Environmental Development xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Environmental Development

journal homepage: www.elsevier.com/locate/envdev

Russian forests: A new approach to the assessment of carbon stocks and sequestration capacity

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ARTICLE INFO

Keywords:
Russian forests
Carbon sink
Carbon balance assessment
Net annual increment
Net Ecosystem Production (NEP)

ABSTRACT

The controversy over how to improve the carbon balance assessment for the Russian national forests is discussed. According to the preliminary calculations, three factors are responsible for the underestimation of the carbon sink in Russian forests, up to ≈ 340 ± 75 million tons per year in total: 1. The methodology of assessments. 2. The methodological ambiguity of forest classification, which excludes some areas from managed forests and therefore from assessment, for instance, ≈ 200 million ha of "inaccessible" forests in remote regions and 74.9 million ha of shrubs. 3. The evaluation of the carbon balance for the latest national inventory report under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (National inventory report of the Russian Federation on greenhouse gas emissions and removals, 2006), which doubled the carbon losses caused by timber harvest and wood removal and over-estimated the forest fire losses.

The new results for the Russian forests carbon sink assessment corrected according to the discussed approach and based on the State Forest Register data following the IPCC methodology are presented in this paper. This assessment for the 2015 Net Ecosystem Production (NEP) of the Russian forests is 630 ± 110 million tons C/year, including approximately 140 million tons/year accumulated in dead biomass.

It must be emphasized that the carbon sequestration capacity assessment of Russian forests presented here is the result of research and has no official status yet.

1. Introduction

Forests cover 67% of the territory of the Russian Federation and are important for stabilizing the climate in the country, as well as globally. The Forest Resource Assessment FAO UN (Global Forest Resource Assessment 2015, 2015a, 2015b, http://www.fao.org/forest-resources-assessment/en) shows that the area of Russian forests has reached 20% of the global forest area. The FRA reports that Russian forest areas without shrubs and human settlement forests (city forests) totals 814.9 million ha. A substantial part, 88%, of Russian forests grow in the boreal zone. The major forest-forming species are larch *(Larix sibirica),* pine *(Pinus sylvestris)*, spruce *(Picea abies)*, Siberian pine *(Pinus sibirica)*, birch *(Betula pendula)*, aspen *(Populus tremula),* oak *(Quercus robur)*, beech *(Fagus sylvatica),* etc. (Forest State Report, 2016). Operating with these large numbers requires exceptional accuracy. Small inaccuracies in assessing such vast areas might cause significant errors in forest policies.

Almost all Russian forest lands are included in the Forest Fund – a unique Russian term sometimes translated as "Forest Estate"

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https://doi.org/10.1016/j.envdev.2018.03.002
Received 12 July 2017; Received in revised form 6 March 2018; Accepted 7 March 2018

(Malysheva, 2005) – and defined as lands under federal jurisdiction. The boundaries of these lands are drawn in accordance with the Forest Code and Land legislation. Forest Fund lands comprise a majority of forests (96.9%) with the exception of forests on lands used for industry, roads, etc.; national reserves and national parks; and forest lands within human settlements (city forests). Currently, the lands of the Forest Fund are under the authority of the Federal Forestry Agency, a part of the Ministry of Natural Resources of the Russian Federation.

Forest Fund lands consist of forest lands: lands covered with forest vegetation and lands not covered with forest vegetation that are meant for forest restoration (clear-cuts, burns, etc.) at 75.4% and non-forest lands: the land serving for forest management (roads, rides, etc.) at 24.6%. The Paris Agreement allows countries to independently specify national contributions to climate change mitigation and response; declares support for conservation, sustainable forest management, and increases in carbon stocks; and reaffirms the importance of promoting non-carbon benefits (Article 5 of the Paris Agreement, 2015, http://unfccc.int/paris_agreement/items/9485.php). The Paris Agreement also highlights the importance of forests as net sinks of carbon within terrestrial ecosystems. In the context of the Paris Agreement, an objective and complete count of the carbon stock and the carbon sinks in Russian forests is of great importance. The agreement provides a reason for revising practices and improving assessments of carbon stocks and the carbon balance in Russian forests. In this article, we analyse the methods currently in use for the accounting of Russian forest sequestration capacity and their validity.

2. Materials and methods

To improve the carbon sink and carbon balance assessments of national forests, assessment methods and data categorization should be revised. We suggest three approaches: first, to revise the methods of calculating sequestration capacity; second, to revise the sub-categories of forest lands for counting; and third, to eliminate the double counting of losses from fires, timber harvesting and wood removal.

2.1. Revising methodology

The only data source for the carbon sequestration capacity and carbon balance assessment of national and regional forests is from the State Forest Register. According to the Forest Law (Article 91, Forest Code of the Russian Federation, 2006), the State Forest Register is a documented source for information on forests, their use, forest protection management and forest reproduction.

All the materials we used for our calculations were taken from the data of the State Forest Register in Russia, which are available for national reporting under international climate agreements. The State Forest Register annually updates all quality and quantity characteristics of forest management and inventory. This information reflects the changes in the areas affected by fires, cuttings, diseases and other disturbances. The State Forest Register data are presented by units of forest management (lesnichestvo) and regions. These data are collected not from sampling plots but from forest stands during forest taxation, and the procedure is implemented at different times. The evaluation of the growing stock through an inventory of forest stands can contain errors of up to 20% of the value, which is much greater than the errors that result from evaluation by sampling plots. The use of State Forest Register data requires taking into consideration the specifics of the source information, which may contain significant systematic errors (Shvidenko and Nilsson, 2002).

The Russian assessment report to the IPCC and the 7th Russian national communication under the UNFCCC (National inventory report of the Russian Federation on greenhouse gas emissions and removals, 2006) are based on State Forest Register data and the IPCC stock change method using IPCC equation 3.2.3 (Good Practice for Land Use, Land Use Change and Forestry, 2003, http://www.ipcc-nggip.iges.or.jp) for the annual assessment of carbon stock in living biomass. This type of equation requires that the inventory data be collected from permanent sample plots at two points in time.

The annual change in growing stock assessed with the State Forest Register at two points in time can in no way be interpreted as an increment for the reporting year. Taking into consideration the characteristics of statistical data, the IPCC equation 3.2.5 shown below (Good Practice for Land Use, Change and Forestry, 2003) must be used for estimating changes in the carbon stocks in living biomass.

$$G_{TOTAL} = I_v \cdot D \cdot BEF_1 \cdot (1 + R),$$

Where

G_{TOTAL} – average annual biomass increment above and below ground, tons d.m. ha^{-1} yr^{-1};
I_v – average net annual increment in volume suitable for industrial processing, m^3 ha^{-1} yr^{-1};
D – basic wood density, tons d.m. m^{-3};
BEF_1 – biomass expansion factor for conversion of the net annual increment (including bark) to the aboveground tree biomass increment, dimensionless;
R – root-to-shoot ratio appropriate to increments, dimensionless.

This equation uses the parameter “average annual net increment,” which can be obtained directly from the State Forest Register and makes the calculated numbers more accurate. We believe that for the carbon sink evaluation of Russian forests to be more accurate, this parameter should be calculated by the above equation based on the average annual net increment data from the State Forest Register.