IMPROVEMENT OF GEOINFORMATION TECHNOLOGIES ON THE BASIS OF SPATIAL DATA

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Abstract
Land management and improvement of computer technologies in land use are one of the most important tasks of the state; their effective implementation is closely linked to the widespread implementation of modern achievements of information technology. The achievement of the maximum transparency of the processes is vital in the field of geo-information and spatial data resources during increasing the reliability and manageability of the infrastructure.
Keywords: geo-informational resource, spatial data, land use, type of land use, sowing area

Introduction

The president of the Republic of Kazakhstan (Decree № 464, January 8, 2013) approved the State Program "Informational Kazakhstan - 2020" (Ukaz Prezidenta Respubliki ..., 2013). One of the main objectives of this program is the development of "e-government" creating a single national geo-informational environment, which will give an access to modern, high-quality and complete geo-data to the public authorities, integrated with the objects of state registration databases. It is expected that the creation of the single national geo-informational environment will significantly raise the efficiency and transparency of public authorities, as well as anti-corruption measures, because about 80% of the information environment to a great extent is related to geographic information resources and spatial data.

In order to implement the mentioned programme, the Government (Resolution №101, February 7, 2013) approved the "Plan of measures for implementation of the program", which prescribes to develop a set of measures directed to the creation of a single national geo-informational environment based on the Law "On Informatization" (Zakon Respubliki Kazakhstan ..., 2007).

The implementation of computer technologies into land surveying production provides for land information automation, storage and processing and organisation of the use of land, as well as restructuring of technologies on the basis of the use of information reflecting the spatial aspects of land use (Bekseitov, 2015). Modern software and hardware tools make it possible to resign from many of manual processes, to improve the quality of the received documents, eliminate many intermediate links of traditional technologies, facilitate the use of graphic materials due to digitization process in the computer-aided design. The purpose of research is to improve geographic information resources on the basis of the analysis of spatial data.

Methodology of research and materials

The methodological basis of the research was the investigations of leading Kazakh, Russian and foreign authors in the field of geo-information and spatial data resources, as well as the thematic materials of specific literature. The information-empirical and normative-legal base of the study included laws, presidential decrees, decisions of the Government of the Republic of Kazakhstan, normative and legislative acts. To solve the problems in the study, scientific methods of analytical, structural and comparative analysis, as well as statistical methods were used.

Discussions and results

Information systems are currently used in various spheres of human activity. However, quite often the users should to determine the spatial position of the objects under study. Any spatial information system is formed on the principles that are inherent to all information systems. Such systems are represented as automated information systems for the display and analysis of natural and man-made objects located on the earth's surface. The spatial reference objects under study served as the basis for the introduction of the term "geographic information systems". Broadly speaking, geographic information systems are seen as a model of the real world, and in the narrow sense it is a system of accumulation and storage of data attached to the earth's surface. The most promising direction of development of geographic information systems is recognized as an opportunity to support decision-making processes (Seredovich, 2008).

Currently in the field of geographic information resources, automation has reached such a level that it can meet the challenges of spatial analysis, to carry out management of graphic and attributive databases, correct the information, display it and make printouts. Thus, the main difference between the geo-information resources of computer graphics systems is that the geographical information system, in addition to the graphical display, contains comprehensive information about the objects and their elements. In addition, they also provide a calculation of the area and the distribution of land by categories, types of land use, ownership, kind of economic use, etc. Information about each object included in the geographic information system, is stored in the digital form.

Materials of automated surveying, scanning, remote sensing, for example, can be used for formation of such information. Thus, the result of operators work is essentially dependent on the accuracy of the previously entered data. Therefore, the land area and other parameters will be calculated from the information contained in the data bases. The more accurate the information is, the more reliable result will be obtained.

The current stage of development of information technology is characterized by the transition to the integration of all kinds of geographic information resources. Therefore, GIS technologies enabling users' interaction are rapidly developing along with the semantic information technologies, using a variety of digital spatial data, which are usually provided with their attributive information. Thus, the spatial data are recognised as digital data on geographic objects, including information about their location, shape and properties presented in the coordinates system, but attributive data - properties, qualitative and quantitative characteristics of spatial objects represented in digital form.

Entering data into geographic information system is an operation of data reading from a variety of information media. Data should be converted into digital format before entering into a geographic information system. This process is called "digitization" and can be automated in modern geographic information systems using scanner technologies. In modern geographic information systems models of relational data are used, which provide data storage in the form of tables. The data on the spatial location (geographical data) and associated with them attributive information are generated directly by the user or purchased from commercial suppliers, or on other basis. These data are integrated with other types and sources of information in geographical information systems. At the same time various external organizations can apply more powerful database management systems to organize and use the information which is at their disposal.

The distribution of land in Karmakshy district of Kyzylorda region according to land categories is analysed in the research in order to improve the geographic information resources on the basis of spatial data. Table 1 presents data from 2011 to 2015.

Table 1

Land distribution in Karmakshy district of Kyzylorda region according to land categories

Categories	2011		2012		2013		2014		2015	
	thous. ha	%	thous. ha	%	thous. ha	%	thous. ha	%	thous. ha	%
Agricultural land	483.5	18	486.5	18	361.5	14	362.4	14	364.0	14
Land of settlements	44.1	2	44.1	2	44.1	2	44.1	2	44.1	2
Land of industry	2.2	-	2.4	-	4.1	-	4.0	-	4.0	-
Land of especially protected areas	-	-	-	-	-	-	-	-	-	-
Forest land	429.0	16	429.0	16	429.0	16	429.0	16	429.0	16
Land under water	10.7	-	10.7	-	10.7	-	10.7	-	10.7	-
Land of state reserve	1,706.1	64	1,702.9	64	1,826.2	68	1,825.4	68	1,823.8	68
Total area	2,675.6	100	2,675.6	100	2,675.6	100	2,675.6	100	2,675.6	100

Changes have occurred in many categories in the course of time. Agricultural land has decreased by 4%, the land of state reserve, in turn, has increased by 4% over the past five years. Forest land remained at the same level, which is especially important in the conditions of Kazakhstan.

The chart analysis showed that the largest area in the Karmakshy district is occupied by land of state reserve (68%), forest land (16%) and agricultural land (14%). The small area is occupied by land of settlements, industrial land and land under water (Fig. 1).

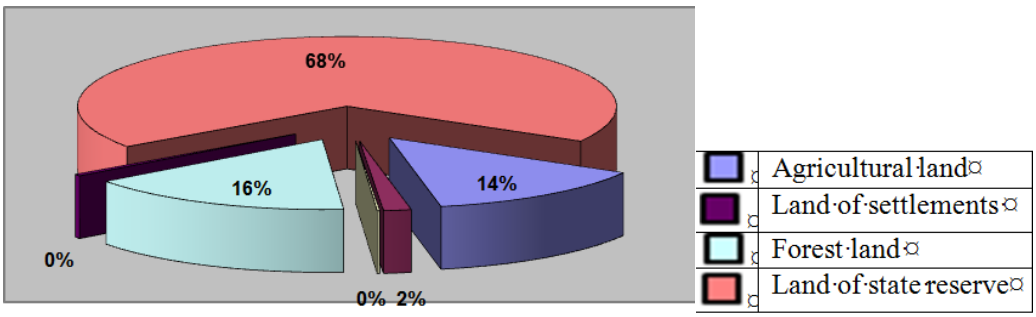

Fig. 1. Breakdown of land categories in Karmakshy district (November 1, 2015)

The analysis of the land used by partnership with limited liability "Zhanazhol" of Karmakshy district (hereinafter – the farm) was carried out for the formation of spatial data. The total area of farm is 12.9 thous. ha, agriculture land (arable land, meadows and fallow land) occupy 10.4 thous. ha or 81%, and other land (soloncs, sand, takyrs) - 2.4 thous. ha or 19%. Sowing area of the farm occupies 3.9 thous. ha. There is the reserve in the farm to increase the area of arable land at the expense of fallow land (Table 2).

Table 2

Breakdown of types of land use in farm "Zhanazhol" (on 01.11.2015)

Type of land	2011		2012		2013		2014		2015	
	ha	%	ha	%	ha	%	ha	%	ha	%
Arable land	3,852	30	3,910	31	3,885	30	3,885	30	3,950	31
Meadows	658	5	658	5	658	5	658	5	658	5
Fallow land	5,923	46	5,865	45	5,890	46	5,890	46	5,825	45
Other land	2,396	19	2,396	19	2,396	19	2,396	19	2,396	19
Total area	12,829	100	12,829	100	12,829	100	12,829	100	12,829	100

Table 3 shows the dynamics of sowing areas taken up with crops and vegetables in the farm "Zhanazhol". In the period 2011 - 2015 the greatest increase was observed in the area of spring wheat and under potatoes.

Table 3

The dynamics of sowing area in farm "Zhanazhol"

Types of crops	2011		2012		2013		2014		2015	
	ha	%	ha	%	ha	%	ha	%	ha	%
Rice	2,580	66	2,600	66	2,600	67	2,600	67	2,650	67
Spring wheat	15	0.4	20	0.5	20	0.5	20	0.5	30	1
1st year lucerne	500	13	530	14	510	13	510	13	530	13
Long-term lucerne	600	16	600	15	550	14	600	15	560	14
Lucerne for seeds	150	4	150	4	200	5	150	4	170	4
Potatoes	7	0.2	10	0.3	5	0.1	5	0.1	10	0.3
Total area	3,852	100	3,910	100	3,885	100	3,885	100	3,950	100

The territory of the farm mainly was used for cultivation of rice (67%), 1st year lucerne (13%) and long-term lucerne (14%) (Fig.2).

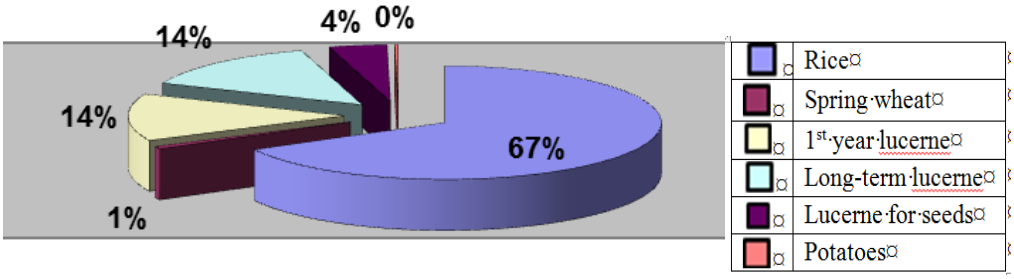

Fig. 2. Breakdown of sowing area in the farm "Zhanazhol" (on 01.11.2015)

Improvement of the geographic information system based on spatial data must include the comprehensive analysis of land use taking into account the balance of graphic and attribute data. The block scheme (Fig. 3) of improving of geographic information system was developed by the authors on the basis of requirements

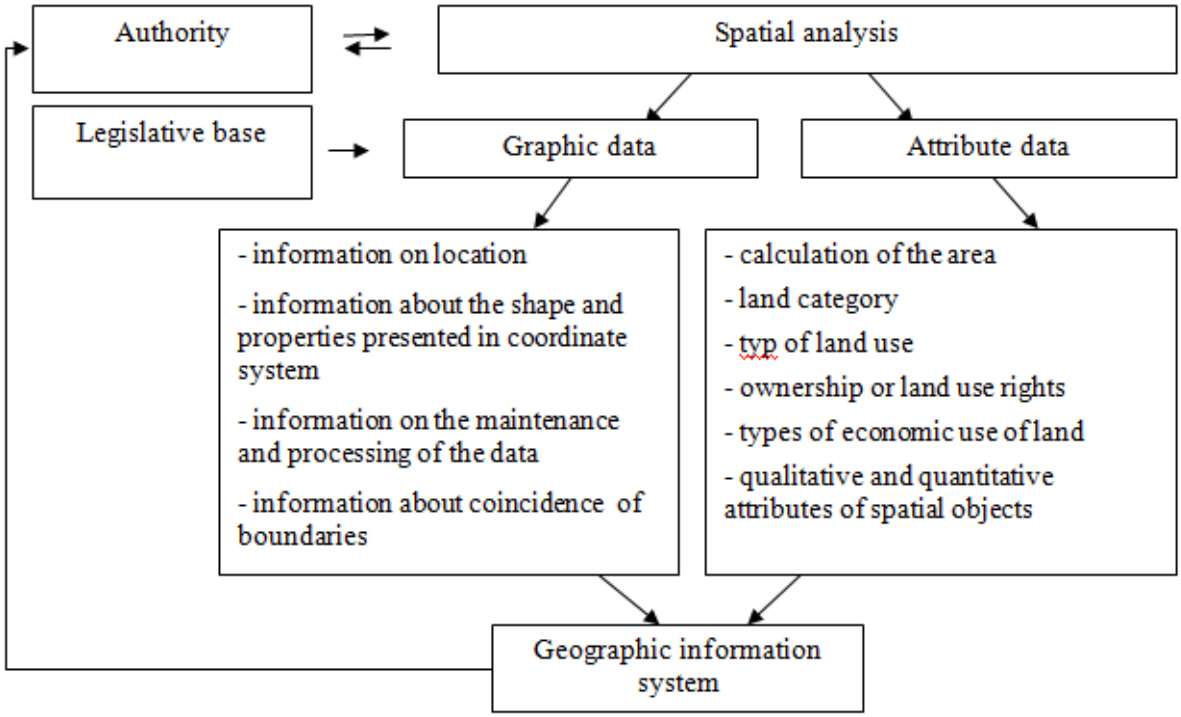

Fig. 3. The block scheme of improving of geographic information system

The graphic data are defined as spatial information, which is considered as the decision-making process, influencing the geographic information system to a large extent. In order to improve the geographic information system, attribute, the data must be performed for calculation of the area of land parcels, determination of land categories, types of land use, ownership rights, land use rights, determination of types of economic use of land, as well as qualitative and quantitative attributes of spatial objects.

GIS technology is formed and improved by technological advances and the growing amount of spatial data. Geographic information systems are being implemented and it opens new possibilities in the field of spatial planning and forecasting. Specialists in the field of land relations are expanding the scope of the use of geographic information systems to solve their specific problems and thereby contribute to the growth of GIS technologies.

Geoinformation technologies allow generating tables in any form, which can be used for database formation. To achieve the progress in geographic information technologies, it is necessary to implement:

- practical implementation of e-government;

- modern software;
- integration of spatial data;
- development of information resources;
- improvement of efficiency of local governments and planning authorities;
- systemic registration and inventory;
- visibility, accessibility and reliability of information.

The improvement of geographic information system based on graphic and attribute data is of great importance for:

- public authorities - to obtain visual information about the value of land and status of land parcels, to make data analysis based on the information on proportion of the right in land, breakdown into land categories, types of land use, etc., to prepare analytical reports on efficiency of land use;
- land services – to identify compliance between cadastral and market value, to provide information services to the public and businesses;
- commercial structures – to obtain information about land parcels and their permitted type of functional use, to form documents in standard format, including the scheme of land parcel boundaries, to perform spatial analysis of the selected territory, to form databases on particular land parcels, to provide informational services to the public and businesses.

The improvement of geoinformation technologies means the introduction and use of modern software for further nationwide development of geographical information systems by multiple approbation and progressive criteria and technologies available in the world community. It will allow to take into account digital graphic and attribute data to use land resources more efficiently.

Conclusions and proposals

1. It is necessary to develop interrelated measures allowing the accumulation of information and its generalization in the relevant geographic information databases at each level of the system based on analysis of spatial data, timely and high-quality collection of primary data on land resources: the quality, quantity, ownership and land use.
2. Formation of geoinformation resources allows not only to improve the spatial system, but also to raise its informational value increasing the interest of agricultural enterprises in geoinformation resources. Thus, further improvement of spatial data through its transfer to automated technology will create favorable conditions for land owners and land users.

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