Information support for the management of forest lands, considering the development of a methodology for assessing the rational use of forest areas

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Abstract. The article considers the issues of information support for forest land management, considering the development of a methodology for assessing the rational use of forest areas. Information support is the usage characterized by an indicator of rational use of land, which determines the greatest effect of achieving the main goal of land use, considering its full-fledged organizational and legal state (provision) and maintaining the specified levels of other indicators (environmental, technical, etc.). In connection with the practical significance of the existing system, the creation of a methodology for assessing the effectiveness of the use of forest plots is a necessary component of the integrated functioning of the forest complex system based on the principle of rational use of plots. The article concludes that the issues of informatization of forestry are in the context of the issues of rational use of forest areas since informatization of the industry is possible and feasible only based on information systems created and created today. Taking into account forest areas and having information about them as an element of the system of organizational and legal support for the rational use of forest lands is the key task of the country in the development and integrated functioning of forest lands.

1. Introduction
The issues of the process of forest inventory and monitoring, storage of big data information in cloud system media have become relevant in connection with digital technologies in various fields of activity of Russian sectors of the economy [1].

The land serves as the basis for the development and distribution of all branches of the national economy, which is the subject area of many sciences. The key task of land management, cadastre, and land monitoring is to ensure sustainable and rational land use.

At present, the lands of the forest fund occupy 65.8% of the entire territory of the country, performing protective, sanitary-hygienic, health-improving, cleaning functions. In addition, the forestry industry occupies an essential place in the country's economy and ensures its dynamic and comprehensive development on the world stage.

In connection with the practical significance of the existing system, the creation of a methodology for assessing the effectiveness of the use of forest plots is a necessary component of the integrated functioning of the forest complex system based on the principle of rational use of plots.
The significant content of the principle of rational use of land is reflected in the classic works on land management and cadastre Varlamova, A. A., Volkova, S. N., Komova, N. V., Sulina, M. A. The author of the well-known textbook on land law, Erofeev, B. V. defines rational use as the goal of state land use management. The goal will be achieved using the combination of state register databases, such as the forest register, the water register, the unified state register of real estate, also through the application of documents for the development, protection, and protection of forests, forest management documentation, and information obtained as a result of cadastral activities. An objective assessment of the efficiency of forest land use consists in the transition of qualitative signs of rationality to a system of quantitative and qualitative indicators based on the creation of technological solutions for the automation of cadastral work on the territory of individual forest districts [2].

Key principles of forest management are shown in Figure 1.

![Figure 1. Key principles of forest management](image)

Several management mechanisms can be distinguished, each of which interprets the need for information support of forest lands in its own way (Figure 2).

![Figure 2. Management mechanisms that interpret the need for information support of forest lands](image)

The current forest management system has its own problems associated, first, with the economic component of the system under consideration.

Forest users incur unreasonable economic costs, use the natural environment as a storehouse of natural resources to ensure sustainability in the system of entrepreneurial activity. There is a lack of compulsory state cadastral registration of forest areas, a unified consolidated information register, a regime for the permissive use of forest and land resources.

In this work, rational land use is understood as the use characterized by the rational land use indicator, which determines the greatest effect of achieving the main goal of land use (for example, the maximum of the objective function that determines the economic efficiency of land use), considering its full
organizational and legal state (provision) and maintaining the specified levels other indicators (environmental, technical, etc.) [3].

Today, the key issue is the task of developing a methodology for assessing the rational use of forest areas, which requires a theoretical and practical solution using the appropriate indicators and algorithms for land and forest use.

2. **Materials and methods**

Rational forest management is a complex of several indicators, such as organizational and legal, technical, economic, and environmental, which are closely interconnected with each other and constitute a sustainable complex system (Figure 3).

The level of rationality of land use for a particular site is understood as an integral indicator, which is calculated according to a specific assessment methodology and determines the measure of its rationality concerning a given site or sites in the established norm [4].

When forming a methodology for assessing the rational use of forest areas within the forest fund lands, we have identified the following main indicators: organizational and legal, environmental, technical. Such a grouping corresponds to the main directions of land and forest management, meets sustainable nature management, regulatory legal documents, and relevant management practice.

![Figure 3. Indicators of sustainable forest management](image)

It should be noted that the indicator in the work under consideration is defined as a parameter for assessing the qualitative and quantitative state of forest management in specific areas, which reflect the principle of rational land use. Depending on the composition of the assessed areas of the object that is subject to study (for example, forestry; forest land; forest land plots), the number of such indicators is determined.

The proposed algorithm for assessing the rational use of sites (Figure 4) should be formed and based on several principles that reflect the essential side of the indicators of rationality.

These principles, in our opinion, include:
1) simplicity and clarity of the application of indicators of rationality for persons interested in forestry;
2) the limited number of several indicators (criteria) that characterize the key aspects of rational forest management and nature management;
3) the potential for using reliable data in assessing forest use;
4) the natural connection of rationality indicators (criteria) with the main regulatory legal acts that determine the achievement of the goals of forest planning, reproduction, development, and protection of forests, the most important directions of state policy in the field of forestry;
5) the constructiveness of the scheme for calculating the indicators of rationality for the objects of assessment (for example, a forest area, forestry, a separate constituent entity of the Russian Federation).

**Figure 4. Algorithm for assessing the rational use of forest areas**

The data of each block of the algorithm represent information from the documentation of forest planning, protection, development, reproduction, and protection of forests, as well as data from various kinds of registers.

Rational use acts as an efficient-economic and socially-grounded mechanism, following which the article determines the initial provisions of sustainable and integrated management of forest resources [5].
3. Results and Discussion
Forest planning and design are important tasks to ensure sustainable development of territories for the rational use of forest areas, which is subject to several conditions presented in Figure 5.

![Figure 5. Factors considered when using forest areas](image)

Conservation, renewal, increase in productivity and use of forests

Features of the forest structure

Forest growing conditions

Assessment of the natural-ecological, social and economic significance of forests

Economic accessibility of forests

Prospects for the possible development of regional forest complexes while maintaining the continuity of the use of forest resources, all ecological, social and economic functions of the forest

Consider the methodology for assessing the rational use of forest areas, taking into account the above factors (Figure 6).

The proposed methodology is a structural hierarchy of quantitative and qualitative indicators proper, and indicators that reveal their criteria and content. The methodology allows to determine the "peculiarity" of forest use, highlights the need to perform cadastral work on the lands of the forest fund as an important condition for the implementation of organizational and legal measures and the preservation of federal property. In general, the methodology makes it possible to reflect the research results that were used as a methodological and informational basis for a comprehensive solution of several necessary tools [6]. These include the preparation of documents to the procedure of the state cadastral registration of forestries, the effectiveness of the implementation of managerial decisions, the assessment of the quality of the development of forest areas.

Fulfillment of the goal of rational use of forest areas, first, should be based on obtaining reliable information about such lands using the methods of cartographic display of the conditions of any considered territory [7]. The set task is realizable and feasible only if there are industry maps and methodologies consistent with each other. This is often very difficult due to the simultaneous manifestation of individual and integral features of the structure and functioning of landscape components, different spatio-temporal scales of changes in their properties.

To simplify the solution of the problem, remote sensing data (aerial photographs, scanner spectrozonal images of LANDSAT, SPOT, MODIS, Aster, etc.), which contain information on the structure and properties of the modern landscape cover, including over a vast territory, and can be successfully used for planning territory [8].

The spatial organization of forest areas is an important component when considering the issue of rational use of forest lands based on the integrated application of space images. Figure 8 shows the algorithm for processing combinations of radar and optical images. It should be noted that the result of processing is the prepared thematic maps-schemes of the identified changes in forest lands.
Following the algorithm for processing combinations of satellite images at different times to detect changes in forest lands, a synthesized image is created under the permissible combinations indicated in Figure 7. The information obtained with the help of multi-temporal images is primarily used to determine the indicators necessary for monitoring forest lands for further rational use of such lands.

**Figure 6.** Methodology for assessing the rational use of forest areas
Figure 7. Algorithm for processing combinations of satellite images at different times to detect changes in forest lands

4. Conclusion
The solution to the current problem, such as the application of the principle of "rational use of land" to assess the effectiveness of the development of forest areas within the forest fund lands, should primarily be based on the transition of the qualitative content of the specified principle into the calculation algorithm. The condition of the assessed site, as analyzed above, is assessed by four indicators: organizational and legal, environmental, and technical. Each of the indicators requires a certain base of information and information from state registers (forestry, real estate cadastre). The list of the required information is presented in Table 1.

The assessment of the rationality of forest management is carried out in the software product "Assessment of Rational Use". The main functions of the program, which make it possible to form a single set of information about forest areas are listed in Figure 8.

The “Assessment of Rational Use” program makes it possible to assess the rationality of the use of a forest area from the standpoint of recognizing its development as satisfactory or unsatisfactory within the boundaries of forestry and (or) within the boundaries of several forest areas [9].

This program makes it possible to increase the efficiency of the executive authorities of the constituent entities of the Russian Federation, separately taken forestries in the field of control and accounting for the proper use of land and forest resources. The “Assessment of Rational Use” program is a key tool for accounting for the development of forest areas, and most importantly, in conditions of a strong anthropogenic impact on forest areas, it allows to rationalize the process of using forest lands.

The issues of informatization of forestry are in the context of the issues of rational use of forest areas since informatization of the industry is possible and feasible only based on information systems created and being created today. The process of information support for forest land management should cover the entire complex of forestry, from separate independent forestry to the federal level to support the activities of all groups of people in the field of rational use of forest lands [10]. The infrastructure of the forestry industry needs a comprehensive revision of the existing information array of forest areas within the boundaries of the forestry. On the territory of our country, there are all the prerequisites for creating a stable base of information support for the forestry complex, especially since work in this area is already being actively pursued in the Russian Federation. This work makes it possible to consider forest areas
and have information about them, as an element of the system of organizational and legal support for the rational use of forest lands.

Table 1. The list of the required information.

| № | indicator                                      | criterion                                                                 |
|---|------------------------------------------------|---------------------------------------------------------------------------|
| 1 | organizational and legal                       | forest management (forest inventory);                                     |
|   |                                               | - cadastral accounting                                                   |
|   |                                               | - registration of the right                                              |
|   |                                               | availability of documents:                                               |
|   |                                               | - forestry regulations                                                  |
|   |                                               | - forest development project                                             |
|   |                                               | - reclamation project                                                    |
|   |                                               | - forest conservation and protection report                              |
|   |                                               | - forest declaration                                                    |
| 2 | technical                                     | volume of forest use                                                     |
|   |                                               | type of forest use                                                       |
|   |                                               | compliance of the information of the registers:                         |
|   |                                               | - location                                                               |
|   |                                               | - land category                                                          |
|   |                                               | - designated purpose of forests                                          |
|   |                                               | - permitted use                                                          |
| 3 | ecological                                    | forest protection measures                                               |
|   |                                               | forest protection measures                                               |
|   |                                               | measures for forest reproduction                                         |
|   |                                               | deforestation                                                            |
|   |                                               | damage and death of forest plantations:                                  |
|   |                                               | - forest fires                                                           |
|   |                                               | - contamination with radionuclides                                        |
|   |                                               | - damage by insects                                                      |

Figure 8. The main functions of the “Assessment of Rational Use” program

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