Modern technologies of digital land management

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Abstract. The article deals with the issues of digital land management based on the use of modern information technologies. The digital land management system is created by digitalizing the agricultural industry and other economic sectors. Along with a digital land management system, staff training is should be carried out.

1. Introduction
Interaction with the Unified Federal Information System on Agricultural Lands (UFIS AL) created by the Ministry of Agriculture of Russia will improve digitization of agriculture. The solution is application of new technologies [1, 5–8]. Modern land management requires complex mathematical models to form design objects, choose and justify design solutions. Due to the use of spatial data (cartographic materials, elevation models, data on areas, distances, quantitative and qualitative characteristics of soils and landscapes, infrastructures and resources, production and consumption centers, etc.), calculations are required [2–4, 6–8]. To perform calculations, computing resources are required. Thanks to the use of cloud technologies, the digital land management system will reduce the level of technical requirements for the user's when integrating disparate information and computing resources required for project development (BigDATA).

Thus, the relevance of the “Digital Land Management” Concept aimed at solving the above-mentioned problems becomes a priority and is a strategic objective of the entire agrarian sector of the national economy. The development of land management as a science and an industry relies on the NTP and NTR. At The goal of digital land management is as follows:

Creation and implementation of a technological geo-information platform of digital land management as a mechanism for implementation of the national agrarian policy, rational use and protection of agricultural land. Smart land management is designed to provide the spatial basis for digital transformation of the following areas: smart field, smart farm, smart storage, smart greenhouse, smart garden.

2. Materials and methods
A scientific and technological breakthrough in agricultural production is impossible without digital technologies for land planning of rural areas which are a key segment of “smart agriculture”. The lack
of systemic generators in agriculture, land management, digitalization of management decisions will cause huge economic losses, irrational use of land resources, land degradation, etc. [5-7]

It is necessary to ensure digital transformation of agriculture by implementing the “Digital agriculture” concept through digital technologies and platform solutions in order to ensure the technological breakthrough in the agro-industrial sector and increase labor productivity in “digital” agricultural enterprises through digital land management [6, 7, 9].

It is necessary to create
- new technologies and software systems for making inventory of agricultural land in order to identify land plots suitable for agricultural development, amelioration and improvement, determine their boundaries, areas and location using a set of remote sensing methods (aerial photography, laser scanning, UAV and space devices);
- new technologies and software systems for agricultural zoning to identify valuable productive agricultural land, compile a register and identify types and parameters of agricultural land management;
- an intellectual reference-analytical system of inventory and monitoring of soil and land conditions based on domestic digital, remote, geo-information technologies and computer simulation methods.
- a scientific and technological platform providing a support for planned business decisions, generation of a scientifically grounded spectrum of operational technological capabilities and proposals for precision management of crop production; a modern scientific and technological base for rational planning, forecasting, management and legal support of digital (smart) agricultural land management [5–8].

3. Results and discussion
Thus, digital technologies of smart agriculture in the management system “smart land management” - “smart field” must be integrated on the basis of digital land management. Otherwise, the lack of a systemic generator in the form of “land management” will lead to huge economic losses, irrational use of land resources, land degradation, etc.

There are five stages of goal implementation:
I. Development of a digital platform structure for smart land management.
   - collection, storage, processing, analysis of information about agricultural land;
   - accounting of land, drainage systems and hydraulic structures;
   - monitoring of the state of land;
   - integration and comprehensive analysis of data on qualitative characteristics of land;
   - visualization of monitoring results;
   - providing authorized users and interested persons with information on agricultural land.

II. Formation of a system for planning and forecasting land management at the federal, regional and municipal levels based on BigData information flows
   - creation of an automated planning system for optimal (adaptive-landscape) land management, including:
     - a block for collecting, updating and storing data on the state of land;
a block for monitoring the state of land;
a block for multi-purpose assessment of land suitability and crop yield modeling;
a block for forecasting crop yields;
a block for planning location of agricultural land and crops, designing adaptive-landscape farming systems and agricultural technologies;
a block for cadastral valuation of land and their value.

III. Formation of a system of automated land management design, digital agricultural regulations and electronic land management documents
- development of intelligent technologies for land management documentation;
- validation of the system and demonstration of its capabilities on the example of a number of pilot projects of adaptive landscape agriculture;

IV. Formation of an effective land management system, including land ownership, a system for involving unused agricultural land into circulation based on spatial data.
- development of a system for collecting land cadastral information;
- creation of an information processing system;
- development of a system of management decision-making (development of robotic technologies based on artificial intelligence systems);
- development of digital projects for adaptive-landscape land management;
- development of a technological platform for using unused agricultural land;
- allocation of high-value agricultural land and development of regulations for its use;
- formation of electronic atlases for the land resource management system.

V. Staffing on the basis of a single online platform “Open Agrarian Education” including educational programs for training in digital land management.
- creation of a network of centers for implementing adaptive land management systems;
- creation of a network of centers for advanced training of specialists for centers of competence

The following scientific and technical results can be achieved:
- a new technology for agricultural zoning of a Russian region to identify valuable productive agricultural land plots, compile a register and establish types and parameters of permitted use of agricultural land plots;
- a software package for agricultural zoning of a Russian region to identify valuable productive agricultural land plots, compile a register and establish types and parameters of permitted use of agricultural land plots;
- instructions for agricultural zoning of a Russian region to identify valuable productive agricultural land plots, compile a register and establish types and parameters of permitted use of agricultural land plots.
- a new technology for making inventory of agricultural land to identify land plots suitable for agricultural development, amelioration and improvement, and determine their boundaries, areas and location using Earth remote sensing methods (aerial photography, laser scanning, UAVs and spacecraft);
- a software package for the inventory of agricultural land in order to identify land plots suitable for agricultural development, amelioration and improvement and determine their boundaries, areas and location using Earth remote sensing methods (aerial photography, laser scanning, UAVs and spacecraft);
- instructions for the inventory of agricultural land in order to identify land plots suitable for agricultural development, amelioration and improvement and determine their boundaries, areas and location using Earth remote sensing methods (aerial photography, laser scanning, UAVs and spacecraft).
- modified versions of the UAV for using in training purposes;
- modified hardware and software products for using in training purposes.
Development of an educational service for new educational programs (using UAVs for training purposes) to study and apply the latest digital technologies:

- the advanced training program “Zoning of agricultural lands of a Russian region”;
- the advanced training program “Automated technologies for zoning agricultural land”;  
- the advanced training program “Modern technologies for studying the state of agricultural lands for the purpose of optimization and regulation of their use”;
- the advanced training program “Automated technologies for studying the state of agricultural lands using remote sensing methods”;
- the advanced training program “Technologies of zoning, regulation and organization of rational use of land in rural areas of the Russian Federation based on remote sensing methods”;
- an educational methodical system and a digital educational resource for the advanced training program “Zoning of agricultural lands of a Russian region”;
- an educational methodical system and a digital educational resource for the advanced training program “Automated technologies for zoning agricultural land”;
- an educational methodical system and a digital educational resource for the advanced training program “Modern technologies for studying the state of agricultural lands for the purpose of optimization and regulation of their use”;
- an educational methodical system and a digital educational resource for the advanced training program “Automated technologies for studying the state of agricultural lands using remote sensing methods”;
- an educational methodical system and a digital educational resource for the advanced training program “Zoning technologies, regulation and organization of rational use of land in rural areas of the Russian Federation based on remote sensing methods”;
- advanced training of specialists in the program “Zoning of agricultural lands of a Russian region”;
- advanced training of specialists in the program “Automated technologies of agricultural land zoning”;  
- advanced training of specialists in the program “Modern Technologies for Studying the State of Lands”;  
- advanced training of specialists in the program “Automated technologies for studying the state of agricultural land using complex Earth remote sensing”;  
- advanced training of specialists in the program “Technologies of zoning, regulation and organization of rational use of land in rural areas thorium of the Russian Federation on the basis of the complex methods of remote sensing of the Earth”.

4. Conclusion
In order to improve the land service of the Russian Federation, increase efficiency of land management, it is necessary to implement a number of measures.

1. In order to implement the Order of the Government of the Russian Federation of November 8, 2018 No. 2413-p on measures aimed at improving the legal regulation of land relations, it is necessary to include provisions on new principles and methods of digital land management in the federal law “On Land Management” (new edition).

2. It is necessary to develop and implement a federal target program (subprogram) “Creation of digital land management and implementation of priority types of land management and related works in the territory of the Russian Federation (2019-2025 years)”. It is necessary to create a research infrastructure (scientific research institutes, problem laboratories, etc.), develop a computer and information support for the industry.

3. It is necessary to organize centers of digitalization of the agro-industrial complex for solving applied problems and developing software (application packages — modules of the agro-industrial
complex information system) on the basis of federal educational and methodological associations of universities.

4. Leading universities have to implement curricula for bachelor and master degree students in "Land Management and Cadastre".

5. To actualize teaching methods by implementing online courses, digital services of national and global online platforms, expanding the use of interactive methods, individual educational trajectories, project training.

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