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ANNUAL FORECAST OF CARBON DIOXIDE "DRAIN – EMISSION" FLOW OF BELARUS FOREST ECOSYSTEM

The object of research is the predicted forests outlook for 2016–2030 in Belarus. The purpose is scientific explanation of carbon deposit practical forest using function in multi-purpose forest exploitation system, search of ways to increase carbon deposit potential of Belarus forests in combination with the effective ecologist and socially focused forestry activity.

Predicted regularities of a year atmospheric carbon depositing by the forests of Republic of Belarus are determined. Estimating of carbon balance of the forests for 2016–2030 is executed.

Introduction. Today the estimating and accounting mechanism of the absorption forest-carbon units appears to be not enough perfect in the republic. There is no formation monitoring of forest-carbon units, annual carbon dioxide flows of "drain – emission" by the forests of Belarus aren't predicted. The consequence of the latter may be the situation of negative forest-carbon balance exit in an immediate perspective. The cause of that is the uneven age structure of the republic forests resulted in recently observed increase of some matured forests that leads to increase of prescribed cutting area and general wood use volume. Out 80–90% of wood use decrease being quite real in the short term, is lead to atmospheric carbon prevalence of emission over drain (absorption). The forests of Belarus can appear to be suppliers of carbon dioxide in the atmosphere. The present article is devoted to dynamics research of carbon flows in the forests of Belarus.

Technique of research. Annual deposit of carbon is defined as bound carbon amount during annual increase (for example, of forest ecosystem), тС [1–4].

In prediction the most important link is estimating of areas and prevailing species stocks. In this connection the method approaches applied by RUP "Belgosles" were used with updating of forest fund taxation indicators and regression relation models of forest stands taxation characteristics (age, height, diameter, the sum of section areas, density, a stock), developed by O. A. Atroshchenko [5].

Main results. Dynamics of the areas and stocks injection of prevailing tree species, planned with taking into account a predicted prescribed cutting area by the main forest exploitation and increase of supplies, is presented in tab. 1 which analysis testifies to the following predicted regularities in the forest dynamics. The increase in the areas of coniferous (+7.8%), including pine (+4.5%) and spruce (+25.3%) formations, as well as an oak formation (+46.3%) is expected. The area of birch (–17.0%), aspen (–50.1%) and partially black alder formations.

Annual deposit of carbon depends, first of all, on forest stands in particular of average stocks efficiency(Table 2).

With general positive tendency to increase average stocks in the forests of the republic, the average stocks decreasing of spruce, oak and black alder is predicted.

The latter is explained by predicted essential area increase of spruce, oak and black alder young growth formations. It is also evident 2.8 times decreasing of average stocks middle-period increase in the republic forests, as a whole (2011–2016 is +1.4 m^3/hectare in a year, 2016–2030 is +0.50 m^3/hectare in a year). It is natural that this tendency will affect annual carbon deposit of the republic forests in the total.

As it was already mentioned, annual flows of carbon are determined by difference of carbon content in the forest ecosystem for a certain period of time (as a rule, on average in a year). The presented calculations deal with annual flows only inphytomass of forest plantings because the prediction mechanisms of carbon content in the soil, dead wood and some components of the forest ecosystem are absent.

Table 1

Prognostic dynamics of areas and stocks in the forests of the Republic of Belarus

Prevailing wood species	Lands covered by forest, one th. hect.			General stock of plantings, million m^3		
	2011 г.	2016 г.	2030 г.	2011 г.	2016 г.	2030 г.
Pine	4036.0	4113.8	4216.6	888.09	926.65	986.66
Spruce	750.6	781.9	940.7	180.69	186.04	217.81
Oak	282.1	291.9	412.8	47.53	48.51	65.45
Birch	1853.5	1812.4	1538.1	295.36	308.88	288.82
Alder black	690.2	656.4	668.9	122.25	122.54	108.01
Aspen	170.9	148.6	85.3	31.53	28.56	17.54
Other	262.6	252.4	206.3	32.04	32.03	26.78
In total on the republic	8045.9	8057.4	8068.7	1597.49	1653.21	1711.07

Table 2

Predicted dynamics of average plantings stocks in Belarus

Forest formations	Predicted dynamics of average plantings stocks, m^3/hectare		
	2011	2016	2030
1. Pine	220	225	234
2. Spruce	241	238	231
3. Oak	168	166	159
4. Birch	159	170	188
5. Black alder	177	187	161
6 Aspen	184	192	206
7. Forests of Belarus	198	205	212

It is also possible to assume essential changes of carbon content in these components only for rather long temporary periods. Increasing of carbon accumulation in pine, spruce and oak planting formations with decreasing of the others is predicted (Table 3). As a whole the forests of Belarus will increase carbon accumulation during the analyzed period (2011–2030). Rates of this accumulation are given in tab. 4.

From table 4 results the redistribution regularity of carbon dioxide flows between forest formations: essential increases inCO2 absorption by forests during the forthcoming period (2011–2030) will take place at expense of pine, partially spruce and oak, formations and a negative increase ("emission") in other forest formations. It is a consequence of the field program to optimize the formations structure of forests with reconstruction of some derivative birch and aspen forest formations in favor of indigenous pine, spruce and broad-leaved hardwoods.

Concerning black alder formation another situation takes place. Large-scale drainage melioration of low-lying bogs in Belarus concerned hydrological mode of marshy black alder woods that leads to the environment deterioration and death. The dynamics analysis of atmospheric carbon dioxide "drain" by the forests of Belarus testifies to steady regularity of decrease in annual atmospheric carbon dioxide absorption increasing.

Table 3

Forecast of carbon content in forest plantingsphytomass

Forest formation	2011		2016		2030	
	Lands covered with the wood, one thousand hectares	Content of carbon, one million hardware	Lands covered with the wood, one thousand hectares	Content of carbon, one million hardware	Lands covered with the wood, one thousand hectares	Content of carbon, one million hardware
Pine	4036.0	337.9	4113.8	352.6	4216.6	375.4
Spruce	750.6	63.7	781.9	65.6	940.7	76.8
Oak	282.1	28.1	291.9	28.62	412.8	38.63
Birch	1853.5	126.0	1812.4	132.1	1538.1	123.04
Black alder	690.2	49.9	656.4	50.1	668.9	44.15
Aspen	170.9	10.1	148.6	9.15	85.3	5.61
Other	262.6	7.0	252.4	6.92	206.3	5.61
Total	8045.9	622.7	8057.4	645.09	8068.7	669.24

Table 4

Forecast of carbon dioxide flow in forest plantings of Belarus

Forest formation	Annual flows "drain – emission" of carbon dioxide for the periods, mill.t. of CO_2	
	2011–2016	2016–2030
Pine	+10.78	+5.97
Spruce	+1.39	+2.93
Oak	+0.38	+2.62
Birch	+4.47	–2.37
Black alder	+0.15	–1.56
Aspen	–0.70	–0.93
Other	–0.06	–0.34
Total	+16.42	+6.33

For expired 38 years (1973–2011) average annual CO_2 deposit was reduced by 5.18 million t. that was a consequence of some increase in a share of the matured forests and respectively of prescribed cutting area growth upon the main forests exploitation.

The forthcoming period (2011–2030) is characterized by essential increase in specific weight of the matured forests in the republic (2011 – 10.7%; 2030 – 19.5%), included in general cutting, and areas growth of I–III age classes plantings with their rather low general stocks of plantings. We will also notice that about 6,0 million t of deposited carbon dioxide current increase are formed in the marshy woods, unprofitable for logging [6]. Therefore the balance of carbon on "drain – emission" for waterless forests becomes equal to zero.

Noted changes of carbon dioxide flows "drain – emission" in the forests of the republic demand a detailed discussion: whether it is rational to increase volumes of the main wood use with reduction of atmospheric carbon dioxide absorption by the forests.

Conclusion. Redistribution of carbon dioxide flows between forest formations at the expense of CO_2 absorption increase by pine, spruce and oak formations and decrease by other formations is predicted.

Annual carbon dioxide absorption by forest plantings of Belarus will be reduced from +30.8 million t of CO2 (1994–2011) to +16.42 million t (2011–2016) and +6.33 million t of CO_2 in the period of 2016–2030.

Taking into account the fact that about 6,0 million t of CO_2 annual flow are formed in the marshy woods, the balance of CO_2 "drain – emission" in the waterless woods becomes equal to zero.

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