Digital land management

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Abstract. The article deals with the issues of modernization of land management as a branch of the economy. Due to the digitalization of the economy, modernization is aimed at creating a digital land management system. Restructuring and digitalization of land management can create annual economic effects in all industries dependent on land management.

1. Introduction

Implementation of the federal target program “Digital Economy of the Russian Federation” approved by Decree of the Government of the Russian Federation No. 1632-r of July 28, 2017 is the main task of all sectors of the national economy. Therefore, a separate program for digitalization of agriculture is one of the priorities in the context of economic sanctions [1].

The Russian Federation needs a new concept of land policy and land management; should improve a paradigm of land and property regulation, update a land management system based on a new land management system supported by the state. This approach will avoid economic losses from irrational use of land resource [2, 6]. This was emphasized in [2–7, 9].

It is necessary to create digital land management capable to update the national land management system and land policy through upgrading the spatial data infrastructure.

2. Materials and methods

The SWOT analysis revealed a direct influence of the land management sector on the national economy through a connecting link - the basic dependence of most economic sectors on the land resource which is their spatial reference.

Results of the poor land policy manifested themselves in land reserves suitable for agricultural purposes (Table 1).

The development of these lands is a major national economic task requiring large financial expenditures. It is necessary to attract specialists in the field of land management; however, there is no full-fledged organizational structure capable of implementing this task. Therefore, it is necessary to create a centralized structure capable of performing the full range of land management tasks.
Table 1. Reserves of lands suitable for agricultural use or more intensive use, million hectares

| No  | Name                                      | Areas (million hectares) |
|-----|-------------------------------------------|--------------------------|
| 1.  | unused:                                   |                          |
|     | arable land                               | 20.0                     |
|     | forage land                               | 34.5                     |
| 2.  | unclaimed plots of arable land            | 16.6                     |
| 3.  | redistribution fund land                  | 43.7                     |
|     | including agricultural land               | 11.9                     |
|     | arable land                               | 3.5                      |
| 4.  | other categories of agricultural land     | 24.4                     |
|     | including arable land                    | 6.2                      |
| 5.  | land in unsatisfactory condition:        |                          |
|     | irrigated                                 | 1.15                     |
|     | drained                                   | 2.58                     |
| 6.  | land of bankrupt agricultural organizations | 15.9                   |
| 7.  | 9.7 million plots                         | 111.9                    |

A significant reduction in financial costs and a relatively rapid restoration of all functions of land management are possible only through its automation, informatization, and digitalization. Priority tasks in the field of land management and land policy whose urgent implementation is possible due to digital land management technologies are as follows:

1. Land inventory;
2. Compilation of the General scheme of land management in Russia, Russian regions and municipalities;
3. Development of lands suitable for agricultural or more intensive use.
4. Development of inter-farm and on-farm land management projects;
5. Development of land redistribution projects;
6. Development of integrated digital land management projects;
7. Establishing boundaries of federal land plots and land management support of measures for the delimitation of federal land ownership;
8. State control and protection of land;
9. Monitoring of crops;
10. Soil mapping and mapping of differential fertilization;
11. Digital relief modeling for land management;
12. Development of agricultural regulations;
13. Evaluation and modeling of crop yield;
14. Identification of valuable productive agricultural land;
15. Development of projects for the improvement of agricultural land, etc.

Digital land management can ensure quality, mass scale and short deadlines of land management works.

3. Results and discussion

Digital agriculture on the basis of smart land management cannot be created without a digital land management system. Digital land management is a basis of the digital economy, digital agriculture based on adaptive-landscape approaches, field monitoring, efficient planning and use of land resources, application of GIS, CAD and information and communication technologies, comprehensive accounting of large factors affecting design and management decisions. [6, 8]

Land management digitalization requires a unified integrated information system, land management forecasting, designing automation based on automated land planning design systems, expert analysis of land use based on neural network analysis, expert and intelligent systems, ICT .... etc.
The land management digitalization project is a complex systemic task affecting the maintenance of land management and the national land management system requiring cardinal structural changes, changes in the relationship of government and departmental structures.

The land management digitalization project should be implemented step-by-step. At the first stage, it is necessary to finalize and put into operation an integrative-integrated automated land resource design system for agriculture and rural development (ICAS-AGRO). Models and software products which carry out land management analysis and land planning, as well as all related electronic services of the agricultural industry can operate on its basis [6, 9].

Thus, digital technologies of smart agriculture must be integrated on the basis of digital land management. Otherwise, the lack of “land management” will cause huge economic losses (poor use of land resources, land degradation, non-rational land use, etc.).

These approaches can be implemented through the creation of an integrative-integrated computer-aided design of land resources which is a software platform for the integrated design of land management in agriculture and other sectors of the rural economy, in programs for sustainable rural development. The technological environment for interaction of all participants in land management, including land resource planners, land users and landowners, credit and financial organizations, expert and controlling organizations should be created.

The system can be created on the basis of previously developed mathematical models and autonomous functional software modules, including:

- discrete model of crop rotation taking into account the cost of maintaining fertility;
- a discrete model of allocation of land plots at the expense of land shares based on preferences of real estate investors and forming optimal land areas for using modern farming technologies;
- methods for analyzing spatial variability of yield characteristics depending on the conditions of the agrolandscape, including relief (morphometric characteristics);
- a unified systematized database of field experiments of the Agrochemical Service of the Ministry of Agriculture of Russia and the Agrogeos geonetwork;
- a module for automated yield assessment depending on agroclimatic and soil conditions and the agrolandscape (an experimental model was developed for one of 23 large agroclimatic regions);
- a module for automated construction of optimal crop rotations (an experimental model has been developed);
- a module for automated calculation of the cadastral value of agricultural land (an experimental model has been developed; there are results of implementation of government contracts for calculating the cadastral value of agricultural land in 24 regions of the Russian Federation);
- a module of automated operations with cartographic information (an experimental model has been developed).

The general concept of this approach is creation of an automated system of flexible support for multi-step processes of making and implementing long-term collective decisions in the field of land management based on semantic web technologies.

The system will provide a wide range of interested users with an access to tools for the automation of land planning based on information on agricultural lands and rural areas. It must ensure the implementation of a long-term strategy for structuring the land market and technologizing land management services.

Creation and subsequent use of the system will reduce transaction costs of agricultural producers using modern innovative technologies by ensuring the optimal inclusion of these technologies in the production system of agricultural regulations modeled by land management projects.

Development and implementation of the system will provide strategic directions of automation and optimization of land management design processes and implementation of rural development projects.

Implementation of the project will increase the level of annual financial revenues in all related and land-dependent industries and additional annual income by to 40%; the total annual cumulative economic effect of restructuring and digitization of land management will exceed 1 trillion rubles.
The integrated complex automated system for designing land resources (ICAS-AGRO) is a software package; each module is able to work autonomously and can be integrated into other software packages.

The system is designed to automate the land management design, including implementation of land management projects and their economic justification, bringing them to industrial implementation with online access to the capabilities of the System through a web interface.

The system provides the user with tools of land planning automation, including: coordination of the work of specialists working on a single project in a distributed mode; coordination and examination of projects with a project regulatory status; mass supervision of project implementation; updating projects; monitoring of projects and fixation of monitoring results; archiving and storing projects and generating standard solutions; use of model projects or individual decisions and information in subsequent works on land planning; assessment of the potential of land resources and their use in production projects.

The issue of providing an automatic mode of information exchange with other specialized information resources (distributed databases) and software and hardware complexes will be solved in stages. There will be an information exchange with state and municipal information resources created and maintained by the Ministry of Agriculture of Russia, the Federal State Registration Service, other agencies, services and authorities, and commercial organizations. To this end, when developing the System, the formats and interfaces of the database will be coordinated with the existing government and commercial systems.

Satisfaction of the growing demand for food is an issue of using new fertile land plots whose main source is Russia. With 20% of world land resources, Russia using modern agricultural technologies will be able to provide about 1.5 billion people with agricultural products; together with CES and BRICS countries, it provides three billion people with food. The dynamics of the service market will be closely linked to the dynamics of agricultural products markets, since involvement of land in agricultural production is based on the land management works (land inventory, spatial planning, land management, etc.).

The System with “... a set of program modules will form a comprehensive sound solution of interrelated land management tasks which will make it possible to achieve the maximum economic effect and produce additional products through better land management solutions and use of new information resources.

When designing the System, solutions that are applicable to any national land management system (building an intelligent three-dimensional digital model of the territory based on land clusters and other model objects, providing tools of three-dimensional design, attracting and interpreting data on soil composition, climatic conditions, erosion processes, production-technological and transport-logistic modeling of farms) are used. At the same time, for the adoption and justification of specific design decisions, standards and criteria established by national regulatory acts (developed and approved in the Soviet Union) are used. If we change these standards and criteria, we can develop projects in other national land management systems. It is necessary to separate legal and accounting aspects of land relations from the issues of land design as an economic resource [6]

Thus, the System may be relevant for former Soviet republics (Belarus, Kazakhstan, Moldova, Georgia, Tajikistan, Ukraine), countries developing based on the Soviet land management system (China, Mongolia, Vietnam, etc.), countries that do not have developed systems for designing land resources for economic purposes, monitoring and controlling of land management [6].

Efficiency of land management activities depends on the degree of readiness of land management producers and experts.

For this purpose, the following additional educational training profiles can be used: computer equipment and digital technologies; applied mathematics and programming; applied informatics and programming.

4. Conclusion
In order to improve land management in the Russian Federation, it is necessary

1. To implement land management projects (land inventory, land management forecasting, land management schemes, etc.) in order to carry out a comprehensive reform of the entire industry. To form
a land management system and focus its main functions in the Federal Agency for Land Management subordinate to the President of Russia.

2. To transfer the function of rendering land management services from the Ministry of Economic Development to the Ministry of Agriculture (Department of Land Management subordinate to the Federal Agency for Land Management).

3. To Develop and implement a federal target program (subprogram) “Digital land management and priority types of land management in the Russian Federation (2019-2025)” [8]. To create a research infrastructure (scientific research institutes, laboratories, etc.). To develop and maintain improved computer and information support for the industry.

4. To develop and implement the Federal Target Program "Land Resources and Land Management of Rural Territories of the Russian Federation (2019-2025)". To improve the use of land resources.

Calculation of the economic effect of the program "Digital land management and priority types of land management in the Russian Federation (2020-2025)” and reduction of the time compared with traditional methods showed that the expected economic effect of modern technologies (2 indicators out of more than 20) will be 15.9 billion rubles with a total cost of the program of 2.6 billion rubles. Taking into account that the total estimated number of facilities required for land management works is about 1.8 million, at least one million specialists in land management will be required to ensure stable employment in land management and related branches of the national economy.

6. In general, the expected annual effect of the Program will be more than 100 billion rubles. According to our calculation, under regular and timely implementation of all land management tasks, the specified level of annual revenues should increase in all related and land-dependent industries and increase an annual additional income from 30 to 40% (more than 1 trillion rubles).

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