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CIRCULAR ECONOMY Blue-Green Bio Lab

Biomass Types
Policy Brief

Grass as a potential biomass for symbiosis

This brief is a part of the Blue Green Bio Lab Tool Kit, that represents the findings in the Blue Green Bio Lab project. The project targets the urgent challenges of reducing nutrients to waters of the Baltic Sea Region, limiting greenhouse gas emissions, and enhancing European self-supply with food, feed, and energy. Together, aquaculture, agriculture and industry can provide solutions to these challenges through industrial symbiosis based on the sustainable exploitation of local blue and green biomasses initially grown and/or harvested with the objective to produce positive ecosystem services. The Blue Green Bio Lab project is co-financed by Inter-Reg Baltic Sea Region with partners in Denmark, Latvia, and Sweden.

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Description of grass composition

The species composition of grass is highly diverse and varies depending on the geographic location and environmental conditions. Grasslands are found in a wide range of habitats like meadows, pastures, heaths, and other open areas (Picture 1). The most common grass species in Europe include ryegrass (Lolium perenne), fescue (Festuca spp.), bentgrass (Agrostis spp.), meadow grass (Poa pratensis), timothy grass (Phleum pratense), and cocksfoot (Dactylis glomerata).

Picture 1. Grass in the meadow.

The ecology of grass species is characterized by seasonal growth patterns, with most growth occurring in the spring and summer and a period of dormancy or reduced growth in the winter. Additionally, grass species have adapted to grazing by regrowth and survival after grazing. Grasses are also tolerant of nutrient-poor soils where species have evolved mechanisms for efficient nutrient uptake and use, such as deep roots, mycorrhizal associations, and nutrient recycling. It is also common for grass species to thrive in disturbed habitats such as road verges, abandoned fields, and railway tracks. These species often have high seed production and dispersal rates, rapid growth, and a short life cycle.

Grass species provide a range of ecosystem services - soil conservation, carbon sequestration, biodiversity conservation, and livestock feed. Grass has been a significant component of European agriculture for centuries, and it continues to play a crucial role in the region's food production and rural economy. Recently grass has also become an important source of protein, increasingly being used as a feedstock for protein extraction. The extracted protein can be used for example as a source of protein for animal feed and as a base material to produce other protein products. Furthermore, the remaining pulp after protein extraction can also be used as feed for cows.

Several grass species have an increased ability to remove pollutants and contaminants from soil through

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phytoremediation. Tall Fescue has high tolerance for heavy metals such as zinc, cadmium, and lead, and it has been used to remediate contaminated soils in several studies. Ryegrass is effective at removing polycyclic aromatic hydrocarbons (PAHs) from contaminated soils. Rough Meadow grass removes heavy metals and pesticides from soil effectively, while Velvet Bentgrass can remove cadmium and copper. Research on the capabilities of grasses in this area is still on-going but it is clear that grass used in phytoremediation is not suitable as feed to animals.

Climate and environmental goals in the Baltic Sea Region

The Common Agricultural Policy is the main policy instrument of the European Union (EU) for supporting agriculture and rural development. It includes a range of measures aimed at promoting sustainable land use and biodiversity conservation, including support for agri-environmental measures, payments for areas with natural constraints, and support for organic farming. Several targets are set to protect grasslands: at least 5% of agricultural land in each member state should be maintained as permanent grassland, grassland diversity is encouraged, limitation of grassland conversion to other land uses to 175,000 hectares per year, maintain or increase the amount of carbon stored in EU grasslands by at least 10 million tons per year.

Like the European Union's aims for climate neutrality, the Baltic Sea region's goal is to be a climate neutral region by 2050, according to the European Union Strategy for the Baltic Sea Region (BSR). The region should aim for clear water in the sea, rich and healthy wildlife, climate change adaptation, risk prevention and management. The emphasis of needed actions is on the reduction of nutrient emissions, recycling of nutrients, prevention of pollution and strengthening of a sustainable and circular bioeconomy.

The Baltic Sea Action Plan (BSAP) adopted by the Helsinki Convention (HELCOM) is the central framework for implementation of the EU Strategy for the BSR with overall objective of reaching good environmental status for the Baltic Sea by 2030. Actions and measures are designed to strengthen the overall resilience of the Baltic Sea, thus improving its ability to respond to the effects of climate change. The management objective of the BSAP with respect to eutrophication is to minimize inputs of nutrients from human activities, including agriculture. These actions should help to reach the desired state of the marine environment regarding eutrophication with concentrations of nutrients close to natural levels, clear water, algal blooms at natural levels, natural occurrences and distribution of plants and animals, and natural oxygen levels.

The HELCOM Baltic Sea Regional strategy for Nutrient Recycling is another tool for improving nutrient use and reduction of leakages to the Baltic Sea environment from agriculture. The Nutrient Recycling Strategy aims to close nutrient cycles, reduce greenhouse gas emissions, improve soil quality, and enhance carbon sequestration. The circular use of nutrients should be safe and secure, based on the best available knowledge and should encourage new business models together with improved policy coherence. The Strategy has a list of possible measures in the form of a tool box with ideas for nutrient recycling development in the region. The emphasis is on the use of organic fertilizers and nature-based solutions for achieving objectives.

Climate and environmental goals for Skive Municipality and Zemgale Planning Region

This section looks at the translation of goals at the Baltic Sea level to the local scale, through the objectives and actions of two project partner regions of the Blue Green Lab project.

Skive Municipality adopted a new climate action plan in 2022 with the goal of a 70% reduction in CO2 emissions by 2030 and climate neutrality by 2050. These climate targets are in accordance with international agreements and with national targets established for greenhouse gas reduction formulated in the Danish Climate Act. To reach the 70% reduction target by 2030, Skive Municipality must halve their CO2 emissions per year by 2030, i.e. by 314,000 tonnes CO2/year. The large reduction in CO2 emissions by 2030 in Skive Municipality is expected largely due to the development of the Power-to-X industry (PtX) and the transition of the agricultural sector, especially in terms of land use.

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The national agreement on the green transition of Danish agriculture sets a binding reduction target for the agricultural and forestry sector's greenhouse gas emissions of 55-65% compared to 1990 emissions. This agreement is particularly important in Skive Municipality, as approximately 74% of the land use in the municipality is dedicated to agriculture. Skive Municipality's climate goals aim for significant CO2 reductions from land use and plant cultivation by 2030. For example, the use of biochar (produced from straw) for soil improvement of 4% of the cultivated areas would bring a reduction of 35,000 tonnes CO2/year in 2030. Additionally, conversion of 9% of cultivated areas from annual crops to perennial protein grass would result in a reduction of 4.500 tonnes CO2/year by 2030 and 18% of the cultivated areas by 2050, a reduction of 8,700 tonnes CO2/year in 2050. This conversion of large areas to the cultivation of perennial grass is also expected to have a positive effect on the aquatic environment of the Limfjord, as grass requires less fertiliser and therefore reduces nitrogen discharges to groundwater, rivers and the fjord.

Zemgale Planning Region has adopted a development programme for its region until 2027. Sustainable development is a horizontal priority in the programme to achieve climate, environmental and biodiversity goals in accordance with the European Union's Green Deal policy. "Environment, nature and climate change" is one of the development priorities until 2027. The programme emphasizes that the region's development requires smart and sustainable governance, the introduction of green development principles into management and everyday life, and adaptation to climate change. The reduction goal for CO2 emissions in the region is 190,000 tons CO2 by 2027, compared to 230,229 tons in 2020. Activities in the local development programme include increasing energy efficiency of buildings and larger share of renewable energy sources but without any specific numerical goals mentioned. Protection of biodiversity is emphasized by enlarging protected areas, and extended management measures for wetlands as a type of grasslands. The region anticipates adaptation to climate change through the establishment of green and blue infrastructure and improving the environmental status of water ecosystems. The use of locally produced agricultural biomass is foreseen as an input for the development of sustainable bioeconomy.

Options of biomass use for achieving the climate and environmental goals

In general, the use of grass as a biomass can contribute to the reduction of greenhouse gas emissions in several ways. Grass species absorb CO2 during photosynthesis and store it in their roots and soil (Illustration 1).

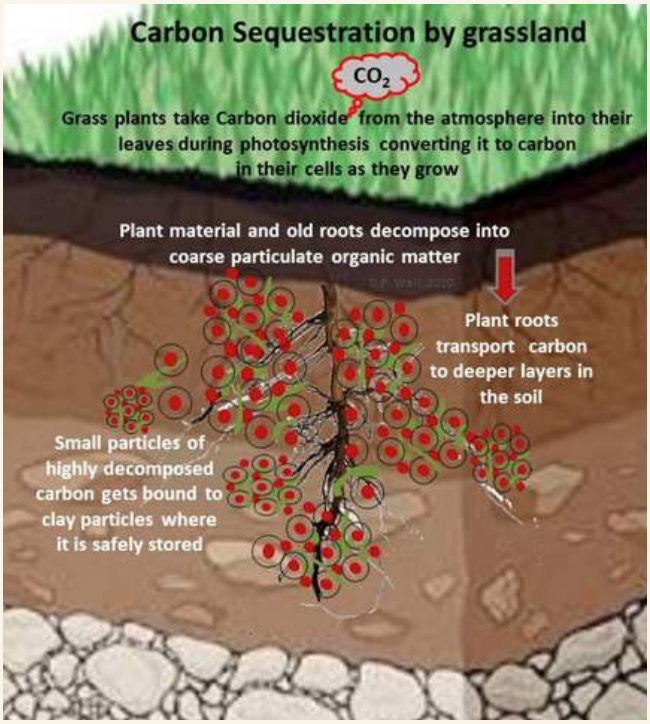

Illustration 1. Scheme of carbon sequestration by grassland, from D. Wall & G. Lanigan, Teagasc.

Grass can be used to produce biofuels (ethanol) replacing some fossil fuels. The use of grasses for grazing and as a feedstock for livestock can reduce emissions from agriculture. By promoting sustainable grazing practices and reducing the amount of feed imported from distant locations, grasslands can also help reduce emissions associated with transportation and fertili zer use (Picture 2). Lastly, the use of grasslands for biomass production can maintain the natural state of the land and avoid the release of emissions associated with land-use change.

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Carbon sequestration rates in grassland soils typically range from 1.5 to 4 tonnes CO2 per hectare per year.

Picture 2. Grassland after mowing, with hay. Photo by Aivars Gulbis, www.redzet.eu.

Grazed grasslands sequester carbon at higher rates than grasslands which are cut for silage or hay. The protein content in annual grasses may be lower compared to perennial grasses, so the option to cultivate perennial grass species like ryegrass (contains 15-25% protein) will be more likely to help achieve climate and environmental goals. Besides carbon sequestration and protein production, perennial species with longer life spans also store more nutrients in their roots and stems, which can be used for regrowth and reproduction in subsequent years.

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Project facts

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Homepage: https://interreg-baltic.eu/project/blue-green-bio-lab/

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