GRASS-BASED CROPPING SYSTEMS: TRANSFORMING THE DANISH AGRICULTURAL LANDSCAPE

Summary

Replacing traditional feed crops with perennial grasses in intensively farmed regions can benefit both terrestrial and aquatic environments, increase biodiversity, and help mitigate GHG emissions. Advancing biorefinery production and supply chains could create incentives for farmers to shift their cropping rotations towards more grass-based systems.

The need and the benefits

Poor ecological status of aquatic environments, low biodiversity, and loss of soil carbon are significant challenges associated with high-intensity agriculture. With agriculture covering about 62% of the landscape, the agricultural sector in Denmark is no exception.

Cereals and maize account for 52% and 7% of the Danish cropping area, respectively, making the agricultural landscape dominated by monoculture feed crops with a relatively high environmental impact. As an alternative, perennial grasses, when managed properly, can improve nutrient use efficiency, enhance soil carbon storage, and reduce the negative impact of farming on biodiversity.

Currently, due to a lack of incentives for farmers, there is unexploited potential to mitigate the negative impacts of agriculture by replacing traditional feed crops with perennial grasses. However, with the recent advancements in green biorefining technologies, economic incentives could be created. A remaining challenge, however, is establishing reliable production and supply chains that ensure stability and security for all stakeholders, including the development of market opportunities, supportive policies, new technologies and education. Developing these systems will be crucial to unlocking the potential of perennial grasses, both as a viable business strategy and an effective environmental solution.

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The function

The substitution of grass on cereal and maize fields can yield a new source of protein through protein extraction from grass through the biorefinery.

In the biorefinery grass is pressed producing a green juice and a fiber fraction. From the green juice, protein is extracted through heating or steaming and can be fed directly to monogastric animals - thereby replacing the less sustainable soya feed.

The fiber fraction can be fed to ruminants (e.g. cattle) or distributed to the biogas plant. In addition, the biogas plant also receives manure etc. from the field, and the energy produced here can be transferred to run the biorefinery.

The biogas remnants including potentially produced biochar finally is recycled back to the local fields as fertilizer and/or to promote carbon storage in the soil, thereby contributing to circularity of the system.

Hence, replacing cereal and maize with grasslands with minimum management, strengthened collaboration of farmers/landowners and circularity at the landscape scale with maximum reuse of co-products may help to reduce the overall loss of GHG and nutrients, improve biodiversity and create more sustainable landscapes in a landscape dominated by agriculture.

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trans4num solution

Aarhus University is investigating the benefits of incorporating more perennial grasses into crop rotations, focusing on both production-specific aspects (biomass yield, protein content, etc.) and environmental factors within a landscape context (nutrient leaching, biodiversity, and climate).

The success of the landscape transformation towards increased grass cultivation depends both on knowledge on how benefits of the grass varies across the landscape and on active and positive engagement of stakeholders. Therefore, our research integrates various elements of landscape scale effects of the grass and stakeholder involvement to gain insight into their perspectives and to disseminate knowledge about the benefits of adopting this production practice.

In Denmark farmers are regulated based on - amongst others - the N retention map. This map is specific for Denmark and depicts the geographically varying sensitivity of how much N is retained in the soil before it reaches the recipient – the fjord. Hence, there is a spatially varying effect of how effective the grass is as a solution. From a farmer's perspective, this can facilitate discussion and potentially increased collaboration between actors of the landscape.

This highlights the importance of involvement of the actors of the landscape. In our research, we conduct interviews with key stakeholders, including early adopters in the green biorefining industry and farmers representing diverse production systems. These interviews provide insights into the opportunities and barriers faced by different stakeholders in the evolving industry. Additionally, we organise stakeholder workshops to disseminate and share knowledge between stakeholders and facilitate collective discussions on the possibilities and challenges in establishing biomass supply chains and collaborative networks between farmers.

What were the challenges / limitations in the implementation process?

- Economic and financial barriers, e.g., substantial investments and market uncertainties-
- Supply chain infrastructure gaps and fixed processing capacity requires significant coordination
- Farmer resistance, e.g. due to risk aversion and lack of incentives and information
- Lack of policies and regulatory schemes to effectively support establishment
- Technological gaps in the supply and production chain e.g. side stream valorisation
- Environmental variability – difference in mitigation potential across the landscape

What kind of resources do you need to implement the proposed solution?

- A strong production chain

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More information

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