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Defining the yield and refining quality of biomass produced on wet peatlands under consideration of greenhouse gas mitigation

Introduction

Background:

- In Denmark, 108 000 ha of peatland and mineral soils rich in organic-matter, account for approximately 6 % [1] of the total domestic greenhouse gas (GHG) emissions.
- Peat subsidence due to drainage and changing climatic conditions require alternative sustainable management options for agricultural production on histosols in order to mitigate agricultural GHG emissions from drained peatlands while maintaining an economic output.
- One possibility is rewetting and the production of flooding tolerant crops (Paludiculture), in particular perennial grasses.

1) Experimental mesocosm set-up (semi-field) to determine spatial differences of GHG flux dynamics of five Danish peatlands.

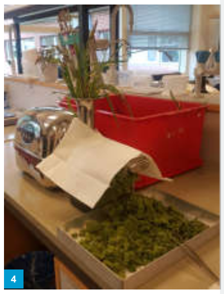
Hypotheses:

- Differences of GHG dynamics occur due to spatial variability in site-specific soil properties, but overall emissions can be reduced by rewetting and cultivation of suitable biomass.
- Perennial grasses can utilise available nutrients more efficiently at more frequent management applications, resulting in higher annual yields and enhanced quality.
- Biomass production on wet peatlands will lower GHG emissions while increasing the soil C content but management practices might compromise the mitigation potential.

Methods

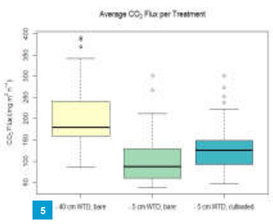
Experimental set-up:

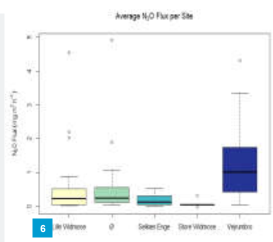
- In total, 75 soil mesocosms were retrieved from five Danish peatland sites (Fig. 2) and grouped in three water table and cultivation treatments to assess differences of GHG fluxes (Figs. 1 and 3).
- Yield and quality of biomass established in Vejrumbro, considering variances in management will be assessed. Further, protein content, quality, and other utilisation options of plant fractions will be identified (Fig. 4).
- Differences of on-site GHG fluxes (Vejrumbro) will be determined with a particular focus on the mitigation potential in relation to management.



2) Location of selected peatlands,
3) Opaque chambers,
4) Lab-scale protein extraction.

Preliminary Results





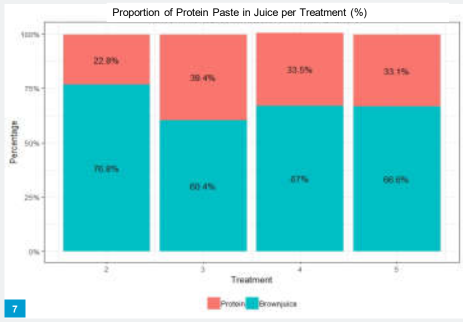
5) Average fluxes of CO_2 per treatment,
6) Fluxes of N_2O per site in mg m^{-2} m^{-1}.

Gas fluxes:

Fluxes of all GHG were low during the first sampling campaigns. CO_2 fluxes ranged between 37.3 (± 11.5) and 390.7 (± 56.7) mg m^{-2} h^{-1}, correlated with a low water table depth (WTD) (Fig. 5). N_2O levels have been negligible with the exception of significant ($p < 0.05$) high fluxes of up to 4.91 (± 0.49) mg m^{-2} h^{-1} from Vejrumbro mesocosms (Fig. 6).

Protein Yield and Quality:

First results indicate a decline in biomass protein content with each harvest, but an increased total yield. The Protein content was highest (39.4 %) in a three cut scenario (Fig. 7), despite having the lowest juice fraction (66.8 %). An analysis of crude protein (CP) fractions indicated that the easily extractable fractions B1 and B2 range between 77 - 115 g CP/ kg dry matter which is comparable to other studies [e.g. 2].



7) Protein content in biomass juice per treatment (numbers indicate cut and fertilisation frequencies) scenario.

Outlook

A critical evaluation of both major parts within this project on their own – GHG dynamics of Danish peatlands and perennial biomass yield and quality – is a valuable assessment in times of climatic change. Interlinking both aspects with a focus on balancing the mitigation of environmental threads while generating alternative economic outputs from agricultural hotspot areas is hence highly topical.

Bibliography

[1] Gyldenkærne, S., & Greve, M. H. (2015). For bestemmelse af drivhusgasudledning ved udtagning/ekstensivering af landbrugsjorder på kulstofrige lavbundsjorder.

[2] Solati, Z., Manevski, K., Jørgensen, U., Labouriau, R., Shahbazi, S., & Lærke, P. E. (2018). Crude protein yield and theoretical extractable true protein of potential biorefinery feedstocks. *Industrial crops and products*, *115*, 214-226.

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PEATWISE
Wise use of drained peatlands in a bio-based economy