FOREST MANAGEMENT, FOREST INVENTORY AND INFORMATION SYSTEMS IN FORESTRY

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ECONOMIC EFFICIENCY OPTIMIZATION OF FOREST SPECIES COMPOSITION OF MINISTRY OF FORESTRY

Forests and forest resources are the main renewal natural resource in Belarus, the important composite of the ecological-economic safety of our country. One of the main direction of the increase of ecological and economic forest possibilities is the optimization of species and age-classes structure of forests. Optimization of species structure of forests including that of Ministry of Forestry has been made according to materials of the soil-site forest inspection, state assessment of forest, the data from GIS "Forest resources", ecological-economic valuation of forests in the forest cadastre.

Economic effect of optimization of forest species structure is being determined on the database of state assessment of forests, optimal forest species structure, timber volumes of reforestation pine, spruce and oak stands instead of the birch stands. Total annual economic effect of forest species structure optimization is 101 billion rubles. The greatest economic effect for one hectare of forest accounts for enterprises of Mogilev (19.0 million rubles) and Vitebsk (18.3 million rorubles) forestries. The economic efficiency of forest species structure optimization is 3,3%.

Introduction. Forest and forest resources are an important renewable natural resource of Belarus, one of the main factors of environmental and economic security of the country. The main direction of improving economic and environmental potential of forests is optimization of their species and age structure. Uneven age structure, irrational species composition of forests, out of date economic relations in forest management and pricing are the reasons for low income of forestry. Belarus is rich in forests. They occupy 40% of the territory. In 1600-1800 forest covered about 50-60%, while in 1944 percentage of forest land dropped to 20%. The age structure of forests has changed significantly. Middle-aged stands dominate (47.4%) and mature forests are not enough (11.6%). Percentage of pine forests decreased by 7% from forested area (50.2%) due to the increase in the share birch plantings to 23.2%. Coniferous (pine and spruce) occupy only 60.3% of the forested area. In Poland (9 million ha of forests), conifers occupy 80% of the area, but only 5% of birch. As a result, forestry of Poland is a self-sufficient one with annual additional revenue to the state comprising up to 20-30 mln. USD dollars.

Main part. Optimization of forest species composition of Ministry of Forestry has been performed on materials of soil typological survey of forests, according to state records, GIS "Forests" economic assessment of forests and forest resources in forest inventory [1].

Design of optimal structure of forests has been fulfilled by computer programs taking into account the following restrictions and options:

1) data of state forest inventory in 2008 - distribution by age groups, dominant species, completeness and forest types;

2) all pine, spruce and oak stands are considered to be target plantings the given soil and cannot be replaced;

3) in dry lands, 20% of birch and black alder plantations are not fallen but remain in order to change species, improve soils and conserve biological diversity. Aspen forests are also cannot be transformed;

4) selection of target tree species (pine, fir or oak) in deciduous birch, black alder and aspen stands are determined by analyzing the distribution of areas of these plants by groups of forest types and ensure their compliance with undergrowth species composition;

5) optimal age structure of forests has been established according to the state forest inventory in 2008, soil-site forest survey, optimal age forest structure of Ministry of Forestry and GPLHO (research scientists).

The area method of forest management includes the transfer of forest management methods in forestry to the target forest growing within the boundaries of the permanent economic areas.

The transition to the optimal age structure of forests will require increasing the area of the Min-

istry of Forestry (shares) of pine forests by 8.7% and birch forests of 11.4% (Table. 1). Especially significant changes should take place in Vitebsk (pine area increased by 9, and birch reduced by 13.7%) and Mogilev (+ 10.3% of pine and birch - 14.1%) GPLHO.

Table 1

**Optimal species structure
of Ministry of Forestry forests**

GPLHO	% of species on forested area						
	pine	fur	oak	birch	black alder	aspen	others
Brest	62.2	3.3	5.8	11.4	14.9	0.6	1.8
Vitebsk	38.2	22.7	1.4	17.1	5.8	3.7	11.2
Gomel	70.0	1.6	9.1	8.8	8.3	0.9	1.2
Grodno	68.5	12.9	3.8	5.6	6.4	1.4	1.4
Minsk	61.5	16.9	2.6	9.5	6.4	1.7	1.4
Mogilev	59.2	18.0	4.8	7.9	6.3	2.8	1.0
Ministry of Forestry							
Inventory data of 2008	50.5	10.4	3.6	21.9	8.2	2.1	3.3
Optimal %	59.2	12.6	4.7	10.5	7.8	1.9	3.3
Changes, %	8.7	2.2	1.1	−11.4	−0.4	−0.2	0.0

Optimization of species and age structure of forests is a long process (30-50 years). Practically during this period it is necessary to replace birch forests by coniferous and hardwood cuttings through reconstruction and reshaping or clearcuts of low-density and middle-aged plantations (900 thousand ha, including 15-20 thousand ha of birch forests annually).

Economic evaluation of forests and forest resources makes possible to determine economic potential of forest fund of any forestry.

For each forestry there have been fulfilled economic assessment of timber and non-timber resources, environmental functions of forests. When optimizing species composition of forests there is an increase of the economic potential of wood resources (stumpage value of standing timber).

Economic potential of forest resources indicates the possibility of forestry tonuse them for the production of forest products (round wood, sawn wood production, by products), its implementation and income from forestry.

Economic potential of wood resources can be increased by opmizing species and age structure of forests, increasing the productivity of forest stands, the size of the main and intermediate forest management. Economic potential of forests in forestry enterprises is different, because it depends on growing stock, species and age structure of forests, forest land fertility [2]. In Rechitsa forestry, the seventh of woodland is presented by oak plantations, half of the forests being pine stands, so economic

potential of forest resources of Rechitsa forestry is high and is estimated as 250 thousand rubles per 1 ha of forested area, that is 1.6 times more than in Smolevichy forestry (157 thousand. rubles).

Economic effect of optimization species composition of forests is determined according to the Ministry of Forestry state forest inventory in 2008, optimum age structure, newly created reserves of pine, fir, and oak stands. When optimizing species composition it is supposed to change birch forests by pine, spruce and oak ones. If forest management in 2050 comprise 1 m³ per 1 ha of forested area, we will get an additional forest products - round wood, e.g. Gomel GPLHO - pine comprise 138 thousand m³, spruce - 6.5 thousand m³. The total cost of timber as final product at the lowest price determines the annual economic effect of optimization of forest species structure (Table 2).

Table 2

**Economia effect of optimization of forest species
composition of the Ministry of Forestry**

State forestry enterprises	Forested area thousand, ha	Total stock, mln. m³	Annual economic effect, mln. rub.	Economic effect, mln. rub. per 1 ha
Minsk	1316.4	280.4	18 341	13.9
Gomel	1563.0	317.3	20 201	12.9
Grodno	811.6	179.1	8 400	10.3
Mogilev	1035.1	216.7	19 638	19.0
Brest	1032.8	189.7	12 610	12.2
Vitebsk	1220.1	236.2	22 300	18.3
Total	6979.0	1419.4	101 490	14.5

The total annual economic impact of optimization species composition of forests in forestry enterprises is 101 billion rubles. Revenues from forestries in 2013 comprised 1.8478 trillion rubles.

Optimization of species and age structure of the Ministry of Forestry forest can provide an additional annual income of 200-300 billion rubles. The optimal age structure of forests determines the increase productivity, forest size, income and profitability of forestry.

The greatest economic effect per 1 hectare of forested land can be observed in Mogilev (19.0 mln. rubles.) and Vitebsk (18,3 mln. rubles.) GPLHO, so it is necessary to make considerable changes in these forest funds.

In Vitebsk GPLHO it is necessary to cut down 17, and in Mogilev one - 15 thousand ha of birch forests and replace them with pine plantations. Expenditure on forestry in 2013 amounted to 3.102 trillion rubles. Hence economic efficiency of optimization species composition of forests of the Ministry of Forestry equals

$$Ef = E / W \cdot 100\% = 101.49 : 3102 \cdot 100 = 3.27\%.$$

Taking into account the optimization of forest age structure, annual economic efficiency can reach 8-10%.

Conclusion. Analysis of forest resources and a cost effectiveness assessment of species composition optimization of forests the Ministry of Forestry led to the following conclusions.

1. It is necessary to improve the species composition of forests through the increase of (share in the forests) pine plantations area by 7.8 %, spruce and deciduous - 2, oak - by 1% due to the decline in the share of birch forests.

When optimizing the species composition of forests it should be considered geobotanical zoning of forests, desired change of tree species, types of site conditions, data of soil typological survey of target forest tree species.

2. Optimization of forest species composition is a long process, intended for 30-50 years. Practically during this period birch forests should be replaced by coniferous and hardwood plantations by means of cuttings, reconstruction and reshaping or cutting of low-density plantings of broad-leaved species. Improving of quality composition of woodlands also occur due to the increased volumes of non-continuous felling and share of softwood (pine, fir, larch) in the structure of silvicultural production.

3. The annual economic effect of optimization of species composition of forests of the Ministry of Forestry is 101 billion rubles. The greatest economic effect per 1 hectare of forested land may be observed in Mogilev (19.0 mln. rubles.) and Vitebsk (18.3 mln. rubles.) GPLHO, so in forests of these associations, significant changes must be performed – it is necessary to cut down 15-17 thousand ha of birch forests and replace them with pine plantations.

Revenues from forestry in 2013 amounted to 1.8478 trillion rubles. Optimization of species and age structure of forests of the Ministry of Forestry can provide an additional annual income of 200-300 billion. rubles.

Expenditure on forestry in 2013 amounted to 3.102 trillion rubles. Hence the economic efficiency of forest structure optimization of species structure of forests of the Ministry of Forestry is 3.3, and taking into account the optimization of forest age structure can reach 8-10%.

4. The optimum species composition of forests determines the increase in forest productivity , forest size, revenue and profitability of forestry, increase the capacity of wood resources in each forestry and its use for the production of additional forest products and forest revenue.

References

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