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GEOINFORMATIONAL SUPPORT MANAGEMENT OF REGIONAL SUBSURFACE USE

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Abstract

The necessity of creating a regional geoinformation system in the field of subsurface use is justified. The main application of the geoinformation system is the creation and storage of various geological and topographic information of various types of geological, geographical and topographic maps, plans, geological sections, remote sensing data and etc. There are considered the possibilities of dimentional analysis of geological data, the creation of geoinformation resources for solving problems of regional subsurface management and the main problems in creating an information system there.The availability and use of a reliable information base for subsoil use management should contribute to an increase in well-grounded and short-term and long-term forecasts, objectivity and a comprehensive assessment of the state of the environment, rational use of mineral resources. In this regard, in order to ensure environmental safety as the main condition for the sustainable development of Buryatia, the most important and urgent task in the modern period is the formation of an integral geographic information system. In this case, the most important organizing principle should be the regional geographic information system, which is necessary for the implementation of specific practical actions and program measures to ensure the environmental safety of the development of mineral resources in the Republic of Buryatia.

Keywords: Natural resources, subsurface management, geoinformation systems

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1. Introduction

Natural resources are interconnected and have a spatial distribution. Making available a resource to one user directly or indirectly affects the interests of another. Under these conditions, the visualization of spatial information becomes the only way to avoid conflicts in the provision of natural resources to users and to ensure the rational use of natural resources. In modern conditions, qualitatively new information tools are required in the study, management, use and protection of natural resources. The use of cartographic methods in solving management tasks is natural, since the map is a means of accumulating and transmitting information, knowledge and education.

Environmental management is the branch of state management that most needs a spatial model of information storage. At the regional level, in the case of solving an interagency management task, government bodies face the problem of the lack of an electronic natural resource map of the territory with which a natural object or ecosystem is connected (Beshentsev, 2018).

2. Problem Statement

Every year, the role of informatization in the field of subsoil use is increasing, based on huge amounts of information and the results of its analysis, managerial decisions are made on a national scale, individual regions and municipalities. The efficiency of finding solutions to numerous problems of subsoil management today directly depends on the capabilities of geographic information systems – the methods of their organization, speed, user experience and other characteristics.

For this reason, the creation and development of a geoinformation system for subsoil use management in the regions of the Russian Federation comes to one of the first places among other problems related to the protection of the natural environment and rational use of natural resources.

When creating an information system for managing the subsoil use of a region, the problems of collecting, storing, sampling, analyzing and displaying data should be solved in the development of cadastres of natural resources of territories, solving problems of territorial administration, conducting environmental monitoring, conducting a geoecological forecast, identifying and mapping environmental risk zones and many others. management tasks.

The complexity of creating a single information space in the field of natural resource use of the territory involves the fact that departments use in their work various cartographic materials made at different times, mainly on paper. Most natural resources departments do not have electronic maps. Forestry management departments, local land management departments use old cartographic materials in the absence of digital cartographic models. In case of necessity to solve an interagency management task, the combination of objects is usually carried out "manually" and does not exclude errors. The result of this information discrepancy are examples of conflicts when granting land plots for mining (after obtaining a license for the subsurface use, approval of the boundaries of the land plot and starting the work, it turned out that the boundaries of land plots were overlaid on the lands of other users or the lands of forest or water fund).

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3. Research Questions

In modern conditions, qualitatively new information tools are required in the study, management, use and protection of natural resources. The use of cartographic methods in solving management problems is natural, since the map is a means of accumulating and transmitting information, knowledge, and training.

4. Purpose of the Study

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5. Research Methods

The purpose of the information system is to provide sufficiently effective opportunities for:

- immediate collection and transmission of measurement data for processing and analysis;
- maintaining database and integrating disjointed databases;
- statistical representation of primary information about objects for transfer to various levels of administrative and economic management;
- support and unification of the used classifiers of factual and cartographic information;
- spatial modeling and construction of mathematical models of objects based on monitoring data;
- solving problems of assessing the state of the studied objects by mathematical modeling methods to analyze possible changes in the environmental situation and develop recommendations for managing the process of subsurface use (Lurie, 2016).

It is necessary to implement a set of measures to create an information block for subsurface management, consisting of a three-level model:

- lower — environmental monitoring;
- medium – geoinformation system (accumulation, aggregation and synchronization of data, forecast of the state of the natural environment, target information development for decision-making structures);
- higher – automated management system (analysis, planning and regulation of subsurface use, development of specific scientific and practical recommendations for making immediate decisions).

Within the framework of this model, practical measures to create the block should include:

- selection and justification of a unified methodology for collecting, inventorying and classifying information;

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- coordination and selection of the methodical instrument that allows to implement the unified transfer of information, and the ordering of data of different content and samples;
- regulation of information flows of resources and environmental protectionkinds;
- creating a database for two interrelated blocks: cartographic and thematic:
- creating a base of models of the relationship of various components of the natural environment and working out its use in the process of making management decisions.

Each of these levels of the technology to create a subsurface management system has its own special roles.

The main purpose of monitoring is to obtain objective and immediate data on the state of the natural environment components on the number of emissions (discharges) of harmful substances, on emergency and bulk emissions (discharges) of pollutants, on high and extremely high levels of pollution (Reimers, 2016).

Through monitoring the following are identified:

- specific points and sources of environmental pollution;
- the most significant factors, processes, and phenomena that cause significant changes in the environment;
- the need to choose the best ways, methods, techniques and means of controlling and monitoring the environmental state;
- the most acceptable frequency and control mode (Makar & Glushkova, 2017).

The most modern and effective tool for working with spatial information are geographic information systems (GIS). GIS allow you to integrate disparate information about objects, showing it in the form of thematic maps and reports. Analytical tools of GIS make it possible to apply both statistical methods of processing numerical data and cartographic research methods. An important advantage of GIS over traditional maps is the ability to visualize various information about natural resources in the form of thematic maps. GIS allow to create layers with different characteristics and combine these or other layers in different ways, depending on the management task that needs to be solved (Berlyant, 1997). GIS implements a flexible approach to the format, scale, and classification of the visualization result, combined with high production speed (Lovtsov & Black, 2012).

The reason is that within the departments cartographic materials are formed without taking into account the need for interaction between the implementation of individual powers in the field of natural resources management (Lurie, 2017).

To create GIS in the field of subsurface use, it is necessary to have a clear understanding of the tasks that follow from its specifics. Cartographic information should be based on the fact, that in the subsurface management system for each natural resource it is necessary to ensure research, use, reproduction and protection. These sections are fixed by law. Accordingly, each direction has its own set of characteristics. In order to provide for the use a natural object or part of it, written approvals from other agencies are required, which is highly time-consuming. The creation of a unified regional GIS "Mineral resources of the

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region" will allow to obtain the necessary information for decision-making and will significantly reduce the time of approvals for the provision of natural resources for use. The first step towards creating such system for solving management tasks was the creation of a unified information system of the regional minerals. Management in this area consists of the implementation of the following functions: the provision of subsurface areas for use and control over their rational use. To do this the information system should allow to solve the following tasks: 1. Detailing spatial information by administrative districts – synthesis of spatial and attribute information to analyze the state of the resource base by districts, storing information by the number of licenses issued, developed and undeveloped deposits and occurrences, assessment of the resource potential of a particular area. 2. Identification of promising areas for exploration and development. 3. Evaluation of the volume and efficiency of the use of minerals, and the selection of objects according to the specified parameters and comparative analysis of the parameters of the objects of interest. 4. Development of license terms. 5. Analysis of the position of the projected objects relative to the existing ones and visual display of the results of the analysis. 6. Monitoring the implementation of the terms of license agreements in matters of compliance with the territorial boundaries of licensing areas, and rational use of territories of the licensed areas. 7. Preparation of cartographic products of various subjects.

Geological and cartographic modeling allows to solve a wide range of management tasks, including: consider the issues of the state of the mineral resource base. The integrated system made it possible to improve the efficiency of geological control, identify possible illegal mining sites, and analyze scenarios for the development of the resource base (Rudko et al., 2011).

The information system allows to store documentary and attribute data on licenses, license obligations, knowledge, resource base, payments, as well as on auxiliary objects, information about the spatial position of objects in digital form (Kashchenko et al., 2012). Data is stored in attribute tables in the following blocks: "Subsurface users", "Licenses", "Deposits", "License areas", "Documents", "Reference information". Constantly incoming new information is recorded in the GIS. The listed actions were carried out to create a geoinformation model of subsurface use management.

In addition to spatial tasks, GIS allow to use an unlimited range of indicators (quantitative and qualitative) to characterize a geographical object and quickly introduce new attributes (Blinovskaya & Zadoya, 2016). So, in the attribute tables that characterize various points of a natural object, in addition to standard information, it is possible, for example, enter data on economic value. This will allow the authorities to quickly respond to changes in market processes, define a flexible policy and form the right strategy that will open the way for rational subsoil use.

Further development of the geoinformation system, the creation of an information and expert system for ensuring environmental safety and rational subsurface use for management purposes should be carried out in three stages.

At the first stage, a project for the organization of the system is developed, which includes the following aspects:

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- definition of specific goals and objectives of the system;
- analysis of existing databases on the state of the environment and natural resources, identification of the structure and scope of available and accumulated information, assessment of the scope of work;
- selection and justification of environmental safety criteria and, based on them, the development of the structure of the necessary databases, assessment of the scope of work on modifying the structures of existing databases;
- development and coordination of the structure of information relations, exchange flows, regulation of access to information and etc.

At the second stage, the conditions for the functioning of the system should be created:

- databases in organizations are developed or modified, the processes of forming an integrated database are started;
- a unified cartographic material are applied or developed for use by various organizations as part of geographic information systems (for the development of the natural resources inventory, environmental monitoring);
- the necessary equipment of all objects of the system by means of computer technology and communication are made;
- communication between all objects of the system is organized;
- other organizational and technical works are carried out in accordance with the developed project of the system.

At the third stage, further development of the system should be organized:

- development of a distributed database;
- created (developed or acquired) libraries of mathematical models and algorithms for data analysis for parametric support of methods of survey and forecasting of the environmental situation;
- development of the use of the results of modeling and analysis of the environmental situation in the process of making management decisions;
- further expansion and equipping of the system.

The system being formed should have an open architecture, i.e. it allows to connect new objects to it, exchange information with objects of other systems or individual organizations.

6. Findings

Based on the above, the following conclusions can be drawn:

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1. The information system makes it possible to increase the efficiency and reduce the time for solving management tasks in the field of mineral resources use.

2. The creation of GIS for subsurface use management should take into account the need to ensure rational use of natural resources and contain the information reflecting the areas of research, use, reproduction and protection.

3. The main purpose in the formation of geoinformation resources in nature management for large territories is to overcome departmental fragmentation, transfer departmental cartographic support to a unified digital basis.

4. It is not possible to create a high-quality unified regional GIS by combining various industry GIS. It is extremely necessary to create a unified cartographic space of the region, on the basis of which GIS of various directions should be created**.**

7. Conclusion

The availability and use of a reliable information base for subsoil use management should contribute to an increase in reasonable and short-term and long-term forecasts, objectivity and a comprehensive assessment of the state of the environment, rational use of natural resources

Thus, in the matter of ensuring environmental safety as the main condition for the sustainable development of Burytia, the most important and urgent task in the modern period is the formation of an integral geographic information system.

The main factors determining the relevance of this issue in the current period in the development of the regional economy are: rupture of the established system of intersectoral and intrasectoral links between subsoil use objects, which fundamentally undermines the foundations for the integration and combination of industries and waste disposal; a steady increase in the cost of environmental protection measures and, in some cases, a complete cessation of nature protection activities; a general rise in the cost of using most types of natural resources, leading to a deterioration in the economic indicators of economic objects; deterioration of the ecological situation in problem areas of the region and the emergence of unaccounted for environmental consequences; low efficiency of the existing subsoil management system, due to the lack of a single unified information base on the state of the natural environment; lack of alternative public ecological control over the state of the environment, due to the information "vacuum"

At the same time, it is known that subsoil use includes various types of specific socio-economic activities, and general categories developed in the field of economic and social development management are applicable to it as an object of management. Improving the management of subsoil use should go in the same directions as for the entire mechanism of managing the natural and economic complexes of the region and the country.

In this matter, the most important organizing principle should be the regional geographic information system. It is necessary for the implementation of specific practical actions and program measures to ensure the environmental safety of the development of mineral resources in the Republic of Buryatia. Today, it is not general considerations about the deterioration of the ecological situation in the region as a whole that are important, but the accumulation of quantitative indicators on the state and use of mineral resources, pollution and violations of the components of the natural environment up to the level of an individual

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enterprise, the degree and nature of economic activities to restore the quality of the environment and reproduction natural resources.

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