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**THE MAIN DIRECTIONS OF THE DEVELOPMENT OF FOREST MANAGEMENT AND METHODS OF FOREST INVENTORY IN BELARUS**

The main tasks of the state program of the development of forestry in Belarus are considered in this paper. The analysis of the used methods of forest inventory, production planning and cartographic materials as well as the technologies of forest management in the Republic of Belarus are presented in the given work. The review is carried out and the main directions of development of inventory methods and forest inventories are marked, as well as the use of materials of air and satellite images (including radar and lidar) in the near and far are presented. Some information and geographic information systems are described, which are used in the forestry sector in different countries.

The features of management branch of agriculture and planning of economic activities are considered in the Republic of Belarus. The basic requirements are presented, they are necessary for the functioning of information system of control of forest management: the accuracy of forest inventory data and planning and cartographic materials; improving the efficiency of the forest inventory design and the current business planning: accounting of forest management activities, making the current changes and update information; assessment of the effectiveness of business establishments. The main directions of the development of the system of forest management in Belarus are suggested that provide forestry sector with reliable information of the status and trends of the forest fund, increase the efficiency of the forest inventory design, planning and evaluation of the current effectiveness of management activities.

**Key words:** forest management, forest inventory, information systems, continuous forest management, methods of sampling forest inventory.

**Introduction.** One of the main tasks of the “State Program on Forestry Development of Belarus for 2011–2015”, approved by the Council of Ministers No. 1626 of 03.11.2010, is the modernization of forestry production through its technical and technological re-equipment, introduction of modern information technologies and aerospace methods, new software, a unified geo-information system of forestry, forest electronic measuring instruments.

Among the areas of forest management one can mention the increase of accuracy in determining the reserves of forest resources; the use of digital aerial and satellite images with a high resolution; preparation of digital forest maps in a single geographic coordinate system, etc. The solution of these problems was provided by the “Strategic Plan for Forestry Development of Belarus until 2015”.

To achieve the goals in the early stages in 2001–2002 the specialists of the Department of cartography in the information and computing center of the RUE “Belgosles” and RUE “Belgeodesy” developed the technology of the automated planning and cartography of forest inventory materials, and by 2013, digital maps are created for all the forestry enterprises of the republic.

Almost all forestry enterprises in Belarus have implemented the information system (GIS) “Forest Resources” (FORMAP), carried out the computerization of the forestry sector, developed the information system for forest management (ISFM).

In 2012, the industry mobile geographic information system on the operating system (OS) An-

droid has been designed to develop a common multi-level geographic information system of the Forestry of the Republic of Belarus “GIS-Forest”, designed to function at the levels of forest, forestry, is in the final stage.

However, not all the directions of forest management provided by the former strategic plan, are successfully realized. Thus, in IFMS only part of workstations is implemented and used, the technology of continuous forest management is implemented at the level of making changes to the current final data, selective forest inventories and district forest management methods are implemented at the level of pilot projects.

**Main part.** The analysis of the current status and trends in the development of forest management and forest inventory of different countries shows that the main criteria for determining its application are:

- the objectives of inventory (usually a current or long-term planning and its level: a separate company, region, etc.);
- the proportion of forests in private and public property;
- the level of the development of the country.

The general requirement for the data obtained in all countries is to achieve maximum accuracy at minimal cost. In general, there are two levels of forest inventory, differing in technology implementation, objectives, obtained results and their use:

1) forest fund inventory of the state and individual regions. The purpose of the inventory – the formation of the national forest policy, the prepara-

tion of statistical data. It is carried out usually by selective mathematical and statistical methods at the ministerial level (offices, departments, agencies) of forestry. It is used in many countries (Austria, Finland, Sweden, Canada, Germany, USA). In Germany, an inventory of federal lands can be attributed to the same level. The main reason for the introduction of selective methods in Western Europe was the need to obtain reliable information on the forests condition and relatively low cost of work;

2) the inventory of forest fund agricultural enterprise or individual forest-owner. The purpose is obtaining of reliable detailed information on the forest fund for the current and medium-term forest management planning, mapping and books on taxation descriptions of plots. This involves an inventory of each planting, which is performed by various methods both visual and selective. Large enterprises can also carry out an inventory by selective methods to obtain statistical data.

There is no fundamental difference between these methods of inventory. The main differences are in the purpose of using the results of the inventory, space and the homogeneity of inventory objects.

The materials of remote sensing of forests from air and spacecraft are widely used in forest inventory. An important feature of the latest generation of imaging systems is a high precision of image coordinates, comprising about 2–3 m.

The materials of radar (RLS) and lidar filming have been increasingly used in recent years. The synthesized images obtained on the basis of radar data in different ranges and different polarization, reveal the features of the forest canopy, and laser location data – receive high-precision three-dimensional images of the canopy of the tree stand.

However, it should be noted that the basis for the inventory and planning of economic activities in any country is a developed modern information systems based on databases, GIS, automated methods of analysis (including spatial), modeling, forecasting and optimization. It is Hugin – forecast system development of the dynamics of forest resources and forest planning for individual regions or large forest enterprises (Sweden), NIMRUM (Sweden), MetINFO (Finland), AVVIRK3 (Norway), Timber RAM and For PLAN (USA), etc.

In the context of the Republic of Belarus, where all the forests are state, forest management works are financed by the state, the forestry and logging activities are not allowed without a management plan, all information is concentrated in a single organization, there is a unique opportunity to summarize data for all forestry institutions at the regional level or the country as a whole. It also allows us to organize a clear record system of forest management activities, logging, updating of data of the wood fund, receiving of reporting documents of

any level. The main condition for the use of information systems is the accuracy of the information stored, so the issues of improving the accuracy, efficiency, design and management, reducing the cost of forest management are still relevant.

The methods of forest inventory should effectively use the advanced features and technologies, to be fully aligned with the standards of development work on the forest taxation and funds allocated for this purpose. It is necessary to ensure the rational combination of various methods of taxation, depending on the economic value of forests [1, 2].

The forest is the object of human activities, planning of which is based on cartographic databases, formed as a result of forest inventory during the carrying out basic forest management. In fact, the database is an immediate (static) snapshot of a dynamic object, and this object is the forest. To ensure a constant effective use of the information collected for the purpose of forest management during the revision period a set of measures for its timely updating is needed. The technology of continuous forest management and forest growth models can be used for this purpose. On the other hand, government forestry institutions are required to maintain documentation on all the activities that are carried out, which makes it possible at the appropriate skill level of employees also to perform updating of data.

The development strategy of forest management in Belarus is aimed at further development of the information support of forestry, improving the accuracy of forest taxation works, strict control over forestry activities and data updating, increasing the efficiency of current and future planning. The key is the technology of basic forest management, conducted with a return period of 10–15 years. To update the data the electronic record of the performed activities is made and making ongoing changes in the distribution database under DBMS ORACLE, comprising integrated cartographic and thematic data on forest fund and forest resources, soils, road network, forest users, hydrography, administrative boundaries, as well as other useful information. As a client application a single multi-level geographic information system “GIS-Forest” will be used, which provides the access to authorized users and automated processing of data to make effective management decisions.

Minimum units of information system will be plots with a maximum continuity of borders and taxation indicators of plantings on the basis if which permanent economic areas will be formed in future. The data on plots are updated during forest management activities or basic forest management, and the information held at different times on economic events and indicators of the dynamics of

taxation plantings, is collected and stored throughout the growth of crops. This enables assessing the consequences of the economic impact on specific planting, improving forest management planning and will create conditions for a gradual transition with minimal cost to the divisional forest management method. For the successful functioning of the system it is necessary to ensure maximum compliance of the stored data with the actual state of the plantings at the level of each sector (economic plot), and the exact spatial attachment.

The main and most important directions of the development of the system of forest management and forest inventory at the present time are as follows:

1. Ensuring the accuracy and reliability of the data:

- the development of technologies and methods of forest inventory and methods of forest taxation;

- the development of automated systems and methods for the interpretation of remote sensing materials to monitor the current status and changes of forest fund;

- the development of technology of producing planning and mapping forest inventory materials that enhance their accuracy.

2. The hardware and software system of forest management and forestry:

- the development of information management system of the forest fund and forest resources, the integration of cartographic and thematic information;

- the development and implementation of GIS technologies into the forestry institutions, ensuring their functioning and interaction.

3. The creation of an effective accounting system and current forest management activities as well as the data updating.

4. Effective planning:

- the improving the system of forest management planning, design solutions and increase the level of automation;

- the development of control systems of project activities, supervision.

5. Qualification and interest of workers in the use of innovation:

- the targeted training decision-makers to introduce in formation systems, data bases and GIS;

- the development of measures to stimulate forestry specialists to innovate.

6. The improvement of forest inventory, the development of automated modules of cadastral valuation of forests on the basis of GIS technologies.

**Conclusion.** Analyzing the modern technology of forest management in Belarus, one can conclude that it is necessary to continue the development of the improvement direction provided by the “Strategic Plan of Forestry Development of Belarus until 2015” and the “State Program for the Development of Forestry of Belarus for 2011–2015”, taking into account modern remote sensing technologies, geo-positioning, forest taxation of electronic tools, apparatus, computer hardware and software.

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