Carbon potential of climate projects in forests: methodical approach and investment decisions

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Abstract. This article is devoted to the description of the main methodical aspects of calculating the carbon potential of the implementation of climate projects in forests, including the initial data and formulas for such calculations. The study analyzes the basic methodical principles for calculating carbon stocks in forests (including the assessment of changes in carbon stocks in forests, assessment of carbon pools (above-ground and below-ground biomass, litter, soil, dead wood), the possibility of using conversion coefficients to assess carbon stocks for the main forest-forming species, potential approaches to assessment carbon absorption by forest lands not covered by forest vegetation), attention is focused on the basic requirements for the assessment of scenarios of climate projects in forests (baseline, project scenario), as well as on the institutional framework for assessing carbon stocks in forests (including state regulation of the implementation of climate projects in forests). On the basis of the analysis, preliminary estimates of the carbon potential of the implementation of climate projects in forests are given, their prospects are determined, the rationale for the need to assess the carbon potential based on the classification of climate projects in forests is given.

1 Introduction

The relevance of this work is due to the need to form holistic ideas about the possibilities of calculating the carbon potential of climate projects in forests, that is, about the possible results in changing carbon stocks achievable as a result of the implementation of such projects.

The carbon potential is a part of the overall potential for the implementation of climate projects in forests [1]. In addition to the carbon potential, it is also necessary to allocate the area and investment potential for the implementation of such projects. In general, the carbon potential can be considered taking into account its measurability in tons of carbon or tons of CO2-eq.

A.N. Filipchuk notes that at present there are a significant number of methods for assessing carbon stocks, including a Regional Assessment of the Carbon Budget in Forests (ROBUL) [2]. The automated version of ROBUL involves filling in data on the areas of the main forest-forming species and on wood stocks, as well as information about forests mortality, areas of forest fires, carried out reforestation and afforestation activities. Upon

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completion of the filling, the specified automated version of the ROBUL presents the carbon balance in the forests.

At the same time, general approaches to the assessment of the carbon budget in forests and carbon stocks have been approved at the state level [3].

Carbon potential is an important signal for economic agents – potential performers of climate projects in forests, since it characterizes the potential number of carbon units that can be obtained during the implementation of climate projects in forests. However, various methodical approaches, as well as methodologies for the implementation of the projects themselves, do not allow for an unambiguous carbon potential assessment of the implementation of climate projects in forests.

N.V. Malysheva notes that according to the recommendations of the Intergovernmental Panel on Climate Change, it is expected to assess changes in five carbon pools in forests: above-ground and below-ground biomass, dead wood, litter, soils [4]. The high uncertainty of calculations of both carbon stocks and carbon balance is also indicated due to the lack of a unified approach to their assessment.

D.G. Zamolodchikov notes that after the adoption of the Paris Agreement, a controversial problem developed in the Russian Federation, the parties to which discussed, in fact, the carbon potential of Russian forests [5]. The scientific community is divided on this issue. Some experts noted an underestimation of the carbon potential, including in accordance with the ROBUL methodology, and some providing scientific rationale for the correctness of modern calculations of carbon stocks and balance in forests.

However, all the theoretical approaches outlined, despite the existence of institutionally defined methods for calculating the carbon balance in forests and its stocks, have not allowed to define a single methodological approach to conducting similar calculations for investors – potential performers of climate projects in forests.

2 Materials and methods

In the framework of this work, an analysis of the literature and regulatory legal acts regulating the assessment of carbon stocks in forests was carried out. Taking into account the institutional approach to the consideration of the carbon potential of climate projects in the forests of the Russian Federation, formulas for its assessment were determined, as well as a list of initial data that correspond to such formulas.

When analyzing the formulas for calculating the carbon stock of pools, carbon losses, the main conditions were established under which it is possible to use them to calculate the carbon potential.

In addition, approximate estimates of the amount of carbon in the biomass pool are given, as well as an assessment of changes in carbon stocks during forest management measures for reforestation.

3 Results and discussion

The main provisions on the methodical basis for calculating carbon stocks and other indicators of carbon potential are established by the ordinance of the Ministry of Natural Resources and Environment of the Russian Federation dated 30.06.2017 No. 20-r [6], as well as by the order of the Ministry of Natural Resources and Environment of the Russian Federation dated 27.05.2022 No. 371 [7]. Also, formulas for calculating the initial data are established within the framework of the National Report on the Inventory of Anthropogenic Emissions from Sources and Removals by sinks of greenhouse gases not regulated by the Montreal Protocol, prepared annually [8].

In general, all the formulas presented in the listed documents can be summarized for the purposes of carbon potential assessment (Table 1).

Table 1. Main formulas for assessment of carbon potential.

N	Formula	Explanation	Modified formula
1	LsPH = ASH CPm/Sm	LsPH - annual carbon losses by the biomass pool of forested lands during clearcut; ASH - annual area of clearcut; CPm - total carbon stock of mature forest biomass; Sm - total area of mature forests.	LsPH = CPm
2	LsPF = ASF * CPa/Sa	LsPF - annual carbon losses by the biomass pool of forested lands during fires; ASF - annual area of destructive forest fires; CPa - total biomass carbon stock on forested lands; Sa - total area of forested land.	LsPF = CPa
3	LsLH = ASH*(CLm / Sm - MCL0m)	LsLH - annual carbon losses by the litter pool of forested lands during clearcut; ASH - annual area of clearcut; CLm - total carbon stock of litter in mature forests; MCL0m - the average carbon stock of litter for the 0-age group (temporarily unforested lands), calculated taking into account the ratio of the areas of predominant tree species in mature forests; Sm - total area of mature forests.	LsLH = CLm
4	LsLF = ASF*(CLa / Sa - MCL0a)	LsLF - annual carbon losses by the litter pool of forested lands during destructive forest fires; ASH - annual area of destructive forest fires; CLa - total biomass carbon stock on forested lands; MCL0a - the average carbon stock of litter for the 0-age group (temporarily unforested lands), calculated taking into account the ratio of the areas of predominant tree species in mature forests; Sa - total area of forested land.	LsLF = CLa
5	Lfire = A * MB * Cf * Gef * 10^{-3}	Lfire - amount of emissions from the fire; A - the area covered by fires; MB - the mass of fuel available for combustion (biomass, litter and dead wood); Cf - the combustion coefficient has no dimension (0.43 for the crown fire and 0.15 for the ground fire); Gef - emission coefficient.	-

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6	$C_{biomass}$ = 0,5*(a*(d2*h)b)	$C_{biomass}$ - biomass carbon; 0,5 - conversion coefficient of biomass into carbon units; d - the diameter of the trunk at a height of 1.3 m; h - tree height.	-
7	$\Delta C_{biomass}$ = ($C_{after\_biomass}$ – $C_{before\_biomass}$) * $A_{reforestation}$ / D	$\Delta C_{biomass}$ - change in carbon stocks in the biomass pool; $C_{after\_biomass}$ - carbon stocks in the biomass pool after reforestation; $C_{before\_biomass}$ - carbon stocks in the biomass pool before reforestation; $A_{reforestation}$ - the area of land on which the reforestation project is being carried out; D - time period between experimental measurements of the carbon stock in the biomass pool on the project lands.	$\Delta C_{biomass}$ = $C_{after\_biomass}$ * $A_{reforestation}$

The change in formulas is due to the following aspects.

Firstly, formulas 1 and 3 assume that ASH = Sm (based on the methodical provision on the complete destruction of the forest if the climate project is not implemented). In addition, for formula 3, it is assumed that MCL0m = 0 due to the debatable conversion coefficients for MCL0m. Then, the potential carbon losses will actually be equal to its total stocks. Similar assumptions are also established for formulas 2 and 4.

Secondly, when calculating by formulas 1 and 3, it is advisable to use information about all forests, and not only about mature ones.

Thirdly, when calculating according to formula 7 in connection with the implementation of reforestation activities within the framework of the "reforestation fund", and afforestation activities – on lands where forests have not previously grown, $C_{before\_biomass}$ is equated to 0. In accordance with international rules [9], the maximum crediting period for projects related to absorption (climate projects in forests), is 45 years, however, since the assessment of changes in carbon stocks is made at the time of the projected end of the implementation of climate projects, it is advisable to take D as 1.

It should be noted that the presented formulas are primarily aimed at assessing changes in carbon stocks and its losses. In this case, formulas estimating carbon absorption by forests are not used due to the fact that absorption is rather a co–product of the project, and the stocks themselves are the main result. This conclusion can be made both on the basis of methodologies laid down in international standards for certification of carbon units, and on the basis of an institutional approach (legislation in the field of greenhouse gas emissions control).

At the same time, the methodical approach, including a certain institutional component, also involves taking into account the classification approach to climate projects in forests. The division by types of projects (and, in fact, by sets of works that will be implemented within the framework of climate projects in forests [10]) leads to the need to assess the carbon potential for each of these types due to the differences in the forestry activities carried out.

The separation of climate projects in the forest is objectively necessary on the basis of orientation. It is necessary to identify projects aimed at reducing greenhouse gas emissions, as well as projects aimed at increasing the absorption of greenhouse gases.

Among them, it should be noted projects implemented on forest and non-forest lands, as well as projects related to the conservation of forests. Each type of project involves its own forestry activities and directly depends on the areal potential of each type of such projects.

All this requires individualization of carbon potential calculations for each specific project. However, a preliminary assessment of the carbon potential of all projects is still possible on the basis of averaged values and a standardized approach, which consists in some assumption about an approximate set of works within various types of climate projects in forests.

In this regard, it is advisable to determine the scope of work within the framework of climate projects in forests in order to assess the carbon potential. This can be considered on the example of reforestation activities on an area of 100,000 hectares (with 3000 plantings per ha of spruces, birches and pines by 1000 of each specie) (Table 2).

Table 2. Carbon potential assessment.

N	Project measure	Formulas for calculating the carbon potential	Carbon potential	Explanation
1	Preparation of the territory	-	It may be accompanied by a decrease in carbon absorption due to changes in soil cover	The first year of reforestation activities
2	Carrying out reforestation activities	-	Direct planting	The first year of reforestation activities
3	Taking care of the forest	-	Agrotechnical and forestry care	2-5 years of reforestation activities
4	Non-interference in growth	1. $C_{biomass}$ = 0,5*(a*(d2*h)b) 2. $\Delta C_{biomass}$ = $C_{after\_biomass}$ * $A_{reforestation}$	For the 45th year, subject to the planting of 3000 plantings per 1 ha (spruce, birch, pine, 1000 pieces each) $\Delta C_{biomass}$ = 9567757,853 tons C	6-45 years of reforestation activities

The issue of defining the baseline remains an important institutional problem. Thus, the order of the Ministry of Economic Development of Russia dated 05.24.2022 No. 248 established that the baseline is mandatory requirements subject to state control (supervision) in the Russian Federation. However, for example, reforestation measures are also included in the scope of regulation of mandatory requirements, since they are carried out within the framework of the “reforestation fund” in accordance with the Rules of reforestation approved by the order of the Ministry of Natural Resources and Environment of the Russian Federation dated 29.12.2021 No. 1024.

In this regard, it is necessary to establish institutionally the need to remove forestry measures from the scope of legislation on mandatory requirements for the implementation of climate projects in forests. In this way, the principle of complementarity for the implementation of such projects will be observed.

It should be noted that the baseline issue should be considered after the carbon potential assessment, as this will greatly facilitate its definition. This is due to the possibility of “reverse forecasting”, namely, determining the baseline based on the total carbon potential of the climate project. Then, to determine the additional carbon absorption, it is possible to subtract the baseline from the project scenario and determine the potential number of carbon units.

4 Conclusions

Thus, in the course of the analysis, the main methodical approach to assessing the carbon potential of climate projects in forests was determined, which consists in determining such potential by the type of climate projects in forests, as well as the existing international and national institutional environment. In addition, during the work on the example of a climate reforestation project, the carbon potential of such a project was preliminarily assessed, taking into account the proposed methodical approach.

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