Improving information support of the cadastral valuation of settlement lands with using GIS-technologies

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Abstract. To solve problems in the field of information support of the cadastral valuation of settlement lands, the article proposes to develop a geographic information system of information support of the subjects of cadastral valuation of settlement lands. The proposed geographic information system includes the results of assessments of the cadastral and market values of land plots and generated assessment cards based on the data obtained, thematic maps characterizing the efficiency of urban land use, ecological land use schemes flowing into the ecological tension schemes of the settlement lands.

When collecting information for the state cadastral valuation of settlement lands (GKOZ NP), inspectors encounter such problems as lack of information about the real estate market, lack of awareness to integrate environmental considerations affecting the value of land plots.

The very specifics of cadastral valuation (and not only the lack and inaccuracy of information in the initial list of valuation objects, but also the use of mass valuation methods, insufficient qualifications of inspectors, etc.) lead to a significant distortion of the value of some objects what entails negative consequences [1-3].

Analysis of the information used in the cadastral valuation of land revealed the following:

- in the collected information there is no complete and reliable information about some objects (including the absence / incompleteness of the address characteristics necessary for accurate reference to cartographic material); inconsistencies of data were revealed in some cases, etc.;
- there is no way to clarify information on the characteristics of some land plots;
- insufficient information to determine the market value of objects on the basis of information on rent;
- inaccurate information about similar objects in the sources of market information;
- a significant distortion of the results of land valuation, when using market prices of single real estate in the calculations;
- the initial information issued by Rosreestr on the objects of assessment is not sufficient to conduct a qualitative assessment [4].
Gathering the initial information required for the GKOZ NP requires a lot of time. However, this stage of the preparatory work is often reduced by instructors, since the general terms of the cadastral valuation are strictly regulated by the customer and the law. Therefore, when checking the information received, all the characteristics of land cannot be clarified. This is due to the fact that the description of real estate objects does not always correspond to the description available in state databases what is especially common in rural areas [5].

The incompleteness of the data obtained is also related to the fact that some indicators are not publicly available. Today, many scientists note the lack of information on the impact of environmental factors on the value of settlement land plots, which is very important for cities. The problem of a comprehensive assessment of the ecological state of large natural-industrial complexes is quite complicated, as it is based on the analysis of a large amount of cartographic information and the use of databases of environmental and economic targets and indicators [6].

Incompleteness and inaccuracy of the initial information used during the GKOZ NP led to an increase in cases of initiation of legal proceedings in relation to the cadastral value of land plots. In order to avoid such situations and to use the full and current information in the future for the GKOZ NP, it is necessary to create a common information base for each subject of the Russian Federation on a single website. This will make it possible to place all the necessary information on one web page.

In urban areas there is a lot of diverse geo coordinated information. It is used by various government services, departments and institutions fragmentarily, in the narrow areas of solving problems faced by specific organizations. There is still no opportunity to assess the situation in the city as a whole, to identify problems relevant to one or another part of it. There is a need to bring together variety of information relating to the city and its structural parts both for a more accurate cadastral valuation and for a comprehensive analysis of the urban territory for more effective management decisions. This problem is solved with the help of modern geographic information technologies. Within the framework of one system, a variety of information should be collected and analyzed (functional zones, transport network, social infrastructure, industrial enterprises, communication lines, etc.). Only synthesis and operational analysis of the complex of digital layers across the city territory will also enable to solve problems associated with the effective functioning of city services and land use planning of the city area [7].

Modern geographic information technologies are the means and methods of obtaining reliable information, on the basis of which qualitatively new solutions and knowledge are formed using dimensional data analysis. Geo information technologies are based on electronic maps obtained as a result of expert and automatic decoding of satellite images and aerial photographs. Such geographic information technologies, including information obtained during field work, observations and expert assessments, enable to organize the data, conduct a comparative analysis, assess and forecast the environmental situation. Due to the fact that geo information technologies are used in the analysis of situations and processes in many areas of human activity, they are an effective tool for a comprehensive assessment of the state of natural-industrial complexes.

GIS technologies can be used in two ways:

- as a general information base, while all analyzes will be carried out using the same methods as at the moment, but at the same time constantly supplement and update the database;
- as a way to analyze the city area in different directions. For this it is necessary to accumulate all the necessary raw information, which after processing will form certain layers of cartographic material.

The number of developed GIS technologies and software products for creating an up-to-date database at the regional level is large. When choosing the most suitable system, there is a need to apply for help of specialists and pay attention to the research of experts in this field.

These activities can be carried out as part of the Digital Economy of the Russian Federation program dated July 28, 2017 No. 1632-r. When digitalizing the economy of the Russian Federation,
the urgent point is the collection and integrated presentation of various information using information technologies to provide individuals and entities with information about spatial structures and objects [8, 9].

To carry out the GKOZ NP in a short time with reliable results, in order to reduce the time for searching for data, it is proposed to develop a unified geographic information system for information support of the cadastral valuation of settlement land (GIS IOKOnp). With the help of this GIS, quick access to information on objects of assessment at the state level in the Russian Federation with a spatial reference will be organized.

The proposed GIS is a system of collection, storage, systematization and processing of information necessary for the state cadastral valuation of urban land. An analysis of the experience of using GIS technologies for solving such problems showed that they are all fragmented and if they carry the necessary information, they cannot interact with each other due to incompatible Internet platforms. The practical application of GIS IOKOnp will significantly increase the efficiency of applying the results of work on the GKOZ NP. Since it is assumed that the GIS IOKOnp should be posted on the Internet and open for general access to information resources, it can be useful for individuals when choosing a place of residence. The recommended structure of the information support system for the state cadastral valuation of settlement land is presented in figure 1.

GIS IOKOnp includes four subsystems:

- data collection;
- preliminary processing;
- GIS IOKOnp (evaluation results);
- delivery of information.

All information collected from the sources presented in the first subsystem undergoes preliminary processing, which includes analysis of cartographic materials, data conversion, document processing. At the final stage of data processing, semantics are associated with cartographic material and, as such, are loaded into the GIS IOKOnp. Visualization of the information will allow working with databases, both for calculating the market value of land plots and cadastral. These data will enable to conduct analytical studies on changes in market prices for land plots of various uses, the formation of price cards will make it possible to display the general picture on the regional land market.

![Figure 1. Flowchart of information support for cadastral valuation of settlement lands.](image-url)
This approach will allow considering the influence of environmental factors on the cost of land, which are not taken into account in the existing methodology. Environmental information will be presented on cartographic material in the form of digital layers by type of negative impact. When maps are superimposed, it becomes possible to visualize the generalized influence of all factors and assess the environmental tension in the area of the subject. Examples of schemes of the ecological state of land use, which are proposed to be included in the GIS IOKOnp, are presented in figure 2 and figure 3.

![Figure 2. The scheme of the ecological state of the settlement lands (by the example of Omsk).](image1)

![Figure 3. The scheme of ecological tension of the settlement (by the example of Omsk).](image2)

At the initial stage of the development of the GIS IOKOnp, existing state geographic information systems and databases that have found application in the cadastral valuation of lands are analyzed and possible directions for using the generalized system are identified.

The geographic information system, based on the mathematical apparatus of relational databases using computer technology and telecommunications, fulfills the following main goals:

- development of scientific and methodological support for the creation of GIS IOKOnp, design of its main structural solutions and system tools for creating IOKOnp;
- establishment of an organization and its functioning technology for the design, implementation, maintenance and development of a geographic information system for the information support of the cadastral valuation of settlement lands.

Figure 4 shows the subsequent structuring of the goals of creating a GIS IOKOnp. At the same time, the first group was obtained by distinguishing the stages of design and operation of IOKOnp as a whole, the second group of goals - aimed at organizing work at specific objects. The third group of goals is determined by the tasks of creating an information support system for specific users of the system.
Initially, the main design decisions and tools for creating the GIS IOKOnp are built. The next step is setting up pilot GIS projects and installing a database update system. The final stage is the study of options and forms for displaying information.

With help of GIS IOKOnp it is proposed to implement the following functions:

- obtaining information on the condition of urban lands;
- assessment of the cadastral value of individual land plots and cadastral quarters;
- maintaining a database of the market value of land;
- assessment of the market value of land on the basis of the cost of land analogue;
- assessment and forecast of economic indicators characterizing the efficiency of urban land use;
- obtaining a series of temporarily distributed thematic maps characterizing the economic efficiency of urban land use;
- schemes for the ecological use of land;
- schemes of price zoning of the city (figure 5).

Thus, the development of the GIS IOKOnp will contribute to improving the accuracy of the cadastral valuation, as well as reducing the time allocated for collecting information from various information resources. A single database will help create an overall picture of the land use of settlements, which will improve the process of territorial management.
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