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EFFECTIVE WAYS OF FOREST PRODUCTIVITY INCREASE

In the conditions of Belarus at reforestation and afforestation it is necessary to give preference to a pine, as the most productive. Replacement with pine forests of spruce and oak forests at a stage of reforestation promotes increase of efficiency of woods in 1.2 times. It is necessary to improve technology of creation of the forest cultures, including processing of soil by loosening by strips with simultaneous destruction of stubs and planting of seedlings by forest planting machine, timely and qualitative addition, care of forest carrying out, lightings and clearings. Reconstruction carrying out of small density (0.3–0.5) stands of coniferous and hardwood species by clear cutting at any age with the subsequent formation of normal pine forest stands will allow to raise efficiency of forests in 2-3 times. Efficiency of forests raises in 6 times and more at reconstruction of forest stands of deciduous species by clear cutting at any age with the subsequent creation of forest cultures and formation of normal pine forest stands.

Introduction. Increase of forests productivity is one of the main objectives of the forestry workers. Efficiency of forest stands can be characterized by quality class of locality, current and average increase, wood stock, phytomass and other indicators.

For characteristic of forest stands productivity it is necessary to recognize insufficient use of increase and wood stock from the economic point of view. So, in the best conditions of growth area aspen forest stands have the greatest average increase, but with a poor quality of the wood. Therefore the successful method for characteristic of efficiency should be recognized as use of forest stands valuation when the quantity of production made by a forest stand and its quality is considered. Besides, the valuation determines the lower assessment reasons of growing forests stands thus forms a basis for actions development of forests productivity increase.

Materials and research methods. The data of forest fund assessment given in the works [1, 2], as well as these ones on 01.01.2011 were used for the research. The technique of valuations is recounted in the work [3].

For the quantitative calculation of forest stands productivity the general average wood increase to the age of the main felling in the second group of the forests was used. Its values were accepted for a pine and a spruce in 80 years, an oak in 100, birches in 60, an alder black in 50 and aspens in 40 years. It should be noted that the difference of an assessment mark between the first and second forest groups makes only 2–4 points and can be considered to be insignificant.

Using point system the following wood productivity factors are used: pine – 8.0, spruce – 7.1, oak – 10.0, birch – 2.3, alder black – 2.1 and aspen – 0.5.

Results and their discussion. It is known that an assessment of forest stands in points and, therefore, productivity depends on growth area conditions, forest stands species composition and density of a wood stage.

According to the classification of forest vegetation in Belarus [3] forests are subdivided into two classes. The plantings growing in the conditions of a moisture lack belong to the first class. The main feature of water-air soil condition in plantings of the second class is excess of moisture. Growth of forest stands in water-air soil conditions close to optimal, forest stands reach the Ia–Ib class valuation.

The more increase in lack of moisture or its excess the less productivity of forest stands up to the V–Vb class valuation.

Productivity increase of the first class forest stands requires an irrigation, and of the second class – drainage. The mentioned actions are technically feasible, but from the economic point of view are unreasonable as the costs of their carrying out exceed those of additional output. In this regard productivity increase of forests is possible now by species composition regulation of forest stands and density of a wood stage.

The species composition of a wood stage essentially affects the productivity of forest stands (Table 1).

The data given in Table 1 indicate that from all forest forming species of Belarus the most productive is the Scotch pine. Assessment of pine forest stands in the conditions of the I class valuation is equal to 79 points. 6 points less is an assessment of oak forest stands, i.e. efficiency of oak groves is 1.1 times less, and spruce – 13 points, or by 1.2 times.

Forest stands of softwoods have a low mark. In the same conditions of growth area (the I class valuation) forest stands of an alder black are estimated by 58 points less, i.e. their productivity is 3.8 times lower, birch – by 60, or 4.2 times, and aspen – by 74 points, or 15.8 times, is lower in comparison with the pines.

Table 1

Assessment of the main forest species stands in the I class valuation conditions of the second forest group

Wood species	General average increase of wood Age of the main felling, m^3/ha	Assessment, points	Difference in comparison with pine stands	
			in points	by taxation cost of wood, th-ous.rub./ha
Pine	9.9	79	0	0
Spruce	9.3	66	–13	–16.9
Oak	7.3	73	–6	–7.8
Birch	8.1	19	–60	–78.0
Alder black	10.1	21	–58	–75.4
Aspen	9.7	5	–74	–96.2

Still there is an opinion on prevailing spruce groves efficiency. Therefore the considerable attention is paid to creation of spruce species that annually makes up 30% and more from the area of developed species. In 1997 on the third part of cuttings from the dried-out spruce area the spruce species were planted that can't have reasonable explanation.

Sometimes the researches study that the bark beetle-printer is the cause of spruce groves drying, i.e. this printer has already turned into the primary pest. In arid years sometimes the crops of agricultural plants are lost on thousands of hectares because of lack of moisture. For this cause spruce groves dry out too. The prevention actions of this phenomenon depend on the cause of drying: if a printer – reduction of its number by catching with pheromone traps, on what huge budget funds were wasted. If to consider the cause of drying is considered to be a lack of moisture, it is necessary to grow up a spruce on high-moisture soils. These conditions are determined and recounted in our works.

In this regard reforestation and afforestation strategy is subject to be changed.

For a long time mixed forest stands are considered to be more productive and steady. This statement has historical roots and is quite widespread in scientific medium and among practical workers. The available researches result from this statement recognized as far-fetched and unsubstantiated.

Reforestation instruction [4] provides 8P2B and 7P3B composition creation of mixed birch and pine forest stands. In Table 2 the assessment of various forest species stands is given in the same growth area conditions (I class valuation). The more a birch part in a forest stand, the lower its point system and efficiency. So, the point system of 8P2B forest species stand composition is five points lower in comparison with a pure pine forest stand, and the wood taxation cost is 6,5 thousand rub/hectare a year less that makes 520 thousand rub/hectare to the age of the main felling (80 years).

Table 2

The I class valuation forest stands assessment of the second forest group

Forest stand composition	Wood species	Density	General average increase of wood, m^3/ha		Productivity factor	Assessment, points	Difference with stand 10P	
			comparison 10P. and density 1,0	according to plan			in points	by taxation cost of wood, th-ous.rub./ha
10B	B	1.0	8.1	8.1	2.3	19	–60	–78.0
6B4P	B	0.6	8.1	4.9	2.3	11	–	–
	P	0.4	9.9	4.0	8.0	32	–	–
	Total	1.0	–	–	–	43	–36	–46.8
5P5B	P	0.5	9.9	5.0	8.0	40	–	–
	B	0.5	8.1	4.1	2.3	9	–	–
	Total	1.0	–	–	–	49	–30	–39.0
7P3B	P	0.7	9.9	6.9	8.0	55	–	–
	B	0.3	8.1	2.4	2.3	6	–	–
	Total	1.0	–	–	–	61	–18	–23.4
8P2B	P	0.8	9.9	8.7	8.0	70	–	–
	B	0.2	8.1	1.6	2.3	4	–	–
	Total		–	–	–	74	–5	–6.5
10P	P	1.0	9.9	9.9	8.0	79	0	0

In the mixed birch and pine forest stands the fire-prevention and fungicide role is taken to a birch and as a whole it is stated that the birch improves soils fertility and thus promotes productivity increase of a pine.

Fire sparks are spread by air streams on tens meters and the birch coulisse of 5–7 m wide isn't an obstacle for fire distribution. The fungicide role of a birch consists in decrease, allegedly, of pine damageability by a pine fungus. Pine fungus pocket arise, as a rule, in the pine families produced on agriculture using lands.

As stated [3], roots of a pine extend through the birch coulisse in the next pine one, i.e. the birch isn't an obstacle for a pine fungus distribution and, besides, the birch is also damaged by a pine fungus [5].

Growing collectively a birch, as a fast-growing species, first of all gets the feel of root system those ground layers where increased moisture content is observed. Therefore the birch is the notable pine competitor in the fight for moisture. The top part of birch makes physical impact on a pine by sweeping over that promotes a pine fall away in adjacent ranks and decreasing in completeness of a wood stage.

Creation of mixed birch and pine forest stands is sometimes primitively substantiated by a biodiversity problem as it is considered, the more species grow on the area the better phytocenosis develops.

Only at the end of the XIX century the outstanding Russian forestry specialist K. F. Tyurmer noted that the birch and aspen low-stemmed woods always will be a shameful brand of careless forestry management [6].

According to the data presented in the work [1], the birch woods occupied 1002.4 thousand hectares and made 16.5% of the forest cover, including European birch – 11.9%. For the 01.01.2009 the area of birch forests increased up 1822.4 thousand hectares (22.9% of the forest cover), including 1522.7 thousand hectares of silver birch woods (19.1%) [2].

According to the forest fund accounting for 01.01.2011, the birch woods are widespread on the area of 1566.9 thousand hectares, or 22.5% of the forest cover. From them 1306.8 thousand hectares occupy silver bitch woods that makes 83.4% of the birch forests area. The given data testify to the birch forests area increase in the last decade. The fifth part of the forest cover area falls to their part.

Table 3 gives data on silver birch woods with distribution under the terms of growth area from III to Ib classes of valuation. These are the conditions where is possible a man-made reforestation by creation of forest species. During reconstruction of silver birch woods by a clear felling with a further formation of normal pine forest stands the average assessment makes 73 points. The average assessment of birch forests, besides having density 0,68, makes only 12 points. Therefore, in connection with growth of the European birch woods losses of the forestry in the taxation cost of wood make annually 138 milliard rubles. When silver birch woods are replaced by the pine forest stands productivity of forest stands will be increased by 6 times (73/12).

Forestry losses aren't limited by this as for 01.01.2011 silver birch woods occupy 1306.8, hornbeam – 11.8, aspen – 146.6, alder – 123.9 thousand hectares. I.e. not valuable forest stands which are subject to reconstruction, are widespread on the area of 2699.1 thousand hectares that makes 38.7% of forest cover area (6970.1 thousand hectares). Carrying out of reconstruction on such area will significantly increase productivity of the woods (by 6 times and more).

Table 3

Point system assessment of pine and birch forest stands and wood taxation cost decrease as a growth result of silver birch woods

Class valuation	Area of birch forests, thousand. hectare	Pine forests with density 1,0		Birch forests			Decrease		
		general average increase at age of 80 years m^3/ha	assessment, points	general average increase at age of 60 years m^3/ha		assessment, points	assessment, points	by taxation cost of wood	
				density 1,0	density 0,68			thousand rub./ha in a year	million.rub./ year
Ib	5.5	12.5	100	10.3	7.0	16	84	109.2	600.6
Ia	131.2	11.5	92	9.2	6.3	14	78	101.4	13303.7
I	648.8	9.9	79	8.1	5.5	13	66	85.8	55667.0
II	668.8	8.8	70	6.9	4.7	11	59	76.7	51297.0
III	266.1	7.2	58	5.1	3.5	8	50	65.0	17296.5
Average assessment			73	–		12	–		
Total	1720.4	–							138164.8

Because of so huge softwoods forest stands area there is a creation reasonability problem of so-called energy plantations. Besides, their man-made production is unprofitable for forestry [7].

Density of a wood stage (tab. 4) considerably affects the productivity of forest stands. In comparison with a normal forest stand the pine one of density 0.3 has a mark only 24 points, i.e. it is 3.3 times less. And forestry taxation cost losses of wood reach 71.5 thousand rubles on 1 hectare a year. Even at density 0.5 the productivity of pine forests is twice lower.

According to the accounting of forest fund on 01.01.2011, low dense conifers forest stands (0.3–0.5) occupy 245.4 thousand hectares, forest stands of hardwoods – 50.1 that as a result is equal 295.5 thousand hectares, or 4.2% of the forest cover area. Carrying out of reconstruction by clear felling with the subsequent formation of normal pine forest stands on this area will allow to increase productivity of the woods by 2–3 times.

In forestry of Belarus a very little area is occupied by areas with the best fertility where forest stands reach Ib class of valuation. For example, the area of such areas in the Central experimental education Negoreloye forestry is equal to 27.2 hectares, or 0.7% of its forest cover area.

On this area pure pine forests occupy 3.9 hectares with density of a wood stage 0.8 and are estimated by 80 points. On other area of 23.3 hectares grow the mixed forest stands of softwoods with density 0.7–1.0 and an assessment 8–13 points. Although the mentioned areas are the most fertile, the average assessment of growing forest stands is equal only to 28 points. The assessment of normal pine forest stands cultivation in these conditions would reach 100 points that is 3.6 times more.

Usually such areas are characterized by a large number of stumps and therefore it isn't possible to carry out high-quality processing of the soil for forest species even by PKL-70 plow. Further, out-time carrying out of forest species addition, silviculture care, clarification and clearings promote formation of forest stands formation of the softwoods.

Conclusion. In the conditions of Belarus (climatic and ground-soil) the preference of a pine as the most productive and less exigent to growth area conditions should be given in man-made reforestation and afforestation.

Pine forests replacement of fir and oak groves at the stage of reforestation encourages forestry productivity increase by 1.2 times. As less productive spruce and oak forest stands, if it is necessary, should be created in the best growth area conditions (Ia–Ib class valuation) as with deterioration of growth area conditions the difference between assessments of these forest stands in comparison with those of pine increases. And the preference should be given to an oak, as steadier against a lack of moisture, than to a spruce.

It is necessary to improve creation technology of forest species. The tool for soil processing by scarification with simultaneous destruction of stumps and the subsequent planting of seedlings by forest-planting machine is wanted. And the back bend of roots, typical for manual planting is thus excluded, and forest stand resistance to the windfall increases. The success of forest species creation is caused by timely and high-quality addition, carrying out of silviculture cares, clarification and clearings for formation of desired species composition of forest stands. Reconstruction of coniferous and hardwoods forest stands low-degree density (0.3–0.5) by clear felling at any age with the subsequent formation of normal pine forest stands will allow to increase the forest productivity by 2–3 times.

Table 4

Assessment of the I class valuation pure pine forest stands of the second forest group depending on density of a wood stage

Density	General average increase at age of 80 years m^3/ha	Assessment, points	The difference in comparison with the normal forest stand	
			in points	by taxation cost of the wood, thousand. rub./ha
0.3	2.97	24	–55	–71.5
0.4	3.96	32	–47	–61.1
0.5	4.95	40	–39	–50.7
0.6	5.94	48	–31	–40.3
0.7	6.93	55	–24	–31.2
0.8	7.92	63	–16	–20.8
0.9	8.91	71	–8	–10.4
1.0	9.9	79	0	0

Forest productivity increases by 6 times and more during reconstruction of softwood forest stands by the clear felling at any age with the subsequent creation of species and formation of normal pine forest stands.

References

1. Березовые леса Беларуси: типы, ассоциации, сезонное развитие и продуктивность / под общ. ред. И. Д. Юркевича. – Минск: Наука и техника, 1992. – 183 с.

2. Федорович, Л. В. Современная характеристика березняков Беларуси / Л. В. Федорович // Труды БГТУ. Лесн. хоз-во. – 2012. – № 1. – С. 124–126.

3. Русаленко, А. И. Леса Беларуси: экология, структура, продуктивность / А. И. Русаленко. – Минск: БГТУ, 2012. – 348 с.

4. Наставление по лесовосстановлению и лесоразведению в Республике Беларусь / – Минск: Минлесхоз, 2009. – 105 с.

5. Воронцов, А. И. Лесозащита / А. И. Воронцов, И. Г. Семенкова. – М.: Сельхозиздат, 1963. – 524 с.

6. Писаренко, А. И. Искусственные леса: в 2 ч. / А. И. Писаренко, Г. И. Редько, М. Д. Мерзленко. – Ч. 1. – М.: ВНИИЦлесресурс, 1992. – 308 с.

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