

УДК 630*161.3

L. N. Rozhkov, D. Sc. (Agriculture), professor (BSTU)

SUSTAINABLE FORESTRY AND CARBON DIOXIDE EMISSIONS REDUCTION

Object of research is the forest fund and applied target silvicultural actions. The purpose is establishments of opportunities of preservation and increase of absorption by the woods of atmospheric dioxide of carbon in the conditions of intensive forest exploitation.

In article the expected carbonproductivity of the woods of Belarus is stated, possibilities of an intensification of carbonproductivity function of the woods are revealed, silvicultural actions are offered.

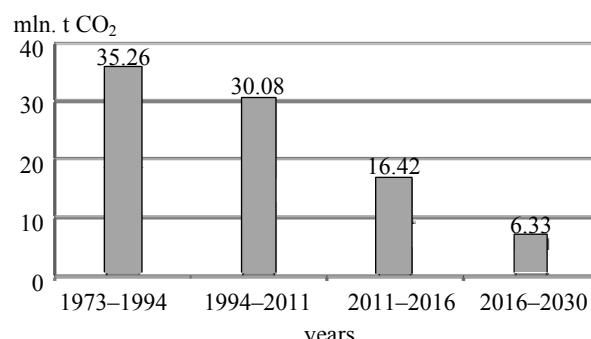
Introduction. Twelve months' storage of atmospheric carbon dioxide by woods compensates about 30% of industrial GHG emissions in the Republic of Belarus. This is a high rate of carbon-storage function of the forest ecosystem of Belarus, its impact on global climate changes prevention. Such level of carbon pickup, its long-term sequestration were provided by effective forestry activity as well as area extend of forest lands and planting of young woods free from cut till certain time. At present the last condition has run out but for the absence of further possibilities of extensive reforestation.

Growth of forest proportion of ripe age group causes the increase of wood utilization and, as a result, reduction of considerable reserves of carbon connected with wood reserve cutting. Forecast analysis on midterm perspective (2030) testifies about possible reduction, in Belarusian forests, of twelve months' storage more than three times in comparison with the expired semicentenary. In case of reserves growth usage till 85–90%, that is rather possible, carbon flows in woods can be redirected into atmosphere. Thus, forest becomes a source of GHG emissions that is unacceptable. This problem needs solving.

Methods of research. Carbon content and yearly flows of “runoff - emission” of carbon in woods are calculated according to Valuation technique of total and annual storage of carbon by woods of the Republic of Belarus [1]. Actualization of assessment index of forest fund has been completed with the help of technical approach of RUE “Belgosles” [2]. Influence of forestry measures (improvement thinning, reconstruction, planting of sylvula, natural regeneration promotional measures) are established according to the results of increment comparison of wood reserve during the long (to 60 years) period of technique influence on forest stand.

Main results. Dynamic of carbon accumulation by woods of Belarus offers the possibility of invariable behavior of total photosynthesis excess of forest stand plants over the breath of plants and phytodetritus decomposition (“breath of soil”). In this respect, the forthcoming period (2011–2030) is characterized by increase of ripe woods in the republic and objective reasonability, at this, increase

of forest exploitation that can cause decrease of storage of atmospheric carbon dioxide by woods from +38.5 mln. t CO₂/year in the expired semicentury to +11.4 mln. t CO₂/year (figure).



Comparative dynamic of annual average absorption of atmospheric carbon dioxide by plants of Belarus

Results of forestry activity for a long period of time (Ivye experimental-industrial and Negorelsk scientific-experimental divisions of forestry), planning of forestry-based measures for a revision period (Osipovich experimental, Bykhov and Cherikov forestry establishments) and forecast of dynamic of forestcarbonaceous pools for a midterm (forest fund of the Republic of Belarus and Brest SMFA) testify about a tendency of carbon dioxide absorption excess over its emission in case of forest management on condition of invariable forest exploitation and usage of environmentally oriented and economically effective methods of economic management in the field of growing, defence and protection of forests (table 1).

Forestry measures act to raise carbon productivity of forests. Among the measures of forest regeneration increase of carbon absorption makes +1.40 t C/ha · year during cultivation of sylvula, in case of natural regeneration with assistance measures +0.99 t C/ha · year. Increase due to improvement measures makes: +1.39 t C/ha · year in case of reconstructions with further cultivation of sylvula; +1.28 t C/ha · year in case of reconstructive felling; +1.18 t C/ha · year in case of improvement thinning (table 2). Usage of the above mentioned measures allows, as you can see, to increase carbon productivity of forest plantation to 50% in case of profitability of measures to 18% and morer (table 3).

**Table 1
Annual average increase of carbon dioxide absorption**

Name of forest fund object	Object area (land covered with woods), thousand ha	Period, years	Carbon dioxide absorption increase, t CO ₂ /ha · year
1. Ivye experimental-industrial and Negorelsk scientific-experimental divisions of forestry	13.673	1946–2008	+2.56
2. Osipovichi experimental, Bykhov and Cherkov forestry establishments	278.261	2014–2023	+0.63
3 Brest SMFA	1068.7	2013–2033	+0.49
4. Forests of the Republic of Belarus	8068.7	2011–2030	+1.10

**Table 2
Effectiveness of a long-term forestry-based influence on carbon accumulation**

Name of measures	Size of measure, ha	Increase for 57–58 years due to the measures	
		Wood stock, m ³ /ha	Carbon accumulation, t C/ha
1. Cultivation of sylvula after felling for primary use	698.5	+115	+44
2. Assistance measures to improve natural forest regeneration felling for primary use	385.8	+54	+21
3. Reconstruction felling	187.1	+97	+37
4. Reconstruction with cultivation of sylvula	86.8	+114	+44
5. Improvement felling	198.2	+84	+32

**Table 3
Expected effect due to carbon accumulation because of forestry-based measures application**

Name of measures	Income for 57–58 years, mln. rub.	Expenses on measures, mln. rub.	Effect from measures		
			Total, mln. rub.	Including	
			mln. rub./ha	rub./rub. expenses	
1. Sylvula cultivation after fellings for primary use	4526.40	3250.10	1276.30	1.83	1.40
2. Natural forest regeneration assistance measures after fellings for primary use	1172.80	79.86	1092.94	2.84	14.69
3. Reconstruction fellings	1025.20	516.40	508.80	2.72	1.99
4. Reconstructions with cultivation of sylvula	555.60	471.14	85.46	0.99	1.18
5. Improvement thinnings	919.60	266.78	652.82	3.30	3.45

Among measures aimed at increase of carbon storage function of forests, the following can be mentioned.

Reduction of forest regeneration terms of forestfree lands at felling, burning sites and etc. to 1–2 years. During the cultivation of slvula usage of large-sized planting material with closed root system and improved breeding properties, qualitative fulfillment of agrotechnical improvements, protection of unclosed sylvula from pests and illness. Transfer of unclosed sylvula into covered with forest lands within timeframes not more than 6–7 years from the moment of sylvula cultivation.

Widening of operational fund areas for partial cuttings of principal fellings oriented at natural measures of forest regeneration of basic (principal)

timber species and reduction of cutting cycle to 5–7 and more years. Ripening stand revealing where it is possible to provide natural regeneration of principal species under maternal forest stand canopy and also planting with tree layers from principal species. Boosting of preliminary regeneration of understory trees of principal species in ripening and last years middle-aged forest stand. Application of environmentally friendly timber cutting technologies with understory trees saving. Fulfillment of assistance measures after final methods of gradual felling and bringing up the number of understory trees preserved after the cutting to regular. (1.0).

Biological amelioration during sylvula cultivation and also understory trees of natural and artificial origin (pea family plants and other bio ameliorants).

Choice of principal species and basic structures based on soil-typological groups.

Reconstruction of low-value low-density (density of 0.6 and lower) needle-leaved understorey trees and middle-aged planting.

Strict abidance of the regulations of the Program on improvement thinning formation of optimal planting recommended by forest felling Regulations in the Republic of Belarus.

Indication of the following data in State forestry register:

— accumulation of carbon on forest lands according to species;

— annual storage of carbon on forest lands according to species. Indication, in Regulations, definition, review and approval of controlled felling areas on fellings for primary use in forests of the Republic of Belarus of the following index: controlled felling area should provide maintenance of absorption (“runoff”, “absorption”) of atmospheric carbon dioxide by forests.

Development at basic forestry management of forestry establishments in Projects of forest management section “Measures on carbon storage productivity increase by forests”.

Usage of swamp woods, unprofitable for storage of timber resource, in regime of carbon storage and biodiversity saving.

Conclusion. Forests of Belarus are notable for invariable tendency of forests to absorb excessive

atmospheric carbon dioxide over its emission: on average +38.5 mln. t CO₂/year for the last 50 years. As for the forecasting midterm positive constituent of Belarusian forests carbon balance under the condition of increase of controlled felling area on fellings for primary use is preserved to the extent of +11.4 mln. t CO₂/year. With the help of goal-oriented forestry measures it is possible to increase carbon productivity of forest planting to 50% at profitability of measures to 18% and more. Remarkable carbon storage function of swamp woods is observed.

Forestry sector of Belarus has good perspectives of participation at carbon markets with innovative projects of invariable forest exploitation and reduction of carbon dioxide emissions, thereby, increasing the profitability of forest management and delaying global warming.

References

1. Методика оценки общего и годичного депонирования углерода лесами Республики Беларусь: утв. и введ. в действие приказом М-ва лесного хоз-ва Респ. Беларусь от 28.03.2011 № 81 / Л. Н. Рожков [и др.]. Минск: БГТУ; ЛРУП «Белгослес», 2011. 19 с.

2. Атрощенко О. А. Лесотаксационные нормативы для актуализации лесного фонда БССР // Лесоведение и лесное хозяйство. Вып. 20. Минск: Выш. шк., 1985. С. 44–48.

Received 20.01.2014