White Paper for Grassland Opportunities

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GO-GRASS

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GO-GRASS

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Grassland is an important type of land use in Europe, covering a large area and providing ecosystem services such as carbon sequestration.

To boost the development of a bio-based circular economy and contribute to the EU's goal of achieving net zero emissions by 2050, there is a need for business models that can be replicated in a variety of locations and contexts, with relatively low levels of investment, risk and technical sophistication. A wider range of rural entrepreneurs need to get involved in the emerging bio-based business sector, including farmers and forest owners (and their associations), policy makers, small rural businesses, and advisors. This is key to diversifying and revitalising rural economies and creating quality jobs in rural areas.

Executive summary

The **GO-GRASS project** aims to create new business opportunities in rural areas based on grassland valorisation, and to support their replication throughout rural communities in the EU. Since October 2019, the project has connected 22 partners from eight countries, which are developing small-scale demonstration sites (demos) of a circular agro-food system in four EU countries - Denmark, Germany, Sweden, and the Netherlands. The partners are developing solutions to produce sustainable grass-based products, such as paper and packaging, animal bedding, organic protein, biogas, and biochar. The project is testing and replicating the technologies and business models in three regions in Spain, Romania, and Hungary.

Results from GO-GRASS provide data and findings for policies that promote the bioeconomy at the field level and support the development of innovative grass-based business models. Policy makers can stimulate grassland valorisation and new opportunities for farmers and rural businesses by securing grasslands' manifold functions as a sustainable source of raw materials, a space for social, organisational and business innovation, and an important contributor to carbon removal and climate change mitigation. This could be achieved through the provision of financial incentives encouraging carbon farming using grass as a resource, while at the same time closely monitoring the impact of business activities on ecosystem services. Another necessary measure at a higher EU level is to connect policies on clean aquatic environments with policies about grassland management to reduce nitrate leaching, as well as to connect policy areas regulating energy production and waste stream usage. At national and regional level, the focus should be on supporting the conversion of arable land to grassland, valorising ecosystem services related to grasslands, and adjusting fertiliser regulations to facilitate the use of innovative fertilisers such as biochar from alternative (e.g., non-woody) biomass. A further necessity is the revision of the regulations for calculating, allocating and recognising emissions savings effects in the upstream and downstream areas of the value chains. Tax incentives for grass-based products and services, ensuring easier access to regional and national funding for the development of new technologies that utilise grass and its side streams as a resource, and support for research and development activities were identified as important measures to promote grass-based businesses. The development of sustainable transport and logistics infrastructure in conjunction with measures to stimulate consumer and industry demand for grass-based products is also crucial for businesses to thrive.

These measures should be accompanied by various support actions aimed at raising awareness of the benefits and ecosystems services of grassland through education and outreach to consumers. In this context, knowledge transfer measures involving farmers and end users to understand the new products of grassland are just as important as a committed and open political dialogue to discuss and promote best practices.

1. INTRODUCTION AND MOTIVATION

1.1 Motivation and methodology of the White Paper

This White Paper aims to demonstrate the wide range of opportunities for valorising grasslands based on the findings from GO-GRASS demos, and relevant best practices at local, national, and European levels. It demonstrates innovative and diverse ways of considering grass and grasslands as new resources for the benefits of society, the environment, and businesses. The focus is on value chains, innovative products, enabling business environments, policy gaps and best practices for policies that promote the valorisation of grasslands and grass biomass. It concludes with recommendations for European, national, and regional policy makers interested in valorising grasslands and promoting grass-based businesses.

Around 17% of the EU's total surface area was covered by grassland in 2018[1] but this abundant resource is often left unused, resulting in costs for society and lost benefits for rural areas. By valorising grass and grasslands, Europe can generate new opportunities for farmers and rural businesses, who are the backbone of the European bioeconomy[2]. In this context, innovative approaches for processing, using, and marketing grass-based products and grassland ecosystem services could become pivotal to the revitalisation of rural areas.

The Common Agricultural Policy (CAP) 2014-2020 included the definition of permanent and temporary grassland in EC Regulation 1307/2013, where agricultural area is defined for receipt of direct payments under Pillar I of the CAP. Temporary grasslands are part of the arable lands meaning those cultivated for crop production, or areas available for crop production but lying fallow, including areas set-aside. Permanent grassland or permanent pasture is "land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown) and that has not been included in the crop rotation of the holding for five years or more."[3]

Permanent grasslands cover 34% of the European Union's agricultural area and are vital for human well-being as they contribute to a wide variety of essential ecosystem services[4]. However, the potential for economic, environmental, and social valorisation goes beyond current practices.

Our policy recommendations are developed from an extensive review of the CAP and expert interviews. The recommendations seek to support **European decision-makers and regulators, planning and rural development agencies, and local authorities** to develop targeted policies for a circular and sustainable use of grassland in collaboration with researchers, networks, and farmers.

The findings and conclusions are based on a collaborative and open approach using qualitative analysis, and interviews with relevant stakeholders. Lessons learned from

[1] For more on EU Land Cover Statistics, see EUROSTAT, 2021.
[2] For more on European Bioeconomy Strategies, see Park and Grundmann, 2022.
[3] For more on EU Regulation for Direct Payments for Farmers, see Official Journal of the European Union - Regulation 1307/2013.
[4] For more on Permanent Grassland Cover, see Schils et al., 2022.

the GO-GRASS demonstration sites and desk research are also included.

Moreover, the takeaways from the **Green Week event** held in June 2023 (and co-organised with the **Biorefinery Glas project**) have enriched the White Paper. During this online event, experts highlighted the importance of connecting farmers, practitioners and researchers to test the technologies and develop skills (entrepreneurship, agronomy, farming, engineering and technology), while revitalising advisory services and farmer cooperatives. Agri-food experts and stakeholders proposed to add more value to grassland through the CAP and make the voluntary eco-schemes more competitive for farmers. Grasslands can be used for nature restoration purposes and for the bioeconomy, but it remains difficult to optimise all the needs given the limited land and biomass. In the current policy context, all environmental benefits should be integrated into the legislation and incentive structures, in connection with restoring nature (in line with the **Nature Restoration Law** and the carbon farming expert group launched by DG CLIMA).

The White Paper is structured in the following way:

- The needs and current challenges for grassland valorisation in Europe;
- Grasslands as a key resource to revitalise rural areas, explaining the opportunities for their valorisation, and drawing on the findings from the four GO-GRASS demo sites;
- Innovative technologies and value chains that can contribute to the development of new circular grass-based business models;
- How innovative grass-based business models may be fostered by supportive business environments;
- The main policy gaps that need to be addressed to improve the value creation of grasslands extrapolated from the GO-GRASS demonstration sites and related projects.

1.2 Needs and current challenges for grassland valorisation

The trend in agricultural land cover in the EU has so far been towards a decrease in arable land, underpinned by fewer hectares of permanent grasslands and meadow[5]. This is in sharp contrast to the important benefits and services that grassland brings to society. Grassland habitats are ideal for a vast **diversity of species** and they are vital as breeding grounds for birds and invertebrates. Indeed, they are among the most species-rich habitats on Earth[6]. High plant diversity gives rise to high microbiota and arthropod diversity and can support grassland-adapted birds and other species such as rodents. Grasslands boast large numbers of insect species such as grasshoppers, beetles and solitary bees,

[5] For more on Grassland and Cropping Patterns, see Eurostat 2016.
[6] For more on Grassland Biodiversity, see Petermann and Buzhdygan, 2021.

which need plant biomass, nectar and pollen as a resource, or that use the often warm habitats and partly open soils for breeding. Vertebrate herbivores are another major group that benefit from the large biomass production in grasslands. Many bird species use the short grass of steppes or grazed meadows for breeding, and they are particularly vulnerable to changes in nutrient status and management.

Grasslands provide important **ecosystem services**, including erosion control, high water infiltration capacity, and water purification linked to nitrate uptake. They also act as carbon 'sinks': grasslands store about 34% of the global terrestrial carbon, from which, about 89% of this grassland carbon is stored in the soil[7]. However, only carbon associated with the forest biomass (both above and below-ground) is considered as part of the carbon accounting in the national carbon off-setting projects considered by the IPCC, while neither the forest nor grasslands soil carbon storage are considered[8]. Nitrate leaching is low from grasslands due to their long growing season and active roots year-round, and even intensive temporary grassland can secure a significant reduction in nitrate leaching compared with arable crops[9]. They provide a wide range of public goods and services, ranging from direct recreational and tourism opportunities to indirect benefits such as fodder supply to produce meat and dairy products.

Grasslands are essential for feeding livestock, which are used for milk and meat for human populations. Grasslands are the cheapest source of feed to supply grazing livestock and can thus contribute to reducing livestock production costs. Valorisation of grassland is important because otherwise it can be taken over for "higher yielding" alternatives, such as intensive croplands. Ploughing permanent grasslands or converting them to intensive croplands, favours soil aeration and microbiological activity that mineralises the organic matter and **releases carbon and nitrous oxide to the atmosphere**. In addition, there is a risk of nitrate leaching into surrounding waters, which may cause eutrophication and additional greenhouse gas emissions to the atmosphere.

The **decrease in permanent grasslands can lead to ecological threats such as increased nutrient leaching** in the case of conversion to arable land with intense fertilisation. Abandonment of perennial grazed grasslands has led to an **increase in wild fires**[10] in some regions in Europe due to the establishment of pioneer woody biomass growth[11]. The heathlands are very flammable in dry summers and can act as catalysts in case of fires, in contrast to the protection that grazed grasslands give against fires[12]. Grazing provides a financial return and increases the length of time between consecutive mechanical or burn treatments[13].

Climate change and its effects on grassland productivity vary across Europe, with increas-

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[7] For more on Soil organic carbon stock in grasslands, see Eze et al., 2018.
[8] For more on Ecosystems Carbon Storage, see Liu et al., 2018.
[9] Manevski, K., Lærke, P.E., Olesen, J.E., Jørgensen, U., 2018. Nitrogen balances of innovative cropping systems for feedstock production to future biorefineries. Sci. Total Environ. 633, 372–390.
[10] Moreira, F., Ascoli, D., Safford, H., Adams, M.A., Moreno, J.M., Pereira, J.M., Catry, F.X., Armesto, J., Bond, W., González, M.E. and Curt, T., 2020. Wildfire management in Mediterranean-type regions: paradigm change needed. Environmental Research Letters, 15(1), p.011001
[11] For more on Wildfires in Europe, see Jaime de Diego et al. 2021
[12] For more on Fire-Prone Shrublands, see Celaya et al. 2022
[13] Rigolot, E., Fernandes, P., & Rego, F. (2009). Managing Wildfire Risk, Prevention, Suppression. Living with wildfires, what science can tell us. EFI Discussion Paper, 15, 49-52.

ingly warmer and wetter winters in the North of Europe and increasingly warmer and drier summers in Southern Europe. According to a scientific literature review carried out by Ergon et al. (2018), warming and elevated concentration of atmospheric CO_2 may boost forage production in the Nordic region[14]. In contrast, production in Mediterranean areas is likely to become even more challenged by drought in the future. Under these unpredictable conditions, plant diversity at all levels is a good strategy to increase grassland buffer capacity.

The decrease in grasslands surface in the EU leads to a reduction of their associated ecosystem services such as biodiversity and soil quality. Valorisation of grasslands through the development of new grass-based products could help to valorise these systems helping to restore their environmental associated benefits.

[14] For more on Forage Production under Climate Adaption, see Ergon et al. (2018)

2. GRASSLAND VALORISATION THROUGH INNOVATIVE TECHNOLOGIES AND VALUE CHAINS

2.1 New technologies, value chains and optimal scenarios: creating opportunities and markets for grass-based products

The farming sector is currently the biggest user of grass from a valorisation perspective: in both its various natural (e.g., pastures or meadow areas) and processed (e.g., pellets, hay, or silage) forms. However, increasing amounts of grass from agricultural and non-agricultural areas (e.g. roadsides, fallow lands and natural reserves) are of little value as fodder for agriculture. This is an important motivation to develop the use of grass for alternative material or energy purposes.

GO-GRASS has explored how selected grass types could be processed into novel products. It is indeed a key learning from GO-GRASS that **the success of new grass-based products depends on their commercial potential**[15]. This implies that the new grass-based product should target a market experiencing a pull-effect, meaning that market demand criteria include other conditions besides competitive pricing. On the right are some GO-GRASS products-based examples:

[15] For more on Success Factors of New Grass-Based Production, see Orozco and Grundmann, 2022.

Demands of the organic farming sector in Denmark for local organic feed production stimulated a market for local feed protein. By developing a value chain and optimising the process, it has been proven that fresh-cut grass can be processed into a feed protein for monogastric animals used by organic farmers. The commercial success of this example relates to the higher prices in the organic market compared to conventional feed protein concentrate, continuous improvements in the efficiency of the process and value chain cooperation, and the strong market pull towards finding good quality alternatives to the current import of organic soya. In addition, the well documented ecosystem services of grasslands have created a general support for this value chain development from policy makers, NGOs and the broader industry.

Reed canary grass is common on farmlands in Northern Sweden and farmers have traditionally used it for feedstuff for their animals, but different projects and initiatives have tested and used it as biofuel during 1980-2011. By developing a process to be installed in farms, farmers are granted an opportunity to process the senesced and dry grass – which is cut in spring anyway – into animal bedding material. In this example, commercial success relates to the market accessibility of the new grass-based bedding and its easy use.

In the Lower Oder Valley National Park in Germany, grasslands are being monitored and areas where ground nesting birds are found may only be harvested after mid-August. This late harvested grass has low feed quality and is not well suited for biogas production but has a high primary energy content and is suited for the combined production of biochar and heat. The produced biochar is a soil amendment with many benefits, such as increased water and nutrient retention and can be used to ameliorate deteriorated agricultural land, along with sequestration of biogenic carbon in the soil. The produced heat may be used to substitute current heat production with fossil fuels. Thus, overall farmers may be encouraged to attain nature conservation practices with minimal management effort to produce a high-quality soil amendment and renewable energy, based on local otherwise wasted feedstock.

Roadside grass and nature areas are usually harvested once or twice a year in the Netherlands. In the case of roadside grass, it is normally composted or left on the side of the road due to its low feed quality and the possible presence of contaminants and rubbish. Yearly harvested grass holds a limited amount of protein, but is rich in cellulose, as opposed to young green grass. Cellulose is the building block for cardboard and paper, currently obtained from softwood trees. The valorisation of nature and roadside grass into paper and carton is a suitable option for a local fibre supply, which does not compete with feed or land. In the production process, biogas is produced. Locally grown fibres have a lower carbon footprint due to lower transportation costs and different processing, when compared to wood, which is not commercially grown in the Netherlands for paper production. In this example, commercial success relies on the improved environmental impact of locally produced grass-based fibres, from a low-value stream.

The examples demonstrate that the commercial success of new grass-based products depends mainly on market demand and value chain coherence. The new products, as illustrated by GO-GRASS examples, are introduced in market segments where well-known products drive market development. It is recommended to look deeper into the mechanisms that facilitate the shaping of markets for grass-based products and, to investigate the demand patterns for them. It is essential that these new products demonstrate attributes that distinguish them from existing solutions, for example by emphasising **sustainability, local production, and organic and circular qualities.** Grass-based products are still niche products demanding only a few per cent of the market in their respective segments (existing products include e.g., soya protein, wood pellets, cutlery and cups, paper, energy, packaging), and a deeper examination of customer preferences, supply chain characteristics and market conditions is needed.

In addition, lock-ins relate to investments in farm machinery, facilities and labour for handling grass as a feed source, or the procedures, machines and public resources and actions deployed for managing roadside verges. However, the abundance of grasslands and great variation in grass typologies across Europe and a strategic focus at the European level on bioeconomy, Green Deal, rural revitalisation, and innovation make it clear that market development is central to enhancing innovative grass valorisation.

Current policies do support land use to ensure agroecosystem sustainability within Pillar I of the Common Agricultural Policy. However, neither the direct payments nor the eco-schemes are thought to support the value chains in the post-2020 CAP. In the 2014-2020 CAP, support for value chains is associated with some Pillar II measures, which in the case of the livestock-derived products is poorly implemented[16].

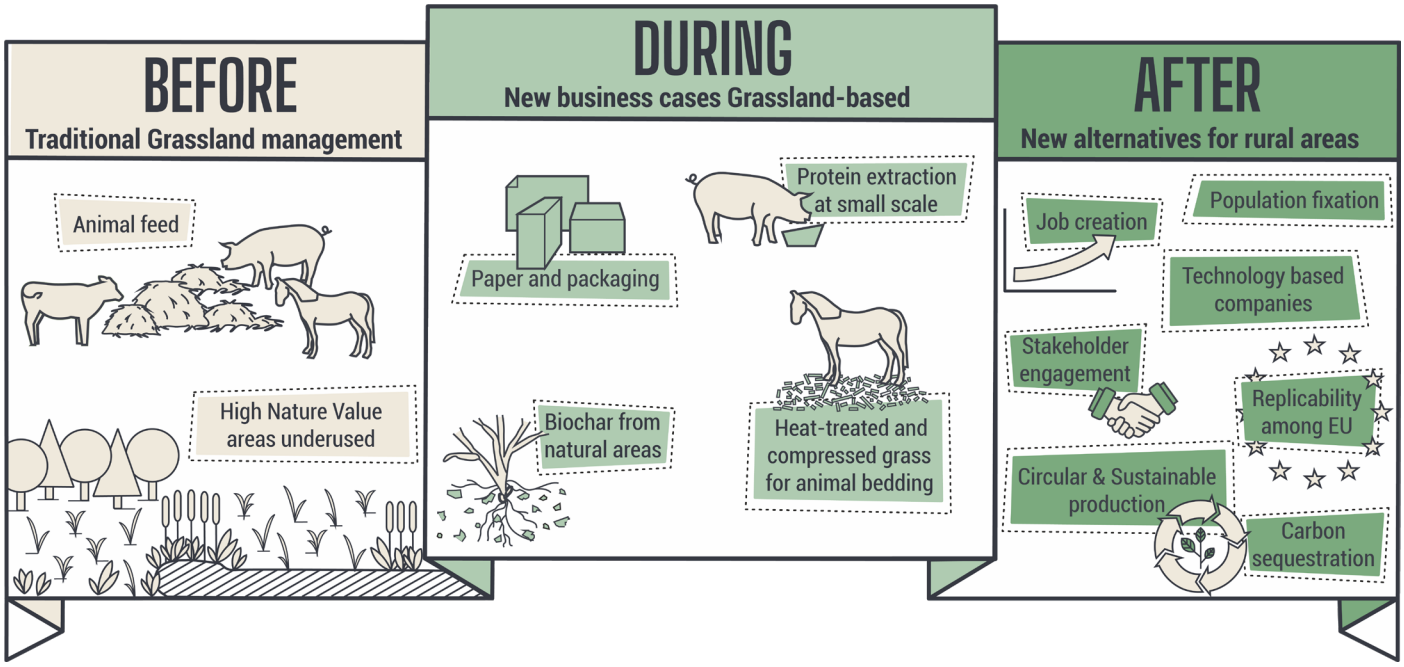
The importance of developing new and alternative grass-based products for the valorisation of grasslands systems seems unquestionable. However, it is also important to optimise the new value chains to exploit by-products together with the development of new technologies aimed at the recovery of potential high-value products from the residues. The carbon efficiency of value chains could be considered as a new evaluation parameter alongside carbon footprint and circular aspects.

Development of markets and value chains for grass-based products are inter-related with the supply and demand for conventional and currently used non-grass-based products, thus pointing at highly diverse markets functioning across several sectors (e.g. agriculture, energy, materials, etc.). Due to the abundant volume of grasses and great variation in properties of grass types, the potential for shaping new value chains is important and covers different scales.

[16] For more on Silvopasture Policy Promotion, see Rodriguez-Rigueiro 2021 and Mosquera-Losada et al., 2022.

2.2 Four demo sites developed within GO-GRASS

GO-GRASS is a Horizon 2020 project which is developing circular and sustainable business models with high replication potential that can be used by entrepreneurs, local authorities, and other stakeholders. The project is demonstrating innovative technologies, processes, and tools applicable within four diverse demonstration sites.



DENMARK

The demonstration site in Denmark aims to develop a small, farm-scale biorefining technology to extract protein concentrates for monogastric animals from grassland situated in nitrate-sensitive areas. Danish agriculture is intensive, and 87% of the agricultural area is in crop rotation.

Main characteristics:

A green biorefinery is used for extracting protein from grass. The extracted organic protein concentrate can be fed to pigs and poultry to enrich their diet and substitute soya meal. Other product streams are a fibrous pulp, that can be used for ruminant feed, biogas, or biomaterials as well as brown juice that can be used for biogas and subsequently as fertiliser. The facility is working on the optimisation of biorefining processes to **provide high yields and high purity of the protein product as well as quality co-products in the form of renewable bioenergy and recycled nutrients.**

Innovative technology:

The demo is testing and optimising new integrated technology and demonstrating it in an industrially scalable facility. The main innovation of the process revolves around using different grasses and legume mixes, harvest and logistics, and mechanical wet fractionation to increase yields of protein at scale. The increasing quality of protein concentrate is tested in feed trials with pigs and the fibre pulp is tested in large farm-scale feeding trials with dairy cows. The demo is cooperating with new commercial biorefineries in Denmark to develop and implement the technology for processing grass and legumes. These biorefineries will produce first a commercial protein concentrate to substitute soya, a fibre fraction for cattle feeding/biogas production and a brown juice that can be used for biogas production. This will open a new market and contribute to the required reductions in nitrate leaching required by the Water Framework Directive by converting annual cropland into more or less permanent grassland[17]. The establishment of grass-derived protein for organic farming in Denmark would contribute to the **reduction of soya imports and derived emissions from the long transport and destruction of ecosystems in the local area exploited for soya production.**

[17] For more on Feedstock Production to Future Biorefineries, see Manevski et al., 2018.

GERMANY

In **Germany**, the demonstration site targets to produce biochar via the carbonisation of **grassland-cuttings from wetlands** as a supplement for soil improvement.

Main characteristics:

The German demo site at National park lower Oder valley converts low nutritional quality grass from the wetlands into biochar. By implementing a first complete processing line, the grass is converted into biochar via pyrolysis (thermal decomposition in an inert atmosphere). The final product can be used on agricultural farmland, where it may provide a multitude of benefits, such as **increasing water holding capacity and nutrient retention of the soil.** During the conversion process, large amounts of energy are released, which can be used for heat generation. A large fraction of carbon from the grass remains in the biochar and is returned to the soil. Therefore, the overall process may be viewed as a **decentralised carbon sequestering technology that releases energy and produces biochar, which contributes to negative emissions.**

Innovative technology:

The demo valorises the late-harvested grass into biochar through the process of pyrolysis. For this, the heterogeneous grass biomass from conservation areas must be conditioned for pyrolysis in an innovative process step. The biochar can be applied site-specifically as a soil amendment to agricultural fields outside the National Park. This process increases the fertility and water-holding capacity of the soil. The biochar can be mixed with compost, biogas digestate or manure to enrich the char particles with nutrients before it is applied. This conversion of the grass to a stabilised char can contribute to capturing and storing carbon in the soil, therefore increasing its fertility. Once implemented, this innovation can also be used to valorise other types of lignified biomasses e.g., from urban parks, nutrient-poor grasslands and even roadsides.

THE NETHERLANDS

In the **Netherlands**, the demonstration site uses digester and fermentation technology to produce paper and cardboard products from **roadside grass and nature or fauna grass.**

Main characteristics:

The demo develops a process to extract fibres from roadside and nature grass to produce high-quality packaging and paper, besides biogas. Partners of the Dutch demo site optimise the technology of reducing sugars by digestion and separating and cleaning fibres from the grass. They also develop a cleaning system, which will separate unwanted components from the harvested grass. The final grass-fibre used to fabricate the end-products reduces transport costs and have less chemical usage for preparation than fibre produced out of wood.

Innovative technology:

The grass-fibres are separated and isolated through a digestion and washing process and then used to produce paper and cardboard. The process of turning a low-value resource into paper generates value and revenues for farmers, other landowners and (regional) governments. The solution reduces the costs previously needed for disposing of roadside grass. The environmental benefits are also clear, as fewer trees have to be cut for the production of paper. The small-scale production of paper, where a small portion of grass (8%) is added, is a process that already exists. However, **liberating the cellulose from the grass and almost completely substituting all the wood-based cellulose is a breakthrough innovation in the paper industry.** Some preliminary results on the environmental assessment of the grass-based paper obtained from the Dutch demo imply a lower carbon footprint when the whole value chain is considered (from the cultivation until the product fabrication) even when considering that the energy needs for grass dewatering are higher than for wood dewatering. However, there are some other components of the value chain, such as less heating and fewer chemicals for the extraction of vegetal fibres from grass than from wood, that reduce the environmental impact of grass-based paper.

SWEDEN

In **Sweden,** the aim is to establish briquetting and shredding technology at local and small-scale to produce heat-treated animal bedding using **reed canary grass**. There are big areas in Sweden that are abandoned and drained peatlands, which are a source of carbon dioxide emission. Swedish authorities have so far only suggested to rewet these areas to stop the CO_2 emissions but research shows that a crop like reed canary grass, with its deep root system and viable growth, can establish several benefits on these fields that are rich in organic matter: acting as a carbon sink, providing biodiversity particularly in forest regions and producing biomass to replace fossil fuel and/or other materials.

Main characteristics:

Reed canary grass is shredded, pressed into briquettes with screw presses and then shredded to flakes – an innovative material for animal bedding, which afterwards can easily be used as fertiliser, as well as for biogas and energy production. **The screw press with a temperature high enough to reach the hygiene quality and the shredding of briquettes are key components in the process.** Reed Canary Grass is a much more suitable source for animal bedding than the materials used so far – sawdust and wood shavings – which hold more potential for use in biorefinery processes or material development. Furthermore, reed canary grass bedding with manure will result in higher efficiency of the biogas process and contribute to increased circularity.

Innovative technology:

The main technology applied in the demo is the briquetting of reed canary grass and shredding of the briquettes at local and small scale. These two main components are the process of converting an agricultural crop into uniform shapes, and facilitating its handling and storage. To provide this supply, the briquetting technology needs to be optimised with the other technologies such as grass shredding, briquette shredding and packaging to create a new affordable production chain that meets the customers' needs.

3. INNOVATIVE GRASS-BASED BUSINESS MODELS SUPPORTED BY SUITABLE BUSINESS ENVIRONMENTS

3.1 Grass-based business models and benefits of the grass-based products

The four GO-GRASS demonstration cases underline the potential of grass-based business models. One of the strengths of the business models is the availability of unused grass as the key resource to produce local-based products and services. **The end-users of most of the primary products are farmers or local manufacturers,** and this enables the creation of backward and forward linkages with other economic and social activities at the local or regional levels; resulting in further opportunities for diversifying business models such as biogas or fertiliser production to complete the circular economy model.

The business model of the demonstration case in Sweden combines better use of the product, reduces transport needs, and the straw and manure can be reused in agricultural farms and gardens.

In the business model of the Dutch demonstration case, the main value proposition is its high-value products made from the low quality and waste grass. This has enabled a more sustainable production of paper and cardboard and new revenue stream and circular valorisation of the liquid fraction for farmers and landowners. **The customer segments indicate the multi-faceted local benefits and beneficiaries of the business model for grass delivery by the landowners, local/regional governments, or natural park management organisations.** Paper and cardboard manufacturers buy the grass fibre while farmers can draw additional benefits from the liquid fraction.

The unique value proposition of the business model of the Danish demonstration case is the co-production of high-value products from grass biorefining and reduced nitrate leaching to support farmers continued license to produce. The biorefining products include organic protein concentrates, high-quality roughage for ruminant feed, and biogas recycled fertiliser from treated biomass. The production of organic protein enables the opportunity to substitute part of the large import of soya bean products, which are used for feed – especially critical in organic farming because organic soya is increasingly difficult to import in the needed amounts. **The main customers are cooperatives, farmers and other local community actors.** Denmark's leading position and political support in developing technologies within biorefining of green biomass has provided the opportunity for the advanced development of the business model and its local commercialisation in Denmark while the GO-GRASS project has been running.

In the German demonstration case, an important area of grassland is underutilised due to the low quality of the grass either for feed or as inputs for biogas production. The value proposition of the business model for biochar production in the demonstration case

in Germany is to increase the water holding capacity, retain nutrients, and store carbon in the soils where it is applied.

The demonstration cases highlight that grass-based business models can create backward and forward linkages with different sectors and local actors. These provide a big potential to close the circular economy model, contribute to sustainability and create different revenue streams in the business models. New sources of revenues such as payments for storing carbon and for the liquid fraction as fertiliser are yet to be exploited to establish new revenue streams to achieve the large potential, and there is a need to create awareness with potential customers about the products and services.

3.2 Supportive business environments and enabling institutions

Grass-based technological and business innovations require supportive business environments and enabling institutional settings to materialise[18].

Some biogeographical regions in Europe researched in GO-GRASS have implemented policy measures to support the development of a circular and bio-based economy. For example, innovative grass-based businesses benefit from regularly adjusted regulations and administrative procedures to develop more sustainable products[19].

Scaling up grass-based innovations and businesses requires investment and access to financial resources. The availability of sufficient direct funds is one of the necessary factors promoting alternative grass-based products and services. Funding opportunities designed to incorporate and promote the specific benefits obtained from grass-production and processing are major enablers from the enterprise's perspective. Practitioners welcome clear and dedicated regulations that specifically support the development of a grass-based industry.

Consumers, farmers and industry's demand play a decisive role in the development of innovative grass-based business models. GO-GRASS findings suggest that building a high level of confidence and trust regarding the quality of grass-based products has a positive impact on consumers' willingness to choose grass-based products. Product certification and clear information on the verified quality, usability, production methods and raw materials used in the production of grass-based goods contribute to the consumers' choice of grass-based products. Consumers can stimulate companies to innovate and supply more resource-efficient goods and services. Appropriate price signals and adequate labelling with clear information on the sustainability of grass-based products are supportive instruments for the development of a grass-land-based bioeconomy.

Creating an enabling environment for innovative, emerging grass-based business models through raising consumer perception and opening market opportunities is a long-term endeavour. Complementary activities should be added to this to be achieved in the short

[18] For more on Developing a Sustainable and Circular Bio-Based Economy in EU, see Lange et al., 2021.
[19] For more on Success Factors for Grass-Based Businesses, see Orozco and Grundmann, 2022.

medium term, e.g. in the areas of technology, knowledge, resource and infrastructure, and funding.

The GO-GRASS experience shows that the implementation of successful business models requires not only technical innovations but also **institutional and organisational or social innovations** that contribute to more cooperation, joint strategy setting, shared governance models and learning at business and other levels. A thorough and comprehensive understanding of the local interdependencies between grass-based business models and their business environment can significantly help to adequately address any misalignments that may hinder the development of business activities.

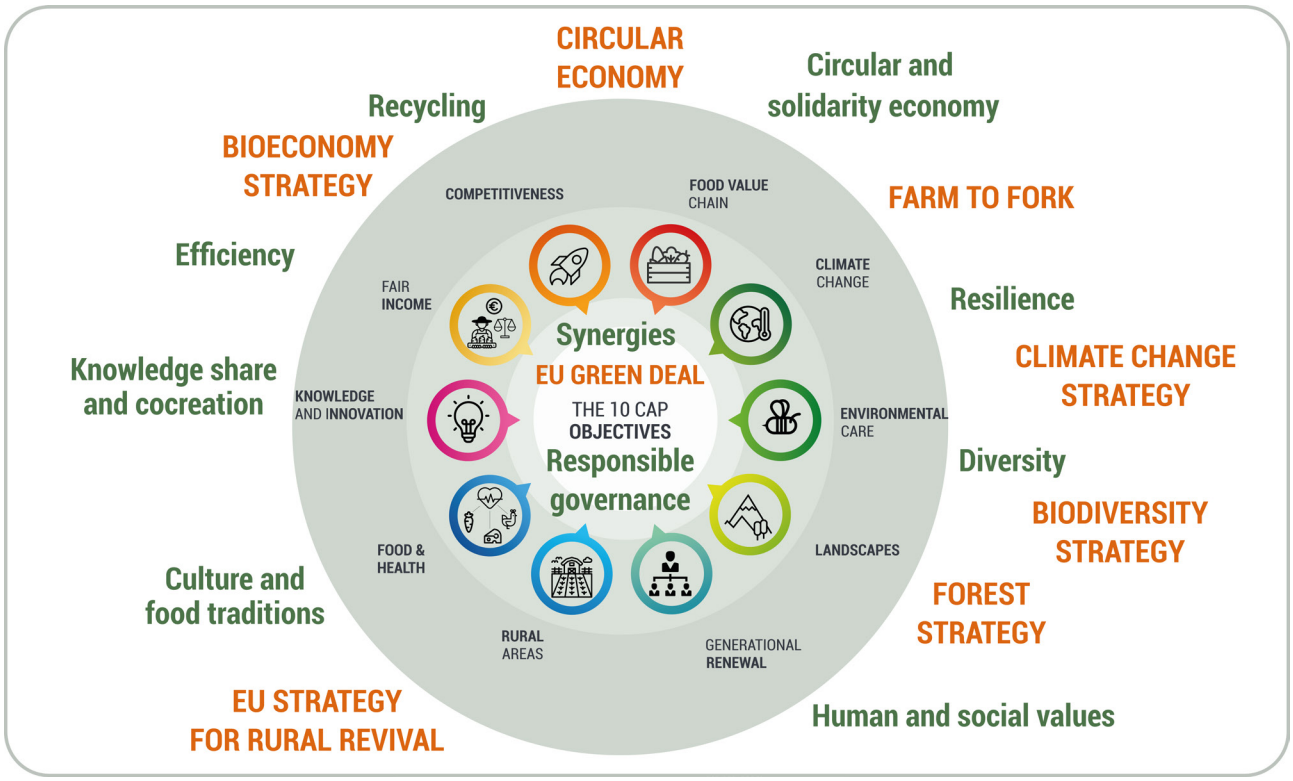
Supportive conditions for creating enabling business environments for grass-based business models are the results of coordinated efforts from stakeholders, such as public agencies, research institutes, cooperatives, networks, or associations interacting with the enterprises. Future policies need to consider social and organisational innovations as part of the overall strategies to promote grass-based business models across rural areas in the EU.

4. GAPS IN EUROPEAN POLICIES AND REGULATIONS

4.1 European policies for the bioeconomy and grasslands

The post-2020 Common Agricultural Policy (CAP) is based on national strategic plans, which are linked to the use of land to fulfil the EU's social, environmental, and economic objectives. Therefore, the CAP is one of the main drivers of agricultural land use across Europe.

After 2007, CAP product-based direct-payments were replaced by land-based direct payments, to increase land use sustainability without differentiating according to the type of land use, products and value chains. The CAP strategic plans do not include payments to products, with these only being residually considered in the coupled payments (e.g. milk). However, the general trend is towards such payments being ended. CAP pays for both temporary and permanent grassland use. Therefore, these CAP grassland payments may increase grass valorisation, as proposed by GO-GRASS, only when abandoned land is transformed into grasslands. This is especially relevant in those areas with a large amount of abandoned land, usually associated with poor production and infrastructure limitations.



EU objectives (in green) in relation to the EU strategies (in orange) and the agroecology principles as a sustainable form of land management.

Pillar II measures that promote value chains, are allocated to the development of products coming from sustainable systems associated with the origin denomination[20]. This could be associated with farm alternative uses, through the promotion of landscape preservation. Pillar I lacks a clear approach regarding the value chain of agro-food systems, and thus, hinders the development of current national protocols to increase CAP payments for grass-valorised products.

The European Commission's **Green Deal strategy** defines new agricultural approaches linked to the agri-food systems. The Green Deal has a holistic approach to farming systems, considering not only the carbon balance in the agroecosystem, but also, the carbon linked to the value chain. Policy makers and end-users need new protocols that enable measuring of this carbon balance to get carbon credits. GO-GRASS evaluated alternative grass-based products, including products to be directly sold or used by farmers (animal bedding, biochar, biogas, protein, fibres). Some of these, especially farms' biogas export, need public infrastructure and control, while others remain under the farmers' control.

The **EU Bioeconomy Strategy,** published in 2012 and updated in 2018, includes the concept of bio-based product development to increase the use of resources. This strategy does not provide specific funding for this, but it does support the development of some European projects and landscape features with high diversity against the background that the EU is aiming to increase these areas to 10% of agricultural land. The Bioeconomy Strategy does not explicitly include extensive grasslands.

The valorisation of grassland biomass is also affected by the challenges of land use in Europe, specifically the **competition in land use, exploitation of marginal land and soil degradation**[21]. Development of the bioeconomy depends critically on preventing conflicts with land usage and other agricultural operations. New biotechnologies that process potentially underutilised biomass in combination with novel value chains may be useful in filling the gap caused by an unsustainable biomass supply[22].

In addition, the lack of EU-specific regulatory instruments to monitor the soil quality and to reduce soil threats, result in clear challenges for bioeconomy development. New channels that foster knowledge exchange between local stakeholders on **sustainable land use management** should align bioeconomy objectives with current policy frameworks. The EU regulations that **monitor the soil quality** for the food and agricultural sectors should be better harmonised.

Besides, EU member states need to fulfil other commitments, such as carbon balance estimation, which requires establishment of carbon accountability linked to the soil carbon stored in permanent grasslands. However, the value chain carbon footprint is not considered per se as part of the accounting.

The European Commission's proposal on **certification of carbon removals**[23] highlights several ways to remove and store carbon, among which, closely related to the GO-GRASS project, are carbon farming and carbon storage in long-lasting products and materials (e.g. biochar). Even though there is no specific mention of "grassland carbon removal" in this initiative, 80% of European grasslands are below saturation of carbon storage, indicat-

[20] For more on European Agroforestry Policy, see Mosquera-Losada et al. 2022.
[21] For more on Value Chains in the European Bioeconomy, see Singh et al., 2021.
[22] For more on Development of Biorefineries in the Bioeconomy, see Ding and Grundmann 2022.
[23] For more on Development of Biorefineries in the Bioeconomy, see EC, 2022.

ing unmet potential in carbon sequestration[24]. The proposal focuses largely on forestry and wood-based carbon storage. However, from a carbon-offset perspective, conserving grasslands and promoting rangeland practices that promote reliable rates of carbon sequestration could help meet the emission-reduction goals more readily than conserving the forestry[25].

The fluctuation of grassland soil organic carbon stocks stems from complex interactions between grazing, soil carbon inputs and decomposition processes[26]. Intensive grassland management such as continuous livestock grazing reduces plant cover, diversity and productivity, but seasonal or rotational grazing show the least negative effects and can even promote soil carbon storage[27]. The perennial grasses that dominate grasslands are characterised by extensive fibrous root systems that often make up 60-80% of the biomass carbon in these ecosystems. To optimise grassland utilisation as carbon sinks, the restoration of grassland, particularly in the regions where they are most degraded or non-existing, to prevent their further degradation due to global changes and overgrazing is crucial. Secondly, though the aboveground vegetation of grassland is a small proportion of the total ecosystem carbon pool[28], the excess biomass generated from grassland management can be valorised to produce innovative bio-based products, which could further contribute positively to the carbon removals. Therefore, the grassland ecosystems may be considered as critical to reach net zero emissions.

All GO-GRASS demonstration cases show strengths, weaknesses, opportunities and threats with regards to implementing **carbon removal as a revenue and business model.** The strengths revolve around the important potential, as well as the additional long-term benefits provided. The weaknesses are related mainly to a lack of knowledge, and barriers to standardisation and governance or coordination. The opportunities exist, as well as the threats, which are mainly related to uncertainties and policy inconsistencies especially for local actors. A preliminary assessment shows that business models for carbon removals at farm level are particularly suitable for the demonstration cases of GO-GRASS related to **biochar production, animal bedding and organic protein from grass.** Models outside the agri-food chain require a certain scale of production, which could be the case for the demo producing paper and packing material from roadside grass and grass from parks and sports areas.

The most important needs for action and policy recommendations for the EU countries can best be formulated from the perspective of the main products and value chains developed in GO-GRASS. Their contribution to achieving the objectives of the EU CAP is prioritised when deriving the following recommendations:

[24] For more on Grassland Soil Carbon Sequestration, see Bai et al., 2022.
[25] For more on Grasslands as Carbon Sinks, see Dass et al., 2018
[26] For more on Climate Effects from Managed Grasslands, see Chang et al., 2021.
[27] For more on Grassland Soil Carbon Sequestration, see Bai et al., 2022.
[28] For more on Grassland Carbon, see Ontl and Janowiaw., 2017.

BIOCHAR

The geopolitical situation around 2022 in Europe has strongly affected European prices of raw materials, energy and fertiliser, with prices in many member states still not fully recovered. Within this context, the European Commission released a communication on 9 November 2022 on **ensuring availability and affordability of fertilisers**[29] including measures aimed (among others) at improving access to organic fertilisers and nutrients from recycled waste streams, especially in regions with low usage of organic fertilisers. The current European policies and strategic plans aim to strengthen the resilience of the EU's agricultural sector, reduce their dependence on synthetic fertilisers, scale up the production of renewable energy without undermining food production, and transform their production capacity in line with more sustainable production methods (Member States' CAP Strategic Plans). In this context, biochar from grass as a fertiliser additive can help to better enrich nutrients in the soils and improve the water retention capacity of the soils.

With regard to the sustainability of the production and use of biochar as a fertiliser additive, it is important to examine how grass as a raw material for biochar production is sourced and to monitor competition in land use. The sustainability of raw material inputs is also covered by the Waste Framework Directive (including the hierarchy of waste and the conversion of fertilising products). This is relevant for some types of grass, such as grass from roadside areas, which are sometimes given the status of waste products or are considered part of the waste stream, which in turn hinders further valorisation and use of the products. It is important for policymaking to consider and value the impact and environmental performance of grass-based biochar and other grass-based products and to avoid the waste status of grass.

Business expectations: The expected shortage of phosphorous fertilisers is due to a shortage of raw materials (in this specific case phosphate rock). The increasing price of mineral fertilisers, triggered by supply chain interruptions and the energy crisis (European Commission, 2022) highlights the role of biochar as nutrient retainer. The success of the grass-based biochar business model requires an adequate and supportive business environment. The current and expected future price increases of fertilisers are the result of raw material shortages, production methods and market structures. It also reflects a lack of development and application of other fertiliser options, nutrient sources and nutrient management. The success of the grass-based biochar business model requires an adequate and supportive business environment.

[29] For more on Fertilisers Availability and Affordability, see https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0590(01)

Policy recommendations: The production and use of biochar can make a valuable contribution in many respects and should therefore be directly promoted by political decision-makers in Europe. Improvement of economic and legal conditions for the production and use of organic fertiliser from residues and waste, emphasised in the Commission's communication on ensuring the availability and affordability of fertilisers, will enhance opportunities for the producers and users of grass biochar. Member States should include this mitigation activity as part of the IPCC accounting and the certification scheme of carbon removals to help reach net zero emissions[30]. This will help create an appropriate market for the carbon credits associated with the biochar, as it has already been developed (GRA 2020[31]). From a CAP point of view, both the agri-food system and the farm scale should be incorporated to account for the benefits of using the grass from the climate neutrality perspective. Finally, the potential contribution of biochar supply chains to the socio-economic development of agricultural and rural communities should be considered in supporting policy measures.

GRASS FIBRES FOR PAPER

Business expectations: The growing need to replace plastics with packaging made from renewable materials such as paper fibres from grass and the opportunity to use surplus grass resources, thereby helping to protect nature and biodiversity, make the grass-based paper business attractive.

Policy recommendations: The innovative use of grass to deliver grass-based paper products is still in a very early stage of development. Once the technologies and business models have matured with the help of projects such as GO-GRASS, Member States should support its replication in other companies with the same business model or support already existing paper production companies to integrate grass resources in their range of materials and products. This could be fostered through direct payments or tax reduction incentives. Moreover, forest tree species are not currently suitable to receive CAP direct payments, while grass production associated with EU farming systems usually receives CAP direct payments, which is an important support for this business model. The actual benefits and negative effects of producing and harvesting raw materials from grasslands and forests respectively should govern payments in the future.

[30] For more on Certification Scheme for Carmon Removals, see EC, 2022.
[31] For more on Carbon Sequestration thought Biochar, see GRA, 2020.

GRASS DERIVED PROTEIN AND BY-PRODUTS

Business expectations: A growing population and increasing prosperity requires increasing amounts of protein to keep up with demands. At the same time in the EU, we have for decades outsourced the protein production and instead built a heavy dependency on import of especially soya protein from other continents to Europe. Grasses and green forages have the potential to become a considerable local source of protein in the EU given its high availability, high protein productivity per hectare, and additional ecosystem services. With the new technology developments achieved in GO-GRASS, the green biorefineries can produce high quality feed proteins for monogastric animals that substitute soya meal 1:1. The development of mechanisms and processes linked to the production of protein products coming from grass is essential for improving EU self-sufficiency in protein. Exploring the use of the green biorefinery value chains with locally adapted grass and legume species across Europe, could make Europe more balanced from a protein perspective and reduce the need for import. The reduction of carbon emissions associated with less transport will also benefit the reduction of the carbon footprint of protein products, when analysed as part of a global perspective.

Policy recommendations: Considering that grasslands are part of the CAP direct payments, the promotion of this activity should come from Pillar II, through the value chain valorisation measure, which is poorly adopted across Europe. The technology to produce protein products is based on specific types of grasses and legumes, and it should be adapted and expanded to other countries considering the different compositions they have in their grasslands. This may be reached through the implementation of operational groups in those countries. The value of new permanent grassland areas to increase soil carbon content and of old grasslands to keep a high stock of soil carbon should be included in the EU carbon removal tools. Converting annual crop rotation into more or less permanent grassland will also reduce nitrate leaching, which can be promoted by subsidies, or by legal restrictions to the level of leaching.

ANIMAL BEDDING

Business expectation: Animal production is likely to increase at the global level due to the growing global human population and consumption of animal products. The scarcity of grassland in extensive agriculture, as well as the intensification of livestock farming, could mean

that animals increasingly have to be kept in stables where bedding material is needed. The possibility of adopting a circular business model will depend on the availability of the grass but also on the availability of other bedding materials. In northern Sweden the availability of grain straw is low, and therefore there is a market for grass-based bedding material.

Policy recommendations: The technique to develop products is based on specific types of grasses, which could be expanded to other countries where animal bedding products are in shortage. An analysis of the potential use of different types of grass as raw material for animal bedding and a comparison with the competitor's end products should be carried out at the demonstration sites level. The funding from operational groups could be key to developing the business models in other areas of Europe. Businesses that include the cultivation of perennial energy-efficient grass such as reed canary grass with a deep root system and good capacity for carbon capture should be included in the carbon removal policy for carbon sequestration.

BIOGAS

Business expectation: With the growing demand and price increase for non-renewable fuels, biogas can make can make a substantial contribution to alleviate fuel shortages and to reduce CO_2-equivalent emissions, if a supportive business environment exists. In addition, the use of fermentation residues from biogas production as fertiliser can help to reduce the rising prices for fertilisers in the European Union. In GO-GRASS, biogas plays an important role as additional value creation by generating biogas from side streams.

Policy recommendations: The policy formulation should consider (i) the level of readiness of the business models in the starting phase when the farmers and rural entrepreneurs are more dependent on economic support to have adequate infrastructures, access to the grid network and training to produce biogas, and (ii) the creation of a business environment that supports the use of the biogas by end-users. From a CAP point of view, both the agri-food system and the farm scale should be incorporated to account for the benefits of using the grass side streams as part of fuel production. This should ensure direct CAP payments for the grassland areas that supply the grass and contribute to the goal of the EU Green Deal to reach a climate-neutral economy with net zero greenhouse gas emissions by 2050.

4.2 Policies applied to bio-based products from grass in specific European countries

The GO-GRASS project identified various requirements and derived good practices based on the demonstration cases in Germany, Sweden, Denmark and the Netherlands. These requirements and practices relate to policy, regulations, markets, funding, resources, education and training, research and innovation, and other areas that are likely to be of importance to potential replicators and policy makers.

Policies applied to paper factories in the Netherlands

A drawback for paper factories to switch to alternative, more locally based fibre sources is the way they define and calculate their own climate targets. The climate targets are usually calculated based on the company's direct GHG emissions (Scope 1), indirect GHG emissions from electricity, heating and cooling (Scope 2) or other indirect GHG emissions (Scope 3). Scope 3 emissions can be both upstream and downstream, and include procurement, transport, production of fabricates or waste management[32]. They make up the biggest part of a company's emissions. However, in corporate reporting, companies often only look at CO_2 emissions from the factory itself, and do not take the value chain into account, which falls under scope 3. From the product perspective, the framework for life cycle assessment and communication (e.g. the European Product Environmental Footprint methodology and International Environmental Product Declaration System) require the entire value chain to be included in the scope of analysis. However, the Dutch government only considers the CO_2 emissions in the factory; therefore, it is beneficial for the factory to reduce emissions there. Reduction of CO_2 emissions in the complete chain is not of interest for larger companies in the Dutch context, since they are not monitored and credited for the processes outside the factory. This is a disadvantage for the use of grass fibre or other alternative natural fibres, considering that the process of papermaking takes longer for alternative fibre when compared to wood fibre. In the same amount of time, less alternative fibre paper is produced, which results in a higher carbon footprint within the factory.

The outcome of the LCA study performed in GO-GRASS suggests that grass fibre is more sustainable than wood fibre in terms of CO_2 emissions. Solutions need to be developed to enable the crediting of the CO_2 emission savings from the use of grass fibres, as this appears to be a major factor hindering the use of alternative fibres in the paper industry. There is an extensive list of EU directives and national regulations that specifies requirements for packaging material, especially for materials that come into direct contact with food. One important regulation is the waste law, which defines when raw materials from grassland are categorised as waste, leading to an extremely difficult situation for grass-based paper companies due to numerous legal hurdles and requirements.

Policies applied to grass biochar in Germany

Farmers receive payment from the government for managing high-diversity, extensive grasslands in national parks and nature conservation areas. This in turn, defines the management practice, e.g. the harvest period. The funding for contractual nature conservation depends highly on the incentives and regulations at the federal state level.

While grass meets the feedstock requirement for biochar marketed as an EU fertilis-

[32] For more on Scope 3 Emissions, see Manevski et al., 2018.

ing product, specified in the amendment to the EU regulation on fertilising products (EU) 2009/1009 in 2021, the current German fertiliser ordinance does not allow the marketing of grass biochar as a soil amendment as it limits the origin of charcoal to chemically untreated wood. The parallel regulations at the EU and national level ensure that the member states consider the specificities of the country and regions in the governance of fertilising products. The producers wishing to market the grass biochar must obtain individual approval for the product or undergo a conformity assessment by a designated assessment body outside Germany in order to be able to market the product in Germany as a fertiliser recognised in the EU. According to the REACH (Registration, Evaluation, Authorisation and Restriction of CHemicals) regulation, biochar producers are required to gather data on the chemical substances of the char and submit a dossier to the European Chemicals Agency, if their production is over 1 ton per year. Biochar can be registered under the charcoal dossier. The registration incurs a cost, and a reduced fee is applied to micro-, small- and medium-sized enterprises[33].The above-mentioned approval procedures as well as the registration under REACH can be costly and time-consuming. Especially, this may place significant financial and bureaucratic burdens on grass biochar producers on a small scale.

The European Commission submitted a proposal on carbon removal certification in 2022, which offers opportunities for biochar. Nonetheless, it is yet uncertain to what extent biochar will be included in the certification scheme. In the pre-legislative synthesis of the European Parliament for the carbon removal certification, the use of biochar was introduced as one of the promising carbon removal strategies. At the same time, the impact assessment report points out that the potential additional carbon sequestration effect of biochar may be limited, as much of the carbon is already sequestered in the feedstock and the additional effect is highly dependent on the type of feedstock used and the conditions of application (e.g. the type of soil and crops).

Policies applied to grass-based protein concentrate production in Denmark

The change of annual cropland into perennial grassland is associated with several ecosystem services, which can be of high value in an intensively farmed country like Denmark. Especially, the significant reduction in nitrate leaching can help fulfil the EU Water Framework Directive, which is otherwise difficult to implement for Denmark. In addition, soil carbon storage can help deliver the emission reduction required by the Danish Climate Law, and reduced pesticide use can help protect drinking water resources. However, as there are no direct economic incentives for farmers to deliver these ecosystem services, there was a lack of pull for their development.

Therefore, the Danish Parliament decided to support the establishment of **green biorefineries** to produce protein concentrate and other products, which can create a market pull for more grassland. The development was initiated by a report on “Proteins for the future” produced by the National Bioeconomy Panel in 2018[34] followed by a government “action plan for sustainable proteins for the future”[35] which included the first 3.4 million € to support the establishment of green biorefineries.

[33] For more on Biochar Registration Regulation, see (EC) No 340/2008.
[34] For more on Proteins for the Future, see The Danish National Bioeconomy Panel, 2018
[35] For more on Danish Action Plan for Sustainable Proteins, see https://fvm.dk/nyheder/nyhed/nyhed/miljoe-og-foedevareministeren-fremtidens-baeredygtige-proteiner-kan-komme-fra-danmark/

Finally, the broad agreement on "Green transition of agriculture" in 2021 allocated 35 million € to support the new business development[36]. These actions, along with general goodwill within farming organisations, agricultural industries, NGOs and the general public to support the transition, have created the foundations for the first two commercial green biorefineries to be established. Additional green biorefineries are expected from 2024, when the support for green transition in agriculture will be implemented. Organic agriculture/food regulation and feed product related regulations are applied to the value chain.

Biogas can be generated from grass fibre, which as a by-product is allowed for use as a supplement to manure and other wastes and will have the same certification status to be part of the EU power grid. This has supported the viability of the business of protein production until now and biogas is expected to become an integrated part of new value streams from grasslands.

The Danish case on producing protein concentrate, fibre silage, and biogas, has been very successful, and the first two commercial plants were established during the project period[37]. The success has been facilitated by the documentation of a "triple bottom line" of economic, environmental, and social benefits that built support from all sides: political, farm industry, farmers, and NGOs, in strong interaction with research. The benefits and triple bottom lines were essential for a new innovative business case to be viable within the agricultural business environment, which is now under great pressure to deliver on climate and environment, rural jobs, and rural development. Involving all stakeholders in the discussion and further development of a new business case is key for a successful outcome.

Regulations and policy context for animal bedding in Sweden

Regulations from the Swedish Board of Agriculture include provisions on animal husbandry. Stables for cattle must be cleaned and emptied from manure every day unless the system for animal husbandry is constructed for other procedures that ensure good hygiene. Lying areas shall be kept clean, dry, and adapted to animal species and thermic climate in the stable. In calving pens, for calves younger than one month, bedding material shall be provided, and it should also be provided for cattle older than one month. During the cold season, bedding material should be provided in lying areas in stables with outdoor-like climates. The bedding material shall be suitable for the animals and of good hygienic quality. The air in the stable may only occasionally exceed threshold values for ammonia, carbon dioxide, hydrogen sulphide and organic dust.

There are also limits for relative humidity. Outwintering cattle that spend more than half the day outdoors must have access to an open shed with clean and dry bedding material during the cold period, i.e., for cattle when there is no growth in pastureland. Similar prescriptions are applicable to horses and pigs. Live animals must have access to bedding material during transportation. These regulations and this policy context are in line with the development and use of animal bedding material from reed canary grass in Sweden.

The competition from other bedding materials (e.g. straw and wood shavings) depends on prices per bedding function, on the price

[36] For more on Danish Green Transition of Agriculture, see https://fm.dk/media/25215/aftale-om-groen-omstilling-af-dansk-landbrug.pdf

[37] For more on benefits of grassland crops and green biorefining, see Jørgensen et al., 2022.

of nutrients and soil improvers that can compensate for removed straw, and on the price of solid biomass fuels in heat and power production. In years when the price of straw is high, animal farmers look for alternatives such as wood shavings and peat. Production of animal bedding based on reed canary grass could contribute to a more flexible and resilient supply and more stable prices of bedding materials and biofuels for heat and power. From the cattle farmer perspective, the higher biogas potential from manure containing reed canary grass compared to straw or wood shavings is also a bonus.

In Sweden, several investment programmes have facilitated the development of biogas production. In recent years, a large part of new production and investment has been run by private companies mainly focusing on industrial organic waste such as manure, waste and residues from agriculture, the food industry, and slaughterhouses. To increase the production of biogas and increase the competitiveness of the producers, support will be granted to biogas producers that upgrade the gas to biomethane (at the most 30 € per MWh) or to liquefied biomethane (at the most about 45 € per MWh)[38]. One shortcoming is that the new common agricultural policy (CAP), that came into force in 2023 on the Swedish Board of Agriculture (**Jordbruksverket 2022**), does not provide any financial support (other than the single farm payment) for the type of Reed Canary grass production included in the demonstration case in Sweden.

[38] Swedish Energy Agency - Energimyndigheten 2022

5. POLICY RECOMMENDATIONS

Based on the main findings of the GO-GRASS project described in this White Paper, the project partners have formulated recommendations to improve the European policy and regulatory framework to support the valorisation of grassland through innovative products and services and to contribute to the revitalisation of rural areas as the basis for an innovative bioeconomy. The specific policy measures and changes proposed next are intended to contribute to a conducive business environment for grass-based enterprises, addressing the environmental, technological, economic, and social challenges. Our recommendations for the grass-based sector emphasise regulations and the creation of market structures for a secure supply of raw materials at stable prices, sufficient and fair market competition, secure and transparent sustainability profiles of bio-based inputs, due diligence of all actors along the value chain, sufficient capacities for funding, regulation and innovation at all levels, and rewarding multifunctional uses of grassland resources.

5.1 Policy measures

The policy actions presented here are based on the learnings, innovations and business models developed in the four GO-GRASS demonstration cases. The compiled policies and support measures were discussed and validated with experts at local, national and EU level, focussing on the development of businesses and value chains at local level.

Measures at EU level

- Design policies that promote opportunities for diversification through grass-based value chains, diverse demand patterns and business models and markets. Future policies need to consider social and organisational innovations as part of the strategies to promote grass-based business models across rural areas in the EU.
- Maintain the area of grasslands at Member State level as part of the greening measures of the Common Agricultural Policy and connect sustainable farming practices with value chains in future CAP grassland payments.
- Remove contradictory and restrictive legislation, which currently limits the potential of carbon removal through grasslands; and introduce legislation that promote the use of grassland for carbon removal.
- Create incentives for farmers to increase carbon capture in grasslands at a feasible and understandable administrative level
- Develop financial incentives to encourage land manager engagement in carbon farming. A formalised carbon credits system as proposed by the EU Carbon Removal Certification can help to increase the market for grass as a resource for the bioeconomy. Carbon credits can reduce the selling price of grass and increase demand.
- Develop monitoring systems to identify trade-offs in ecosystem services and reduce the environmental footprint of new business activities.
- Connect policies on clean aquatic environments with policies about grassland man-agement to reduce nitrate leaching.
- Create incentives for producing bioenergy and preserving ecosystem services provided by grasslands; and connect policy areas to promote grassland valorisation and new business models.

Measures at national and regional level

- Support conversion of arable land into grassland to preserve the environment, build up soil carbon, and facilitate the delivery of resources for biorefineries and facilities that can produce feed, food, materials, and bioenergy.
- Develop specific actions supporting the maintenance of grasslands threatened by abandonment and provide targeted policy support to maintain the ecosystem services related to grasslands (such as fire control, biodiversity, prevention of nitrate leaching, flood and drought mitigation).
- Allow marketing of biochar from alternative (e.g., non-woody) biomass as soil amendment by national fertiliser regulations with proper environmental requirements and provide policy support and advisory services for small- to medium-scale circular biochar business at national or regional level.
- Climate impact calculation should include the upstream and downstream emissions of a company.
- Ensure access to regional and national funding for the development of new technologies for the utilisation of grass and its side streams.
- Address regulations regarding side stream use that set unnecessary barriers to their exploitation.
- Provide tax incentives for circular bioeconomy innovations to encourage investment.
- Support research and development activities to help bridge the gap between innovation readiness and market entry, including relationship building between private actors, universities, research institutes and other research-based businesses.
- Support the establishment and development of sustainable transportation and logistics infrastructure to enable technologies to become financially and environmentally sustainable.
- Introduce measures to stimulate market-pull by consumers and industry for grass-based products.

5.2 Support Actions

GO-GRASS partners also recommend the implementation of the following support actions:

- Increase awareness of the benefits of grasslands through education, workshops, and outreach to consumers via non-specialised media. Enhance the knowledge level by academia and practitioners about the ecosystem services delivered by grasslands. Technological companies can implement business models through a licensing model to obtain revenues
- Organise engaging open policy dialogues to discuss and promote best practices, in cooperation with related projects (Value4Farm, Nefertiti, Super-G, BRANCHES, BE-Rural).
- Establish adequate knowledge transfer actions that allow farmers and end-users to understand the new products delivered from grasslands, including demonstration fields, biorefineries and extension services that allow farmers to understand the new products delivered from grasslands.
- Promote the establishment of community-led initiatives involving e.g. farmers cooperatives and farmer-led associations, through the development of operational groups linked to the EIP-Agri, to foster innovation in the grassland's bioeconomy.

Get in touch & discover more

NOTES, COMMENTS, QUESTIONS?

This space is for you.
But don‘t hesitate to contact us and let us know.