

Peatland restoration in Russia for reduction of carbon losses and greenhouse gases emissions: the experience of large scale rewetting project

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Abstract

Large areas of peatlands that were drained for agriculture and used for peat extraction in European Part of Russia were left abandoned with CO₂ emissions and high fire risks. Rewetting could return peat soils to their original water-logged state prevent their vulnerability to fires and peat oxidation. The project “Restoring Peatlands in Russia – for fire prevention and climate change mitigation” is aimed to prove effect for climate change mitigation of over 70 thousand hectares of drained abandoned peatlands, rewetted after severe fires of 2010. Different methods based on remote sensing were developed to map peatlands, to assess their conditions, to bind emission factors and carbon data, to evaluate rewetting effectiveness both for fire prevention and GHG assessment. The scientific and practical results of this large-scale project could be expanded to other restoration projects, help further development of methodologies for GHG inventories under UNFCCC and IPCC, and support integration of restoration projects into an economically derived climate change mitigation and adaptation national programs.

Key words: carbon losses, climate change mitigation, greenhouse gases, peatlands, removal, restoration, rewetting

Introduction

Peatlands occupy more than 8% and, together with paludified shallow-peat lands (peat <0.3 m), occupy even more than 20% of the Russian Federation (Vompersky et al. 2011, etc.). Peatland use has long tradition in Russia: in European part alone the total area of peatlands drained for peat extraction, agriculture, and forestry reached several millions of hectares (Minayeva, Sirin, 2005, Minayeva et al. 2009). Several hundreds of thousands of hectares have been subject to milled peat extraction. Now, such areas are poorly overgrown by vegetation and are subject to water and wind erosion, significant carbon loss and the highest fire danger (Sirin et al. 2011). Vast areas were drained for agricultural purposes, but later largely taken out of service. Milled cut-over peatlands require after-use reclamation. Previously, Soviet standards required reclamation of extracted peatlands for after-extraction utilization (agriculture, forestry, etc.). After the economic changes in the 1990s many half-depleted peatlands were left abandoned without reclamation. They are concentrated mostly in the central part of European Russia (Moscow Region is leading) and are the sites with the largest fire hazard, what became apparent by severe peat fires in 2002 and especially in 2010 (Sirin et al. 2011). Nowadays prevention of peat fires which are a natural phenomenon within the boreal and other zones (Minayeva et al. 2013), but which can occur with increased probability and frequency due to climate change, is nowadays the main driver for peatland restoration in Russia (Sirin et al. 2011). The project “Restoring Peatlands in Russia – for fire prevention

and climate change mitigation” (the PeatRus Project) financed under the International Climate Initiative (ICI) by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) is aimed at climate change mitigation and adaptation by restoration of several dozen thousand hectares of drained abandoned peatlands. The project activities are linked to the governmental programme (2010-2013) of rewetting of more than 73,000 ha of fire hazardous abandoned drained peatlands, initiated after severe fires in 2010. The leading project partners are: Wetlands International, Michael Succow Foundation, Greifswald University and the Institute of Forest Science of the Russian Academy of Sciences. The project is supported by the Ministry of Nature Resources and the Environment of the Russian Federation (MNR Russia) and Governments of Moscow, and other provinces.

Inventory of peatlands

Vast, often impassable, peatland areas require reasonable methods to assess and to monitor their conditions and fire hazard status, to support prioritization for restoration, and to test the effectiveness of rewetting and restoration measures for climate change mitigation and for other purposes. Methods for peatland mapping, classification of their land cover, GIS and monitoring system based on Earth Observation (EO) data have been developed and verified. Peatlands, including those transformed by peat extraction, agriculture, forestry, belong to various land categories in Russia, and there is no general system for their inventory and accounting. Remote sensing methodology based on high-resolution (Spot 5) space imagery and supported by various available sectorial (peat geology, forestry, etc.) and cartographic data was introduced and approved for mapping of over 250 thousand hectares of peatlands in the Moscow Province (Sirin et al. 2014), and it can be also used for various scientific and practical tasks, which need development of regional GIS for peatlands. The results of mapping were used to pinpoint peatland fires occurring in 2010 from the archival data, and to evaluate the extent of burned peatland area.

Peatland mapping creates the background for more accurate classification of peatland’s vegetation/land cover by cutting off adjacent non-peat areas which could have similar spectral characteristics. The classification approach was developed on the basis of the National park “Meschera” (Vladimir Region) and led to identification of 6 classes: bare peat; sparse willow-herb, reed and birch-reed communities; communities dominated by pine; communities with willow and birch; hydrophilic communities with cattail, tall sedges and reed; open/sparsely vegetated water surfaces (Medvedeva et al. 2011). The approach was further tested using different EO data as Spot-5 HRG, Spot-6 HRG, UK-DMC2 MSI and Landsat-7 ETM+ (Landsat-8) satellite images (Medvedeva et al. 2017). The verified methodology was used to monitor and assess status of 73 thousand ha of rewetted peatlands in the Moscow Region.

Assessment of carbon losses and GHGs emissions removal

Significant progress has been made over the last years with respect to estimation of emissions of GHGs from drained peatlands. Combining the latest national inventory reporting to the UNFCCC with the newest IPCC emissions factors (2014) shows that annual greenhouse gas emissions from peat oxidation in drained peatlands worldwide amount to 1.5 Gt of CO₂-eq (excl. emissions from peat fires which may contribute on average another 0.5 Gt). The largest emitters from drained peatlands are Indonesia, the European Union and the Russian Federation; respectively, 27 countries (incl. 14 countries in Europe) being responsible for 95% of all emissions. Long-term studies in the Moscow Region (Russia) show that CO₂ emissions from abandoned peat extraction sites have resulted in carbon losses from 1.6 to 4.7 mg C/ha, depending on the year. This means that the amount of uselessly mineralized peat lost over 10 years would be comparable with annual rate of milled peat production. A lesser limit for C losses due to CO₂ emissions from unused agricultural land (hayfield) was estimated for one year at 0.8 mg C/ha (Suvorov et al. 2015). These estimates do not consider C losses by wind and water erosion, by peat fires. The methodological background for the GHG accounting applied in the project is derived from the recent UNFCCC processes and the updated 2013 (2014) IPCC Wetlands Supplement. The calculations of the reductions of emissions resulting from the rewetting projects in the Moscow Province included three elements: reductions as a consequence of changes in peatland classes’ ratio; reduction due to changes in area of ditches; reduction as a consequence

of peat fires. As the process to obtain emission factors based on local measurements is not yet complete, more general emission factors had to be used such as those from IPCC guidelines and literature (IPCC 2014, Wilson et al. 2016). Hence, the EFs used in the current study could slightly be altered after studies on local fluxes based on chamber and Eddy Covariance measurements is finalized. Within the project activities the results of national observations will be integrated into the existing vegetation-based Central European GEST model (Couwenberg et al. 2011). The largest carbon losses were found in relation to peat fires (Makarov et al. 2015) and refer to main benefits of rewetting for climate change mitigation.

Conclusions

The large-scale rewetting demands an integrative approach to planning, implementation, monitoring and adaptive management. The PeatRus Project is the testing ground for development and implementation of the methodology based on the integrative approach. The scientific and practical results obtained could be expanded to other restoration projects, could contribute to further development of methodologies for GHG inventories under UNFCCC and IPCC, and could enhance integration of restoration projects into economically driven climate change mitigation and adaptation national programs.

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