Project brief

Thünen Institute of Climate-Smart Agriculture

2022/45a

Potential for emission mitigation by *Sphagnum* farming on highly decomposed peat

Bärbel Tiemeyer[1], Jan Oestmann[1], Dominik Düvel[1], Arndt Piayda[1], Ullrich Dettmann[1,2]

- ***Sphagnum* farming on highly decomposed peat is possible, but needs elaborate water management.**
- **Experimentally raised temperatures may increase carbon dioxide and methane emissions.**
- **Even under unfavourable soil and weather conditions and accounting for irrigation polders and dams, greenhouse gas emissions were much lower than in the case of drainage-based agriculture.**

Background and aims

Drainage for agriculture or peat extraction turns peatlands into hotspots for the emissions of greenhouse gases (GHG) from soils. Classical peatland rewetting may restore the function of peatlands as natural sinks for atmospheric carbon dioxide (CO_2) or reduce emissions, but does not allow for productive use. Cultivating peat mosses (*Sphagnum* spp.) as substrate for horticulture might combine ecological and economic goals. The project presented here aimed at quantifying the GHG exchange at a large-scale experiment of *Sphagnum* farming on former peat extraction sites characterized by highly decomposed peat.

Methods

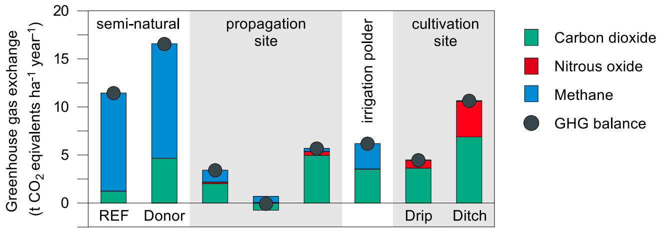
The exchange of CO_2, methane (CH_4) and nitrous oxide (N_2O) was measured manually with chambers at a semi-natural reference and donor peatland, two *Sphagnum* farming fields (propagation and cultivation) and an irrigation polder for two years. We also evaluated different water management approaches: Drip irrigation, ditch irrigation and polder-fed ditch irrigation. Additionally, Open Top Chambers were installed at three sites to elucidate the effect of increased temperatures.

Results

Peat water levels at the semi-natural peatland were close to the surface during the first year (2017), but fell to 15 cm during the dry and warm summer 2018. Water levels at the propagation site were too low (annual mean of 25 cm), but the *Sphagnum* carpet was still nearly closed at the end of the project. At the cultivation site, ice and ponding of nutrient-rich water damaged the mosses during establishment. Thus, despite higher water levels facilitated by drip irrigation, biomass development was worse than at the propagation field.

In 2017, the reference site and one of the sites at the propagation field were sinks of CO_2. However, both the warm and dry conditions in 2018 and the experimentally increased temperatures increased CO_2 emissions or reduced the sink strength. Already high CH_4 emissions from the reference site were further increased by experimental warming. The much lower CH_4 emissions of the cultivation sites were regulated by the cover of vascular plants. Noteworthy N_2O emissions only occurred at the cultivation site where both biomass cover and water levels were low. During the first year, the donor site showed lower CO_2 uptake and higher CH_4 emissions than the reference site, but recovered already in the second year. In contrast to experience from fen peatlands, CH_4 emissions from the irrigation polder were rather low.

Mean annual greenhouse gas exchange of the measurement sites.



Source: Thünen Institute, data from Oestmann et al. (2022a)

For an areal GHG balance, the potential *Sphagnum* harvest was estimated from *Sphagnum* biomass at the end of study. Further, areas needed for dams (GHG data from literature) and water storage were accounted for. This resulted in GHG emissions between 5.3 and 8.9 t CO_2-eq. ha^{-1} yr^{-1}, which is much lower than typical values for grassland on peat (32 t CO_2-eq. ha^{-1} yr^{-1}). Optimisation by e.g. better water management is still possible.

Further Information

Contact

[1] Thünen Institute for Climate-Smart Agriculture
baerbel.tiemeyer@thuenen.de
www.thuenen.de/ak

[2] Institute of Soil Science, Leibniz University Hannover

DOI:10.3220/PB1669649721000

Partners

Institut für Umweltplanung, Leibniz Universität Hannover

Klasmann-Deilmann GmbH

Duration

9.2015-3.2021

Project-ID

1784

Publications

Oestmann et al. (2022a): Ecosystems 25: 350-371, doi: 10.1007/s10021-021-00659-z

Oestmann et al. (2022b): Plant and Soil, doi: 10.1007/s11104-022-05561-8

Grobe et al. (2021): Mires and Peat 27: Article 27, doi: 10.19189/MaP.2020.APG.StA.2022

Support

Lower Saxony Ministry for Nutrition, Agriculture and Consumer Protection (AZ 105.1-3234/1-13-3) & German Federal Environmental Foundation (FKZ 33305/01-33/0).