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Digital Information Technologies in Land Resources Management System

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***Abstract*—Nowadays the frequency of digital technologies use in economy is increasing. It is vital to employ innovative approaches to increase the efficiency of management and get new possibilities for permanent search and access to the relevant, full and reliable information about the object of management in complex socio-ecologic economic systems. This is of utmost importance, when we speak about land resources management system. That is why the state and corporate entities have to create up to date databases and employ modern digital technologies to process local geospatial information on land resources that is contained in the national (regional) geo information systems. The aim of the study is to identify the possibility of use and evaluation of land resources data set and all the relevant information that is kept in corresponding geo information system (-s) in order to boost land use efficiency. The authors of this article have obtained the following results and conclusions that have scientific novelty: 1. The authors of this article have proved the possibility to boost land use efficiency by means of digital technologies and geo information systems. They should act as a tool for obtaining, processing, interpretation and visualization of geospatial data, related to land resources. 2. The authors have elaborated a pattern for common information space that contains land resources data and consists of certain subsystems and levels.**

Keywords—digital technologies, management, land resources, pattern, information space.

I. INTRODUCTION

The economy of the country is a complex multilayered system, which consists of many interrelated elements. This implies a variety of objects of management and that, in its turn, generates different system management tools. The modern society is characterized by application of different digital information technologies, regarding management of complex socio-eco-economic systems, to which also belongs land resources management system. Digital technologies in management are, first of all, the tools that are aimed at getting positive managerial outcomes. The positive outcomes of management mean carrying out certain reasonable activities, aimed at gaining maximum possible benefit from the object of management [1]. If we want to get positive outcomes of management, when we use land resources management system, we should perform a comprehensive analysis of the relevant, complete and reliable data, related to the object of management. As the land data is permanently linked to a certain surface area (this occurrence is called geospatial positioning), interpretation and visualization of this data are essential for performing proper analysis and evaluation of land use efficiency. The data that has been properly processed and digitalized is the data that characterizes the object of management. At this stage of management we have to use digital technologies, for they possess certain functional capacities that are able to meet the needs in processing, storage and submission of the most accurate data about the object of management [2, 3].

II. METHODS

Under the objects of management in this study are meant land resources, represented by land fund at different management levels: federal, regional and municipal. The land fund, first of all, is defined as the set of all lands, located within the boundaries of state or region that have legal status and different economic use. The traditional definition of land resources is that they are natural ones and the source of life, and form the basis for all the spheres of human economic activity [4]. Moreover, land is the main source of agricultural and forest goods manufacturing, as its main property is fertility. If we treat the land as the object of management, then the definition will be quite broad and complicated. The main features of land resources depend on its size and quality and the variety of environmental conditions within state or region. The land quality depends on climate, ground forms, soil covering and other natural and anthropogenic factors. It is important to consider all these factors by providing information support for land resources management system. Apart from that regulatory bodies and all the subjects of land relations should receive reliable and current information about land fund state and development, so that they can carry out efficient land resources management and make reasonable and sound decisions in terms of land relations control [2]. This particular information provides the basis for evaluation of land state and land use efficiency that further helps to establish goals of efficient management.

Land information is a set of data about land (land resources, land use), using which we can regard it as an object of management [5]. The burning issue of the information support for land resources management system is that the content is not specific and the land data sources are fragmentary. Multiple sources of information and huge land resources data sets trigger chaos and mess in management system. The main sources that deliver data to the land resources management system are executive authorities and local government bodies, to be exact:

- The Ministry of Agriculture of the Russian Federation (and regional departments);
- The Ministry of Natural Resources and Environmental Protection of the Russian Federation (and regional departments);

- The Ministry of Economic Development of the Russian Federation (and regional departments);
- Local government bodies (municipal governments) etc.

It is worth mentioning that to the land resources data users belong, among others, the ministries and agencies, mentioned above. The data delivery algorithm is quite simple and clear, it is based on the rule "from the smallest to the largest one", which means that it has a strict hierarchy [6, 7]. The raw data about total area, state, use, application quality and other land features is delivered, first of all, to the municipal, then to regional and federal authorities. The fragmentation also exists both at structural level and at the level of land data selection, as well as in the chain "sources – suppliers – users". That means that different authorities (ministries and agencies) deal with land data of different content. It leads to the absence of the unified organized system of land data collection, storage and delivery. Owning to that the land data is fragmentary.

Nowadays the Unified State Register of Immovable Property (USRIP) is the only systematized land data register. However this system doesn't contain data on land resources, it contains data on land plots, and these plots are considered in this system only as economic objects of management. The data is fragmentary and the access to it is restricted. The land plot or it parts are the most common structural units of the land fund in the land resources management system. According to the general definition a land plot is a detached part of earth surface, which has a fixed area and legal status [5, 8, 9]. In this case the detachment means that turning points of land plot boundaries should be represented in planimetric rectangular coordinates X and У in documents and electronic database of the Unified State Register of Immovable Property. The USRIP presents the main features of a land plot, such as: cadastral number; total area; coordinates of turning points for boundaries; cadastral value; land category; permitted use data; legal status data; property owner data, etc. Unfortunately, the register doesn't provide such land plot data as: land quality, vegetation and soils, agroclimatic conditions, eco-epidemiologic conditions and others.

Based on the above, we can conclude that the existing land plots and land fund data belong to economic-legal area of the state economic activity, that is why, the mentioned objects should be regarded as economic-legal management categories. However, it should be noted that nowadays the USRIP and other databases don't contain enough data about agricultural lands, which are vital for agricultural goods production and agricultural enterprises functioning and arrangement. The agricultural lands data presented there is fragmentary, random and local and doesn't permit to make reasonable managerial decisions. Moreover, the functionality of the USRIP information system doesn't allow to carry out a complete geospatial analysis of the given data, for it is impossible to visualize it on the map. Publicly available cadastral map also doesn't give the user the opportunity to carry out comprehensive analysis and assess land resources management efficiency properly, as the data, shown on the map, is of acquainting nature, incomplete and very often is not relevant.

Thus, we can highlight the following fundamental problems of information delivery in land resources management system

- The The provided land data is not clear, is fragmentary, the access to it is limited;
- Limited possibilities of data processing, conversion and interpretation, there is practically no possibility of visualization, which is essential for performing geo-spatial analysis;
- The problems with IT support for land data processing.

III. RESULTS

To solve the issues, mentioned above, it is necessary to consider a number of recommendations and suggestions, which, in our opinion, can facilitate the increase in land data quality and provide the possibility to use this data in order to enhance the land use efficiency at all the levels of land management system:

1) On the one hand, to make proper comprehensive evaluation of land as the most valuable natural resource, we should describe lands more thoroughly, taking into consideration a wide range of parameters that characterize land resources as the complex object of management. Such evaluation would allow making more accurate forecasts and enhancing the land use efficiency. And the development of long –term plan of the efficient land use, which is one of the main goals of both regional and national economic development strategy [1], will become one of the key directions of national land policy. On the other hand, it is necessary to employ systemic structural approach to the collection and storage of certain land data. It is essential to create a well-organized system for collection and distribution of data according to its content and structure. Land resources are complex social –eco-economic objects of management, which have many features; the information about them will also be complex and will be based both on the composition and certain hierarchy. The land data composition depends on the certain land features. Data about land pollution, disturbed lands, ecological disasters, land recultivation, reclamation works, etc. constitute ecologic data set. The USRIP data (cadastral and market values, land turnover and land market data constitute economic data set. Data about climatic conditions, underlying surface, vegetation and soil covering, soil fertility, chemical composition, hydrological conditions, etc. constitute natural data set. The data about land plot accessibility and remoteness from well- developed infrastructure, distance from important natural objects (rivers, lakes, woods etc.) constitute social data set The hierarchical pattern follows the rule of subordination: in the land resources management system: the lower levels are subordinate to the higher ones. The same happens to the delivery of information: from the source of origin (municipality) it goes to the regional and then to the federal agency.

2) Nowadays digital platforms are the most popular solutions, employed for providing information support and meeting the need for information. They form IT-basis for digital economics [10]. A digital platform is a set of digital data, standards, patterns, methods and tools that are informationally and technologically combined into unified automated functional system, aimed at managing target area and its subjects [11]. That is why, it is crucial to create

common information space to meet the need of all the land relation subjects for proper information support. This common information space should both provide the access to the land data and give the users the possibility to make interpretation of land data in geospatial terms. This platform should accumulate land data by means of geo-informational systems (GIS). GIS are the best and the most suitable tools for processing, interpretation and visualization of land data and for territories development management at all levels [3, 12]. The common information space should be based on Internet data portal, devoted to the land data. As the common information space provides information support for state authorities and all concerned subjects of land relations, it should be equipped with information- telecommunication systems that are able to provide information support for different areas of management activity. This will help to take the best possible advantage of the data, located in the land resources management system. Pattern for common information space as a land data portal is presented in figure 1.

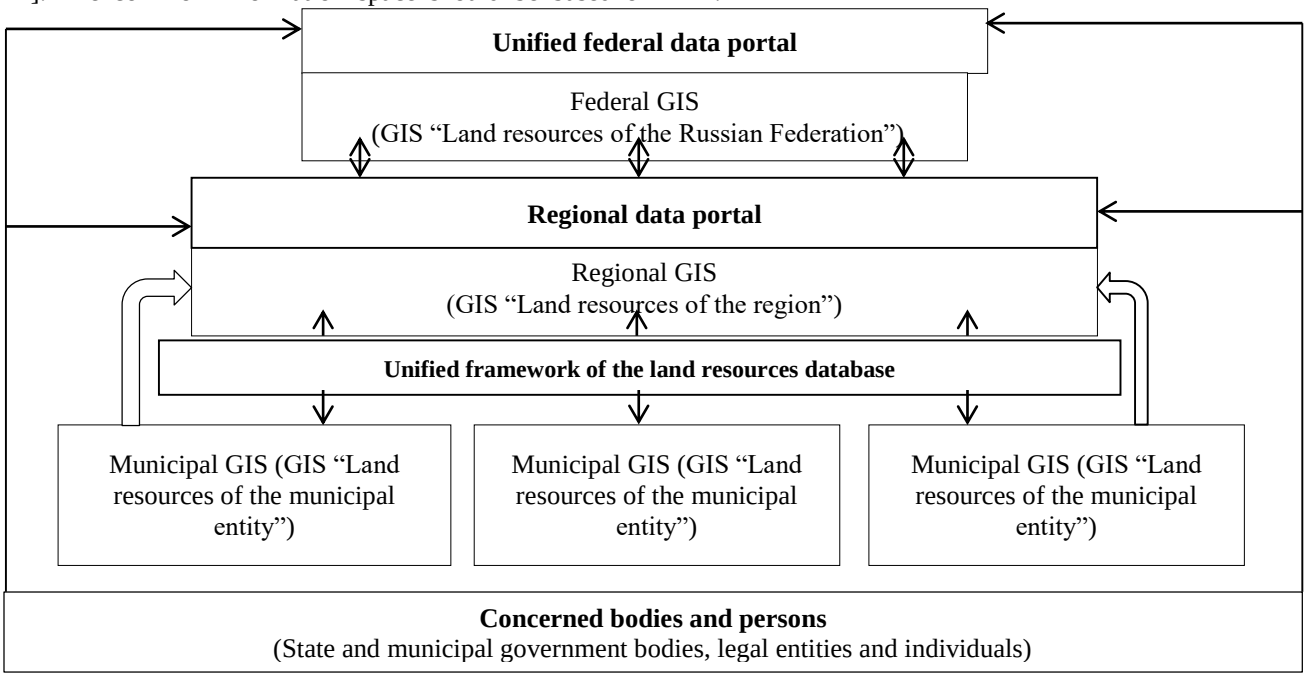

Fig. 1. Pattern for common information space as a land data portal.

When creating common information space, we should take into account the hierarchy [13} of land resources management system, as the local municipalities are the main suppliers of land resources data (data on land state and use). Besides, when creating databases for land resources management system we should employ systemic structural approach with regard to land resources data collection and storage. The databases (DB), created in local GIS [14, 15] should have a unified framework; the land resources data should be systematized. These databases should be easily integrated into the databases that are located in regional GIS, which, in its turn, will be the main suppliers of land resources data for the GIS "Land resources of the Russian Federation"). It is worth mentioning that the GIS functionality and content should comply with the requirements to the decision-making, related to land management efficiency improvement, which constitute main production baseline and at the same time form part of the human environment [16]. The common information space will provide the opportunity to use the data on a direct basis, without any intermediaries and to perform comprehensive dimensional analysis of actual and predicted land use/

IV. Conclusion

Thus, the common information space development would meet the requirements of all the subjects, involved in land relations. The common information space will allow both to accumulate all the land data in databases that have certain hierarchy and are created pursuant to systemic structural approach and to perform comprehensive comprehensive dimensional analysis in order to improve land use efficiency and quality. Besides, the application of digital information technologies for processing and geospatial interpretation of land data, GIS, in particular, (for performing comprehensive analysis), is stipulated by the fact that there are different possible outcomes of implementation of digital information technologies into land resources management system. The main possible outcomes of common information space and digital technologies development are: ecological, social and economic ones. The set of outcomes will result in maintenance of positive environment in society; reduction of social tension in the society, boosting the level of confidence to state, stability and civil consent; rise in the gross national product and national income, increase in budget funds at all levels, rise in corporate entities incomes. All these factors should harmonize the interests of state, economic entities and population.

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