



Trading Wood For Water in Peatland Forests: Towards Sustainable Bioeconomy Development

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Introduction

Landscapes are social-ecological systems that provide goods, services and benefits required for human well-being. Society has become more environmentally aware of the critical issues arising from intensive landscape management. Nevertheless, the increasing human footprint on forest landscapes illustrates that the demands for benefits may exceed their capacity. This is a wicked problem. For a long time, land management has favored high yield of crops, wood and other renewable goods at the expense biodiversity conservation, and other landscape benefits for human well-being.

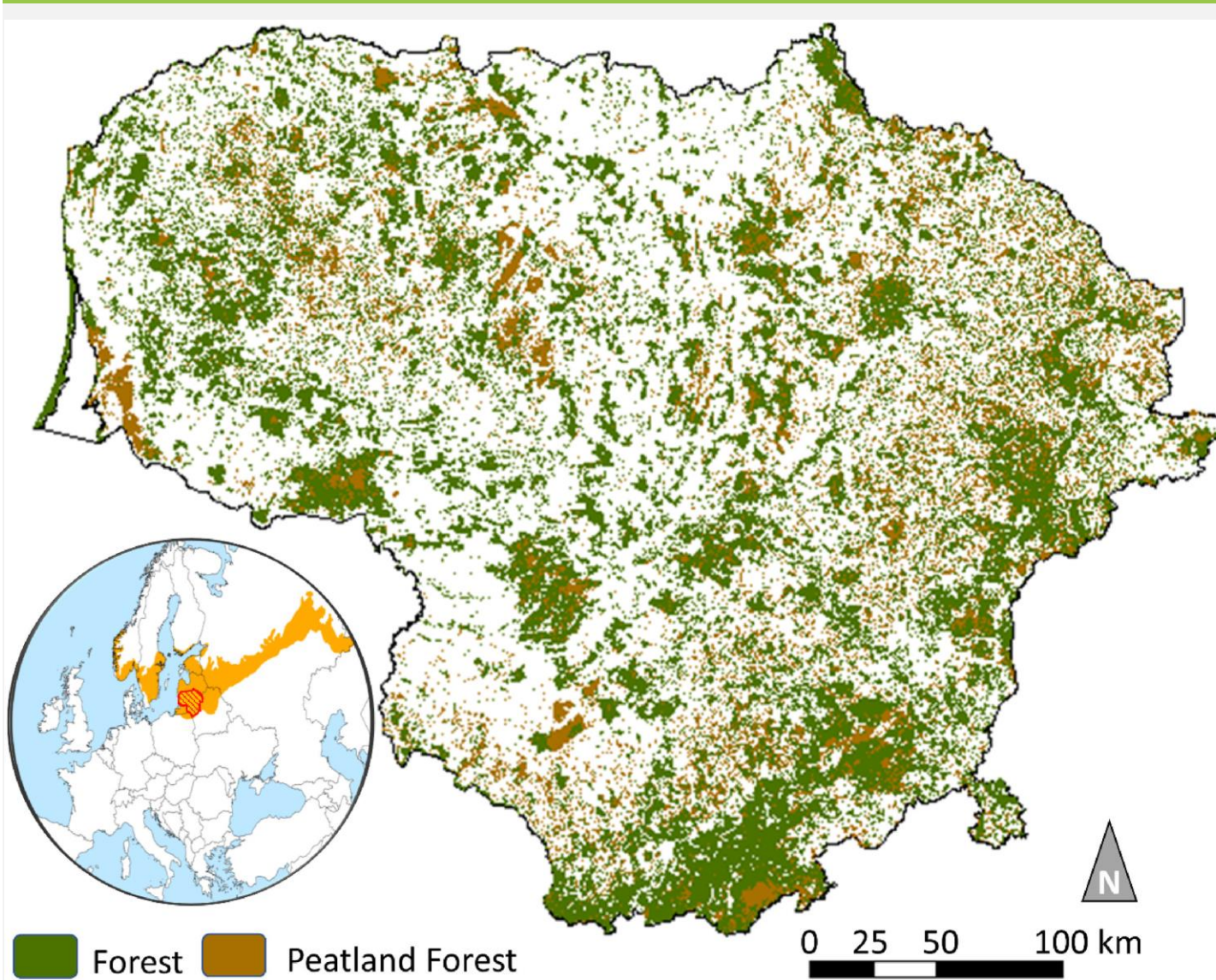
This has triggered shifts in policies, such as the Green Deal, that promote sustainable bioeconomy development and use of forest landscapes. According to FAO, there are three interrelated forest management pathways that can contribute to sustainable bioeconomy development and environmental recovery of forest ecosystems; (1) halting deforestation and maintaining existing natural forests; (2) restoring degraded forest land; and (3) sustainably using forests and building green value chains.

The ecosystem services approach emphasizes that forest landscapes provide an important range of goods, services and benefits. Peatlands sequester and store more carbon than any other type of terrestrial ecosystem, including the global above-ground carbon stock of forest ecosystems. However, peatland forests have sustained unprecedented degradation and loss in the drive for timber production. This includes the draining of peatlands which impairs hydrological processes, modifies energy flows, nutrient cycles, and GHG emissions and causes losses in biodiversity. Rewetting peatland forests is key towards mitigating climate change, conserving biodiversity, and improving human well-being

Aim

The aim of this study is to quantify the economic trade-offs among natural, current, and re-wetted peatland forests using seven indicators, viz. drainage maintenance, rewetting, water retention, wood production, and three types of carbon sequestration as economic indicators.

Study Area



Lithuania's peatland forests, located in the hemi-boreal forest zone (orange area in the map), were the focus of this study because their management is at the crossroad between continuing forest management for sustained yield wood and meeting the EU's recent Green Deal and related policies that support the development of multi-functional forests that deliver a variety of ecosystems services.

Lithuania's forest area covers ~2 200 200 ha (~34% of the country). Peatlands forest cover ~302 000 ha forest area of which is ~144 000 ha are drained.

Methodology

A **3-step framework** was applied to assess the trade-offs between peatland forest benefits delivered by wood production, water retention and carbon sequestration for **three different peatland forest scenarios**. This includes;



1. Potential natural 2. Current condition 3. Rewetted

1. **Estimate** drainage maintenance and rewetting costs of peatland forests.
2. **Estimate** of ecosystems services values of wood, water and carbon
3. **Perform** a Cost-benefit analysis of the seven economic indicators; a) drainage maintenance, b) rewetting, c) water retention, d) wood production, wood CO₂, soil CO₂ and wood processing CO₂.

Results

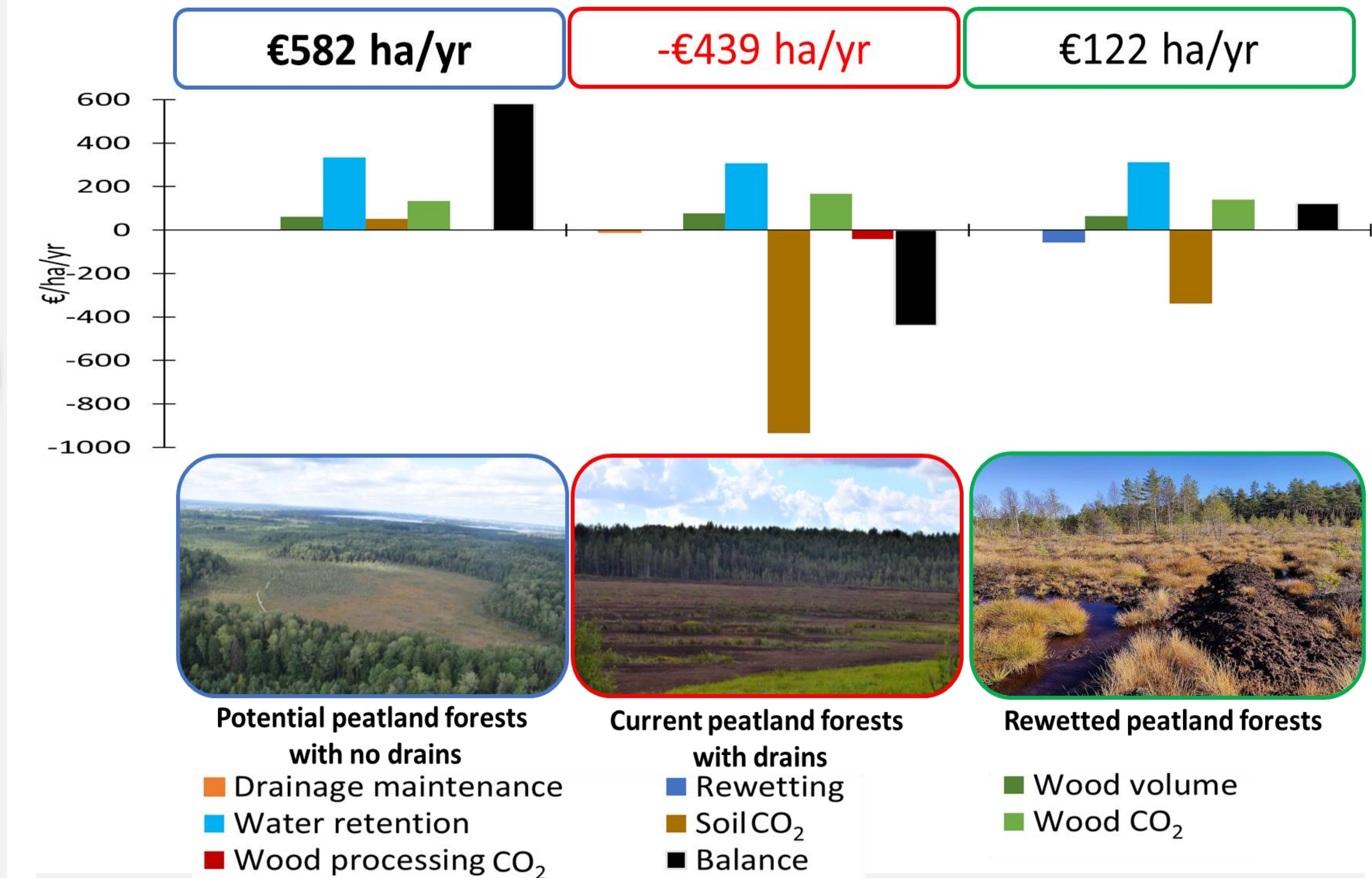
1. The mean drainage maintenance cost to remove debris and beaver dams in a ditch 4 m wide x 2 m deep was on average €1 488/km. This equates to an average drainage cleaning price of €5.64 ha/yr or €811 000 annually.

To rewet Lithuania's drained peatland forests, we estimated that ~220 000 dams need to be constructed. We estimate that the average cost to build one dam was €1 487. Rewetting all the drained peatland forests would cost €56.81/ha/yr or € 8.2 annually for 40 years.

2. Estimated quantity and economic market values of five indicators for the three peatland forest conditions.

Indicator	Condition	Quantity				Estimated value €	
		m ³ /ha	total m ³	tons/ha/yr	tons/yr	ha/yr	Total/yr
Wood	Natural	146	44.2·10 ⁶	NA	NA	61	1.86·10 ⁹
	Current	182	55.2·10 ⁶	NA	NA	77	2.32·10 ⁹
	Rewetted	153	46.2·10 ⁶	NA	NA	64	1.95·10 ⁹
Water	Natural	25 230	7.6·10 ⁹	NA	NA	334	101.2·10 ⁶
	Current	23 162	7.0·10 ⁹	NA	NA	307	92.9·10 ⁶
	Rewetted	23 576	7.1·10 ⁹	NA	NA	312	94.5·10 ⁶
Soil CO ₂ emissions	Natural	NA	NA	-0.77	-0.23·10 ⁶	52	15.7·10 ⁶
	Current	NA	NA	14.52	4.2·10 ⁶	-933	-282.4·10 ⁶
	Rewetted	NA	NA	11.33	1.5·10 ⁶	-338	-102.3·10 ⁶
Wood CO ₂ sequestration	Natural	NA	NA	1.97	597 534	134	40.6·10 ⁶
	Current	NA	NA	2.46	745 760	167	50.6·10 ⁶
	Rewetted	NA	NA	2.06	624 735	140	42.4·10 ⁶
Processed wood retained CO ₂	Natural	33	9.9·10 ⁶	1.48	448 150	100	30.4·10 ⁶
	Current	41	12.4·10 ⁶	1.85	559 581	125	37.9·10 ⁶
	Rewetted	34	10.4·10 ⁶	1.55	468 812	105	31.8·10 ⁶

Results



4. The peatland forest cost benefit analysis using three peatland forest scenarios and seven economic indicators for Lithuania showed; Peatland forests in a **natural state** would deliver an estimated economic value of ~€176.1 million annually.

Peatland forests in the **current state** are estimated to deliver a disservice of ~-€132.9 million annually.

Rewetting all Lithuania's drained peatland forests would deliver a benefit of ~€37.1 million annually.

Main conclusions

1. Managing for a diversity of ecosystem services is a balancing act. This study shows that the focus of wood only forest management overlooks many important ecosystems services that can help mitigate the negative effects of climate change.
2. Using seven economic indicators viz. drainage maintenance, rewetting, water retention, wood production, and three types of carbon sequestration, we estimated that the draining of peatland forests have lost ~€309 million annually. Rewetting drained peatland forests would transform these current losses into a ~€170 million benefit.
3. A sustainable bioeconomy requires;
 - A. Development relevant indicators, valuation tools, economic payment schemes or subsidies.
 - B. Development of decision support systems about entire landscapes that involve informed evidence-based dialog and learning among a range of actors and stakeholders.