its automation, informational support and full digitalization. The modern solution of application tasks is in the employment of new technologies. The work performed in the field of digital land management is aimed at creating and implementing an intelligent system of planning, land management support and optimization of agricultural landscapes, land use and protection in agricultural production at different levels of generalization (field, farm, municipality, subject of the Russian Federation, country, foreign territories), operating on the basis of digital, remote, earth information technologies and computer modeling methods with online access by means of a web interface. Smart land management is designed to provide the basic spatial basis for implementing digital transformation in the following priority areas: smart field, smart farm, smart storage, smart greenhouse, smart garden, etc. This development in the form of creating and implementing a technological earth information platform for digital land management as the main mechanism for implementing the state's agricultural policy, rational use and protection of land resources is key in relation to the sectors of the economy that have a spatial reference.

1. Introduction

Creating a system of automated land management design (SAZPR) is a relevant objective of digital land management, a necessary tool for a modern land management system at the level of an economic entity – an agricultural enterprise.

By means of correct territorial organization, the productivity of land use for agricultural purposes can be increased twice as large, this can be achieved through systems of dynamic crop rotations, developed complex land management projects: the land consolidation projects, projects of demarcation and land order, projects anti-erosion organization of the territory, the reclamation project orientation (drainage, irrigation, etc.), and other land management projects.

These modern projects implementation is possible on the bedrock of digital land management through the use of automated land management design systems.

In the previous period of SAZPR development, some progress was made in its creation, but old versions of operating systems, Microsoft software, GIS platforms, and CAD systems for which they were created became outdated. All the more, with reference to the implementation of the Federal
dedicated program "Digital Economy of the Russian Federation", approved by governmental order of the Russian Federation dated 28.07.2017 No. 1632-R., part of which should be the sub-program "Digital Land Management", the updated SAZPR should provide mass work on land management projects implementation at the farm level, in light of the compulsoriness condition, according to the draft Federal law "On Land Management". [1]

The organization of an independent digital land management program should be put on the front burner of land policy new concept and land management in Russia. This task should be based on "a conceptually new system of land management, controlled and supported by the state across the board, concentrated and managed by a single completely new structure" (Federal Agency or Ministry) that controls the rational use of all land resources in the country. [6]

Many experts, scientists and professionals in the field of land use and land management back the strategy in their publications. [2–7].

In this vein, there is a need to identify the main directions and methods of creating digital land management.

2. Materials and methods
A new generation of SAZPR requires a new explanation, using new versions of software (SOFTWARE), compilers of high-level programming languages, including new database technologies, WEB programming, network applications, Blockchain technologies, Big Data, and client-server solutions. Also in SASPR the following unit services have to be adapted to interconnect:

- multi-purpose zoning and thematic mapping unit;
- a unit of territorial planning and land resource forecasting;
- automated land management design unit;
- a unit of intelligent land management system of augmented reality;
- investment analysis and business planning unit;
- a unit of complex land management expertise
- etc.

Together with changing the SOFTWARE used to create and modernize SAZPR, it is necessary to plan to improve the thesaurus of the system's knowledge base. Over the past decade, many new terms have emerged related to scientific and technological progress (STP) and the creation of new technologies, including the following: laser scanning, drone aircraft (UAV), digital agriculture, digital land management, smart land use, smart field, smart farm, etc.

A system should be created that allows the user to directly participate in the decision-making process through web access, equipped with all the necessary infrastructure – a complex of highly automated supporting and controlling processes. This opens the way to a radical increase in the efficiency of web technologies by directly involving users in processes instead of indirectly providing information about processes.

For the first time, a mass land user should have convenient access to the most modern services and automated technologies for completing the following tasks:

- formation and analysis of three-dimensional intelligent models of the territory (including crowdsourcing);
- intelligent search and rapid assessment of land plots;
- design and multi-criteria optimization of land management activities;
- simulation of long-term land use scenarios;
- land management projects;
- monitoring the results and side effects of land management (including the use of digital sensors and unmanned aerial vehicles);
- compliance with all land use regulations and regulations;
- improving their own competence in land use.
For the current state of collaborative decision-making, including in the field of land use in Russia and the CIS countries, the proposed innovations allow us to achieve a significant technological shift, radically reduce the cost of production and improve the quality of solutions.

Based on the above, we must assume that SAZPR we are creating today is largely based on a progressively developing methodology, mainly using proven methods for justifying project land management decisions.

Therefore, external changes in the block-modular structure of SAZPR are insignificant, and their content, or rather technological component, changes radically in the process of implementing the system in new software codes and applications. In addition, the system is supposed to be implemented as a multi-user, multi-level WEB service, implemented through a WEB portal with the connection of databases of land and resource information of various departments and structures.

3. Results and Discussion

At the first level of functional structuring of SAZPR, the block-modular object-functional complex principle is appropriate as the basis for allocating subsystems. It allows dividing the system into relatively separate independently operating components that combine various types of land management design, having their own specific objects, terms, finances and stages of design, the nature of output design (reporting) documents that provide planning of design and survey and design work, as well as monitoring the completeness and timeliness of their implementation.

SAZPR architecture - a general logical organization of automated land management systems that defines and (or) complements the process of processing and interpreting data that has a spatial reference; including means of encoding, storing, updating and visualizing data; composition, purpose, principles of interaction between hardware and software; acting as the basic framework - the basis of the system subject part. The implementation of this approach to the construction of a functional SAZPR system is reflected in the form of a generalized information-logical model based on a block-modular approach, reflected in the literature [1-3, 5, 6].

One of the new system blocks provides access to the services of the digital land management WEB platform, which is described in the relevant publications and developments of the system's authors.

In the process of creating SAZPR, it is necessary to be supported by the basic provisions of the land management automation and land management design concept. SAZPR must ensure:

- monitoring processing of land and resource information (on it quality, quantity and distribution by land users and landowners), information on land use (targeted, non-targeted) and implementation in nature full range of land management activities (including author's supervision);
- accumulation, structuring and generalization of it in the corresponding databases at all levels of the system hierarchy;
- concentration, updating and maintenance across the board of the system of economic and technological standards and rules for the management and land use organization;
- generate reports and answers to all the queries of users of SAZPR and group support.

Realization of land inventory using a Web portal that operationalizes the principles of client-server operation, allows you to automatically or semi-automatically quickly get up-to-date information about the amount and condition of land, which is necessary for all further work on land use. Also, open-source algorithms significantly speed up the program update and improvement, which leads to an indispensable increase in the number of users and success in the market.

Digital land management is the basis - the territorial spatial reference of the entire digital economy, as well as all digital agriculture, including all issues of precision agriculture based on adaptive landscape approaches, issues of land monitoring based on field condition control, effective planning and rational use of land resources taking GIS, CAD and information and communication technologies (ICT), as well as on the basis of comprehensive consideration of a large number of factors that affect design and management decisions. [2, 6]

Thus, a set of SAZPR software modules, supplemented with the help of program users, should form a comprehensive, well-founded solution to interrelated land management tasks with the achievement of
maximum economic effect as a result of automation, and obtaining additional products not only due to the best land management solution, but also in the form of a new information resource presented as a Digital Land Management web portal that allows processing big data online, and also creates additional surplus value and generates additional economic effects.

4. Conclusion
The creation of a digital land management system will make it possible to significantly increase the number of factors and indicators that affect the quality and validity of project decisions, which will significantly reduce the cost of project development, especially with a multi-variant approach, and create the necessary conditions for mass land management work.

It is expected that the source code of our system will be available for viewing, study and modification, which allows verifying the absence of vulnerabilities and makes it unacceptable to user functions (for instance, covert tracking of user program) to participate in the revision but facilitates the use of the code to create new programs and fixes errors in them — through borrowing the source code or through studying the used algorithms, data structures, technologies, methods and interfaces (as the source code can greatly complement the documentation, and in the absence of such it serves as documentation).

The functionality of the system will largely be supplemented by the ability to receive data from state data sources, such as Federal Service of State Registration, Land Register and Mapping, as well as to automatically prepare documentation for cadastral registration in the appropriate format according to the standards of the cadastral chamber.

Therefore, in many ways, the services of the projected system can be a good addition for both ordinary users (landowners and land users), and for the experts of the Federal Service of State Registration, Land Register and Mapping system and other structures that operate with spatial data.

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