KEY SUCCESS FACTORS FOR CREATING NATURAL CARBON SINKS WITH FARMERS

IMPRINT

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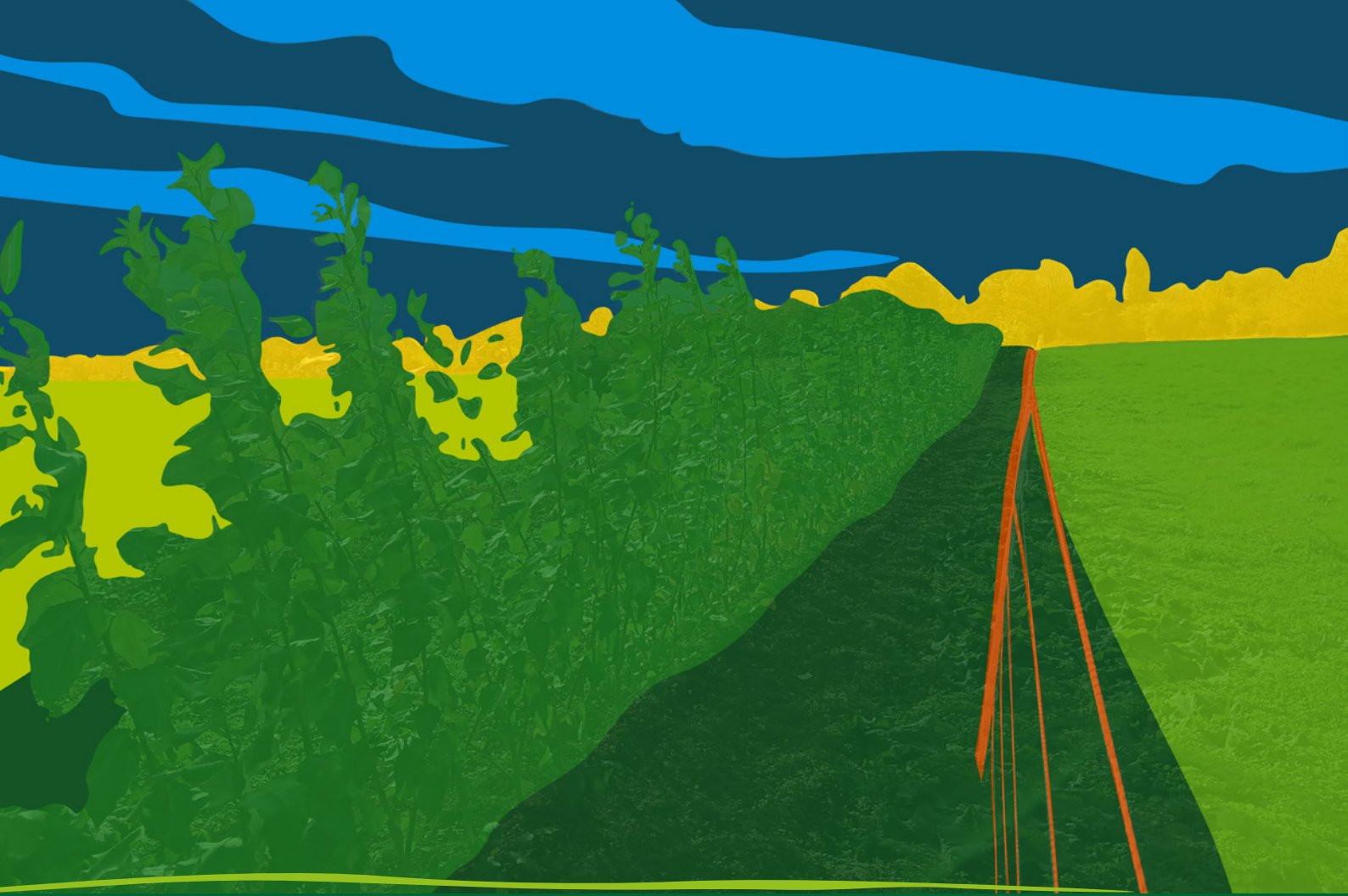


LIST OF ACRONYMS

AFS	*Agroforestry systems*
CH_4	*Methane*
CO_2e	*Carbon dioxide equivalent*
CAP	*Common Agricultural Policy*
GAEC	*Good agricultural and environmental conditions*
GHG	*Greenhouse gas*
GLU	*Grazing livestock unit*
LCA	*Landcare (-like) association*
LE	*Landcare Europe*
LULUCF	*Land use, land use change and forestry*
MS	*Member State*
N_2O	*Nitrous oxide*
NSP	*National Strategic Plan*
SOC	*Soil organic carbon*

1. FARMING AND CLIMATE CHANGE MITIGATION

This publication aims to improve the knowledge of agricultural landscapes as natural carbon sinks.
It is dedicated to farmers, multipliers, and decision-makers in Europe.
Farmers are key stakeholders in mitigating climate change, as the way in which land is farmed has a significant influence on the emission of greenhouse gases. However, soils and biomass also have the ability to store carbon if mitigation practices are applied.

This booklet demonstrates four relevant fields to reduce greenhouse gas emissions *(carbon dioxide (CO_2), methane (NH4), and nitrous oxide (N_2O))* from the agricultural sector and shows best practice cases for their practical implementation: *(1)* healthy soils, *(2)* extensively managed grasslands, (*3)* agroforestry systems, and *(4)* peatlands with paludiculture. It is not intended as a detailed guide to these techniques; rather, it provides an overview of possible methods for further exploration and learning.

Between 2018 and 2022, it is estimated that the EU agricultural sector emitted 377 million tons of carbon dioxide equivalent *(CO_2e)* per year on average, accounting for 12% of the EU's total greenhouse gas *(GHG)* emissions.

In the same period, EU activities in the land use, land use change and forestry *(LULUCF)* sector removed on average 243 Mt net CO_2e annually from the atmosphere, equal to 7% of the EU's annual estimated GHG emissions.
Overall, croplands, grassland, and wetland are net sources of LULUCF emissions. With approximately 61 Mt CO_2e, they account for 1.9% of the EU's annual GHG emissions.[1]

Major drivers are climate change, land use change, and soil erosion. However, healthy peatlands, grasslands, soils and agroforestry systems are natural carbon sinks. The highest soil organic carbon *(SOC)* levels *(EU mean = 318 g kg^{-1})* are found in the wetlands of the Boreal and Atlantic zones *(peatlands)*. The mean SOC content of grasslands is 40 g kg^{-1} and 55 g kg^{-1} in shrubland.
Organic carbon content is the lowest in croplands *(EU mean = 18.3 g kg^{-1})*.[2]
Given that **the way in which agricultural land is used influences its capacity for carbon storage**, there is strong potential in reducing CO_2e from agriculture by adapting farming practices.

It is important to note that farmers in the EU are generally not economically independent, but work with payments that are regulated in the Common Agricultural Policy *(CAP)*.

Consequently, CAP regulations have a strong impact on farming practices in Europe and the carbon balances in our agricultural landscapes.

The EU has defined climate change mitigation and adaptation as a specific objective of the CAP 2023-2027, which includes reducing greenhouse gas emissions and enhancing carbon sequestration, as well as promoting sustainable energy. [3]

The EUKI project **"Common Agricultural Policy Contributions to Climate Protection in the EU"** has shown that the largest potentials for supporting climate-friendly farming in the CAP lie within four fields: the reduction of nitrogen inputs including the reduction of nitrogen surpluses; the land commitment of livestock, in particular grassland commitment for ruminants; the management of organic soils used for agricultural purposes; and the expansion of uncultivated land and agroforestry systems. [4]
The focus fields of this publication are derived from this study.

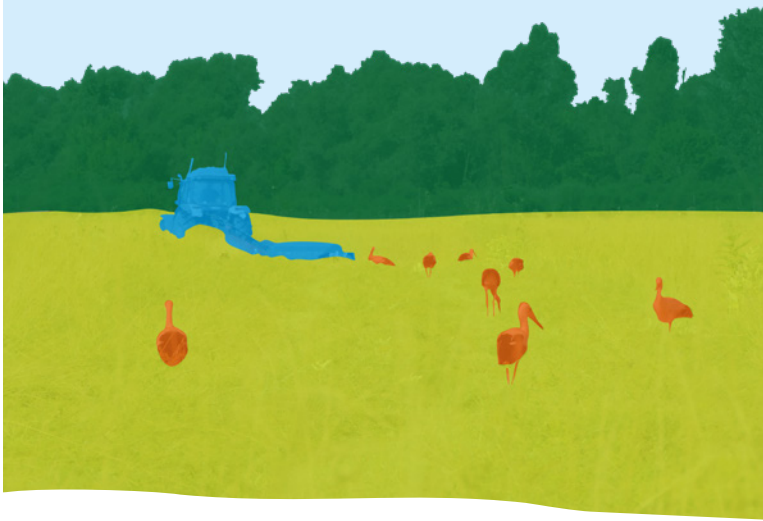
The mean SOC content

of peatlands is: 318 g kg^{-1}

of grasslands is: 40 g kg^{-1}

of shrubland is: 55 g kg^{-1}

of croplands is: 18.3 g kg^{-1}



2. LANDCARE ASSOCIATIONS AS FACILITATORS OF CLIMATE-FRIENDLY AGRICULTURE

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Farming is a time-consuming and demanding profession, which is why farmers appreciate advice and practical support in adapting their farming methods.

Landcare (-like) associations act as agroecology consultants and work closely with farmers on different projects related to climate-friendly farming.

2.1. HOW DO LANDCARE ASSOCIATIONS WORK?

Cooperatively – Landcare(-like) associations (LCAs) collaborate very closely and as equals with people working in agriculture, nature conservation, and politics. This approach enables mutual understanding, acceptance and trust.

Voluntarily – Landcare associations work with farmers and other stakeholders voluntarily and offer advice on nature conservation measures in agriculture.

Regionally – Landcare associations operate at the regional level. Given that each region differs in ecological habitats, biodiversity, agricultural structure, political, and cultural context, LCAs can develop appropriate solutions that fit the region's specific situation.

Interdisciplinary – By bringing together experts from different disciplines, Landcare associations develop complex, holistic concepts that address issues of agriculture and nature, including biodiversity, water, soil, and climate.

Independently – As non-profit and non-governmental organizations *(NPOs/NGOs)*, LCAs serve the public by ensuring the preservation of ecosystem goods and services that cultural heritage landscapes provide.

2.2. HOW DO THEY COLLABORATE WITH FARMERS?

Communicating as equals on the individual farmers' concerns, suggestions, and professional expertise.

Involving farmers in decision-making, e.g. as board members in LCAs.

Finding economically viable solutions for nature conservation and climate measures.

Balancing nature conservation goals, feasibility, and actual impact to develop feasible solutions.

Advising on funding sources.

Helping with administrative tasks.

Securing financial compensation for farmers when involving them in workshops, excursions, projects, etc.

Being aware of the various demands that farmers need to meet.

Adapting meetings and training to farming schedules.

2.3. HOW CAN THEY FOSTER CLIMATE-FRIENDLY PRACTICES IN AGRICULTURE?

Educate and advice:
Inform about climate-friendly agricultural practices, soil and water management, and biodiversity.

Role models:
Identify best practice farms and organize exchanges.

Trainings:
Organize farmers-to-farmers trainings and invite experts.

Public relations:
Organize farm visits for media representatives, schools and expert groups, and make media contributions *(TV, radio, social media, newspapers, etc.).*

Facilitators:
Communicate with authorities such as agricultural administration, nature conservation administration, water authorities, or municipalities to facilitate the planning process.

Funding:
Inform farmers about financial support and help with administrative work.

Projects:
Manage collaborative projects at landscape levels to coordinate different stakeholders *(farmers, NGOs, research, authorities)* and measures.

Collective approach:
Implement collective approaches as a bridge between decision-makers and farmers who are willing to group together but experiencing formal obstacles, as current administrative systems are planned for individual farming.

Rural economy:
Connect farmers and markets to foster regional value chains.

Legal framework:
Liaise with governments and political decision-makers to foster subsidy and supportive regulations for climate-friendly farming practices.

3. NATURAL CARBON SINKS IN AGRICULTURAL LANDSCAPES

3.1. HEALTHY SOILS

What are healthy soils?

Healthy soils sustain the productivity, diversity, and environmental services of terrestrial ecosystems.[5] Humus is a crucial part of healthy soils. It improves essential soil functions such as aggregate stability, water retention capacity, nutrient storage, cation exchange capacity, and acid buffering capacity. Additionally, it reduces the risk of soil erosion and soil compaction. Moreover, healthy soils can enhance the natural resilience of crops against pests and diseases and consequently reduce the need for chemical inputs. Farmers apply measures that avoid erosion and additionally build humus to generate and sustain healthy soils.

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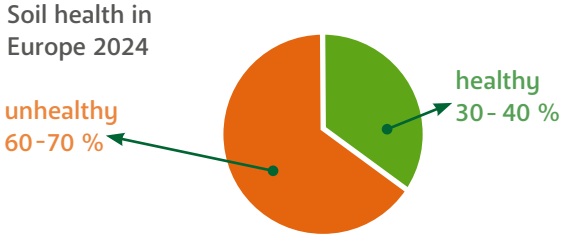
> ***Healthy soils are key in climate-friendly farming.***

Why are soils relevant for climate mitigation?

Soil stores relevant amounts of CO_2: Humus contains 58% carbon (C). As a result, healthy soil contains about three times as much organic carbon as plants and twice as much as the atmosphere. [6]

However, it is estimated that between 60% and 70% of European soils are currently **unhealthy**. [7] Soil degradation and loss result in the release of CO_2 emissions to the atmosphere. The median change in SOC content indicates an average decrease of 0.4 t C/ha for the EU and UK. [8] **Farming practices** can significantly influence soil health and its capacity to store CO_2. At the global level, there is major potential to increase SOC in arable soils.

Mineral fertilizers lead to higher N_2O emissions from agricultural soils. This GHG is 300 times more active than CO_2, thus representing a considerable saving potential.



Other benefits for public goods

→ Providing ground for a**gricultural food production and food security** *(>>> EU Farm to Fork strategy)*, and the production of **renewable energie**s and forage.

→ Preserving **nature and biodiversity** *(>>> EU Soil Strategy for 2030)* as living soils are a habitat for many organisms and animals, as well as the foundation of terrestrial ecosystems.

→ Improving **natural water retention** capacity and groundwater levels, rising with the amount of humus in the soils due to less surface runoffs and higher infiltration rates *(>>> EU Water Framework Directive)*.

→ **Reducing effects of extreme weather situations** such as water erosion, flooding, and landslides during heavy or constant rains and drying up and wind erosion during droughts *(>>> EU Climate Adaptation Strategy)*.

Tips for farmers

Keep the **soil covered** with plants, e.g., with cover or catch crops, perennial crops, winter crops, or leave untreated stubble fields over the winter.

Cultivate different crop types in **mosaic-like structures** on small, adjacent agricultural parcels.

Implement **diversified crop rotations** and crop diversification.

Use **legumes** and legume mixtures.

Reduce/avoid synthetic chemical and mineral **fertilizers** and pesticides.

Return **biomass** to the soil, e.g. mulching of crop or pruning residues. Reduce tillage for minimal **soil disturbance**.

Farm within the **local farm context**, considering soil and climatic conditions.

Maintain or extend **grassland** areas to avoid erosion.

Integrate **animals** and their manure back into the landscape where possible.

Maintain or integrate modern and traditional **agroforestry systems**, e.g., hedges, fruit and nut trees, trees for valuable timber and trunk wood.

Maintain or introduce **organic** or **regenerative farming**.

Integrate **flower areas** and strips between plots.

Use **buffer strips, riparian zones**, or **grass margins** along waterways. Leave **fallow land** with spontaneous vegetation.

Avoid soil compaction through proper planning of machinery traffic and the use of lighter equipment or track systems.

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How do Landcare(-like) associations support the transition?

*One-on-one **agroecology consulting** with farms, with a holistic concept including ecological, economic, and social aspects.*

*Developing **regional soil and water management plans** together with farmers, authorities, and planners to stop erosion problems, prevent floods, and adapt to droughts.*

*Organizing **field days** and farmers-to-farmers trainings, including e.g., machine demonstrations with soil-conserving technology.*

*Building cooperations with universities and companies to develop models for **carbon sequestration** and compensation.*

3.2. EXTENSIVELY MANAGED GRASSLANDS

What are extensively managed grasslands?

Extensively managed grasslands show a diversified horizontal and vertical structure of the grassland and higher numbers of plant species compared to intensively managed grasslands.

This is the result of their management, characterized by:

→ no use of mineral fertilizers, herbicides, and pesticides;
→ sustainable grazing, including a minimum and maximum grazing livestock unit (GLU) per ha and timely rotation between plots;
→ sustainable mowing, involving a mosaic mowing regime with adapted cutting dates and frequency, depending on the type of vegetation and the environmental and climatic conditions of the region and farm.

> ***Grasslands cannot survive without the extensive management of animals on them or for them, neither can the grassland-related biodiversity.***
>
> Justas Gulbinas,
> Baltic Environmental Forum

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Why are they relevant for climate mitigation?

More stable CO_2 storage capacity of the soil through better humus building function compared to cropland and intensively managed grasslands due to the plant roots and biomass input, as well as less soil disturbance, soil compaction, and fertilizers.

Reduced CO_2 emissions by preventing soil erosion and the loss of organic material.

Lower N_2O emissions from agricultural soils due to the non-use of mineral fertilizer.

Lower CH_4 emissions from digestion, as two-thirds of the CO_2e from the agricultural sector are emitted by the livestock sector in the form of enteric fermentation and manure management. [9]

The commitment of livestock to grasslands and grassland-based nutrition will result in a reduction of the overall number of ruminants.

Improving management practices and breeding/ adopting new species and cultivars can improve the quantity and quality of feed to animals, while enhancing soil carbon storage in some regions and systems. [10]

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Other benefits for public goods

→ Preserve **biodiversity** on grasslands *(>>> EU Biodiversity strategy 2030 & Nature Restoration Law)*

→ Reverse the decline of **insects** *(>>> EU pollinator initiative)*.

→ Higher **water retention** compared to arable land *(>>> EU Water Framework Directive)*.

→ Reduced effects of extreme weather events, including heavy rains and droughts *(>>> **climate change adaptation**)*.

→ Preserve **cultural heritage landscapes** *(>>> rural economies and quality of life)*.

Tips for farmers

Aim for quality instead of quantity in meat production by feeding a **grass-based diet**, which also reduces GHG emissions.[11]

Choose **old and adapted breeds** that are not dependent on concentrated feed. Its production is associated with high GHG emissions. Old breeds are resistant to diseases, do not require assistance in delivering offspring, and are efficient in clearing invasive plant species. Additionally, low-input breeds are often not routinely dewormed, which allows dung beetles to thrive in their feces, reflecting an important biodiversity support.

Apply **mob grazing** according to the regional conditions to strengthen the grassland (turf) and maintain healthy, humus-rich soils. [12] Pasture planning includes the consideration of recovery time, recovery height, stocking density, length of stay, mulch layer, plot shapes, etc. Factors such as good soil fertility, high precipitation, spring *(and autumn)* season, and many lower grasses with a short leaf lifespan will require a shorter recovery time.[13]

Avoid reseeding and soil disturbance to preserve the original vegetation cover unless to improve biodiversity and carbon storage capacity, e.g., through plants with deeper roots.

Increase plant diversity, which can enhance yield, nutrient use efficiency, and soil organic C-storage. Moreover, it can reduce greenhouse gas emissions from both the soil and livestock per unit of feed intake.[14]

Include deep-rooting grass/herb species in the grassland to sequester carbon in the soil and raise resilience to drought, e.g., grass species such as tall fescue, cocksfoot, smooth oat, and festulolium, and herb species including chicory, caraway, ribwort plantain, small meadow button, and dandelion. [15]

Include legumes *(e.g., red/yellow/horn clover, alfalfa/lucerne, or vetch)* in grassland for grazing or silage production. They contain more protein than grasses, benefiting forage quality and additionally reducing fertilizer nitrogen *(N)* input and thus N_2O emissions. Legumes have also shown an effect in reducing enteric methane emissions.[16]

Compost manure, which significantly reduces methane emissions, improves stability and fertilizer quality, and stabilizes the soil structure. [17]

Only apply manure cautiously based on need. Apply in cool weather, just before rain, and when there is no wind. Apply close to the ground and incorporate rapidly within an hour to reduce emissions. [18]

Include **agroforestry systems** in the grassland. They sequester carbon in wood and soil and provide extra benefits, e.g., fodder hedges, willows as living fence posts, oak and nuts trees for timber and shade.

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How do Landcare(-like) associations support the transition?

Consulting *farmers on management practices and supporting* ***agri-environmental and climate measures*** *and other funding programs such as late mowing, insect-friendly mowing techniques, mob grazing, etc.*

Building regional value chains *"from pasture to plate" (e.g., creating regional brands, establishing cooperations with public canteens, local restaurants, butchers, and shops).*

Creating regional brands *for meat and dairy products. Brands help farmers compensate for the lower productivity even without subsidies (e.g. Grazing for Life, Grazing for Nature/Climate, N2000 brands, etc.)*

Organize communal used ***infrastructure*** *such as milking parlours, cheesemaking, or slaughterhouses.*

Communicating *the health benefits of free-range animal products and their benefits for public goods.*

Implement grassland restoration *of species-rich grasslands with local seeds.*

Developing and executing ***Natura 2000 management plans*** *with different stakeholders for natural or semi-natural grassland, including priority habitat types such as semi-natural dry calcareous grasslands (6210*) and their scrub stages or species-rich Nardus grasslands (6230*) on siliceous substrates in mountain and sub-mountain areas in continental Europe, which are dependent on extensive grazing.*

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3.3. AGROFORESTRY SYSTEMS

What are agroforestry systems (AFSs)?

→ **EU regulations define** AFSs as "land use systems in which trees are grown in combination with agriculture on the same land" (Article 23 of Regulation (EU) No. 1305/2013).

→ **The European Association for Agroforestry** (EURAF) defines agroforestry practices as all forms of association of trees and crops (silvoarable systems) and/or animals (silvopastoral systems) on a parcel of agricultural land, whether in the interior of the parcel or on its edges.

→ **Traditional AFSs** on farmland include systems such as (grazed) orchards, wood pastures (e.g., Romania, Germany, Austria), hedgerow systems, *dehesas* (Spain), or *montados* (Portugal).

→ **Modern AFSs** are systemically designed in lines or patterns on arable land or grassland in a way that the wooden structures are established according to the width of agricultural machinery and create ecological, economic, and/or social benefits.

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Why are agroforestry systems relevant for climate mitigation?

Carbon sequestration in biomass (wood, roots) and soil *(more humus, leafy)*. The average reduction effect is estimated at 10 t CO_{2eq} per ha/year. [19]

Trees and bushes from AFSs can **provide material** for bioeconomy products **and partly replace fossil fuels** *(e.g., wood chips for heating from poplars grown in short-rotation coppice)*.

Less/no use of **fertilizers/pesticides** on woody areas, reducing N_2O emissions.

Other benefits for public goods

→ **Windbreaks effect**, around -94% reduction of wind erosion, protecting the soil's carbon stored in humus [20] *(>>> EU Soil Strategy)*.

→ Reduction of **water erosion** through mechanical barrier and improved **soil structure** through roots, soil rest, and humus accumulation *(>>> EU Soil Strategy)*.

→ **Water** protection through filtering effect *(water quality) (>>> EU Water Framework Directive)*, better **water retention** under wooden strips *(less evaporation)*, and improved microclimate with higher **humidity** due to more transpiration.

→ Higher **biodiversity** *(up to +60%)* in silvoarable systems compared to cropland [21] and potential to connect habitats *(>>> EU Biodiversity Strategy)*.

→ **Supporting bird populations** by providing critical habitats, food, shelter, nesting opportunities, and movement corridors for woodland and edge-dwelling bird populations *(up to +50% compared to open agricultural land)*. [22] *(>>> EU Birds Directive)*

→ **Animal welfare** *(shade, fodder trees, and hedges, protection from birds of prey)*.

→ More diverse agricultural **landscapes** in Europe.

→ **Economic and social benefits** such as diversifying agricultural production and resilience, fostering rural development and green jobs.

→ **Reduced pressure on forests**, including natural (highly valuable) forests. Agroforestry can reduce deforestation pressure elsewhere and provide benefits for agricultural soils and biodiversity.

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Tips for farmers

Think about which **goal(s)** you want to achieve with your agroforestry system and prioritize them *(e.g., erosion prevention, diversification, long-term investment, animal welfare, water retention).*

→ **Fruit and nut trees** in grassland or arable land as an additional harvest.
→ **Valuable timber wood** (e.g., apple, pear, cherry) as a long-term investment.
→ **Energy wood** (fast growing) on arable land as (wind) erosion prevention, and the production of wood chips.
→ **Fodder hedges** (e.g. hazel, willow, maple, mulberry) to provide extra minerals and protein in the diet of grazing animals and be more resilient to droughts.
→ **Oak or nut trees** to provide shade for grazing animals and fodder for free-ranging animals.
→ **Pollarded trees** (e.g., silver willow) as living fence posts to avoid renewal work and provide additional fodder.

Start with an **easy and small system** before upscaling, and consult with agroforestry experts before and during the process.

Choose tree species according to the **soil and climatic condition**s, and mix tree species for higher resilience of the system toward droughts and pests.

Choose long-lasting systems over short-rotation coppice *(SRC)*.
Only introduce SRC if the erosion reduction effect is decisive and wood chips are used locally.
For SRC, plant several rows of trees, and harvest in stages to constantly maintain the windbreak effect.

Pick a plot of land **close to the farm building**, as AFS need a lot of care in the first years.

Design the **layout and width** between rows of trees according to the width of your machinery *(including a buffer)* and your management patterns.

Plant trees in lines oriented with contour lines and crossing above drainage systems to improve **water retention**.

Think about how to **harvest and sell** agroforestry products *(timber, fruit, nuts, fodder)* before planting.

Plant in spring or autumn and protect trees from animals such as deer, rabbits, or voles with tree and root protection.

Calculate sufficient time for the **tree care** in the first years of establishing the system, including checking/ renewing tree protection, watering, *(ideally mechanical)* weed suppression, pruning, and replacement planting.

In case of leased land, talk to the landlord and fix ownership, rights, and duties in relation to the AFS in the **lease agreement.**

Staggered harvest of trees maintains the benefits of AFS for the soil and leaves of overmature trees.

Wide strips of woody plants *(e.g., multiple rows, min. 5 m wide)* improve erosion protection.

Enhance biodiversity by integrating elements in wooded strips, such as flower strips, dead wood from tree pruning, or stone piles for reptiles and insects.

How do Landcare(-like) associations support the transition?

Raise awareness *of the importance and protection of traditional AFSs in danger of loss due to their limited agricultural productivity.*

Contact and communicate *with the* ***local administrations*** *for agriculture, the environment, and/or water to clarify the legal requirements and support.*

Consult *on initial funding through CAP measures and beyond e.g., in carbon credits, nature conservation, or research projects.*

Consult *with the right plant choice for native woody plants and robust old varieties,* ***contact*** *and order trees from the nursery.*

Organize *communal planting and/or harvesting* ***campaigns****.*

Organize *training for pruning fruit trees.*

Build regional value chains*, e.g., developing local brands for agroforestry products such as fruit or nuts, and organize infrastructure projects, e.g. nutcracker and walnut processing, juice press, or distiller.*

3.4. PEATLANDS WITH PALUDICULTURE

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What are peatlands with paludiculture?

Paludiculture is the productive land use of wet and rewetted peatlands that preserves the peat soil and thereby minimizes CO_2 emissions and subsidence. [23]

It includes wetland-adapted crops, hay production, and extensive grazing with adapted species.
Peatlands are **"a type of wetland with a thick water-logged organic soil layer (peat) made up of dead and decaying plant material"** *(Ramsar Convention on Wetlands)*.

We distinguish between:

Fens: mineral-rich, fed from groundwater or surface water, with vegetation comprising sedges, reeds, grasses, and sometimes shrubs and trees.

Bogs: nutrient-poor, fed from rainwater, in areas with precipitation>800mm/year, with vegetation comprising sphagnum moss, heathers, cranberries, insectivorous plants *(e.g. sundews)*, and dwarf shrubs. They usually emit less GHG than fens.

We are focusing on degraded, drained peatlands already in agricultural use, mainly fens. Only degenerated bogs with a thin peat layer can be used to grow paludiculture. Intact peatlands must not be converted to farming land.

Why are peatlands relevant for climate mitigation?

Peatlands hold up to one-third of the world's soil carbon, while covering only 3-4% of its land surface, with 12% in Europe. Draining peatlands leads to soil subsidence and peat oxidation, resulting in high carbon and nitrous oxide emissions. Almost 50% of the European peatland area is degraded, and it is estimated to emit 600 Mt CO_2e per year. Drained peatlands account for only 3% of the EU's agricultural land, and rewetting them could reduce **up to 25% of the EU's greenhouse gas emissions from agriculture.**[24]

© Valdas Balčiūnas

Other benefits for public goods

→ **Preserving nature and biodiversity** *(>>> EU Biodiversity Strategy 2030 & Nature Restoration Law)* as they are habitats for many plants and animals, such as birds, mammals, reptiles, amphibians, fish, and invertebrate species.

→ **Supporting water purification** and **water retention** capacity affecting groundwater levels *(>>> EU Water Framework Directive).*

→ **Reducing effects of extreme weather situations** such as water erosion, flooding, and landslides during heavy or constant rains and drying up and wind erosion during droughts *(>>> EU Climate Adaptation Strategy)*.

→ Peatlands are important **cultural landscapes** and part of the **cultural heritage** of humanity *(>>> European Landscape Convention).*

Tips for farmers

Get support. Changing from drained farming to undrained farming is a complex process that requires the development of a new farming and business concept, including, e.g., conversion from arable land to grassland or specialized machinery, management of the water level, and a sales concept.

Aim for a **gradual, controlled rewetting** technique, as it maintains plant cover and thus reduces emissions compared to open water surfaces, which promote CH_4 production.

Keep the **water level** consistently close to the surface *(ideally within 0–10 cm)* to prevent peat oxidation.

Farm with **soil-protecting machinery** e.g., small and lightweight, wide tires/ caterpillar tracks.

Consider **conversion from arable land to grassland**.

Extensive grazing is possible with robust livestock, e.g., traditional cattle or water buffalo that can tolerate wet areas.

A seasonal/rotational grazing concept and management avoids trampling damage to the peat surface or vegetation cover.

Wetland-adopted crops such as cattail *(Typha)*, reed *(Phragmites)*, reed canary grass (phalaris arundinacea), sedge *(Carex)*, alder *(Alnus)*, or willows (*Salix* spp) are suitable for fens with high water levels, while cranberry *(Vaccinium oxycoccos)* and peat moss *(Sphagnum)* can be cultivated on bogs.

Extensive farming - especially the control of fertilizers - prevents eutrophication and GHG emissions. Wetland biomass can be cut and used on mineral soils.

Sell paludi crops as bioeconomy products *(e.g., insulation, paper, building boards, fodder, medical use)* in **regional value chains**.

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How do Landcare(-like) associations support the transition?

Support farmers *with consultation, planning, help with administrative tasks, coordinating the rewetting process, and securing inclusion in decision-making to facilitate the transition.*

Species protection, biotope network, *and* ***biotope management*** *(e.g., meadow birds, butterflies, vegetation, scrub clearance, meadow mowing, grazing).*

(Bio)monitoring and hydrology *(e.g., birds, vegetation, insects, water level data, planning, supervision, waterlogging).*

Securing land and supporting local *authorities (e.g., purchase, lease, and usage agreements, eco-accounts, compensation, recultivation).*

Collaboration between science, industry, and practical implementation *(e.g., projects, discussions, testing in the field, product development).*

Visitor guidance*, information, and public relations work (e.g., boardwalk, audio tour, adventure trails, TV films, books, press, radio).*

How do you rewet peatlands with farmers?

Trust farmers, give them the tools and the possibility to do what they like to do.

Valdas Balčiūnas, peatland farmer, Lithuania

Cultivate permanent contacts. Stick to what you have promised. Be understanding of the other side. Make fair offers with prospects.

Anja Schuhmann, Landcare Organization „ARGE Donaumoos", Germany

4. BEST PRACTICE EXAMPLES

The following section demonstrates best practice examples from Europe that show how natural carbon sinks can be strengthened in cooperation with farmers.

They represent model farms, projects, initiatives, and CAP measures. The examples provide benefits for the climate, as well as biodiversity, water, soil, and our cultural heritage landscapes.

They also allow for food production and consider farmers' needs for their farm management. Ideas that bring improvements compared to conventional products and processes or save time, financial, or (natural) resources should serve as inspiration.

More examples including short profiles of model farms, projects and initiatives, and CAP measures and can be found on our website (www.landcare-europe.org).

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4.1. REGENERATIVE FARMING IN THE HARGHITA MOUNTAINS, ROMANIA

Fazakas Farm

Location

50 hectares in a mountain basin, 700m above sea level, partly Natura 2000 area in the Alpine region of the Eastern Carpathian Mountains, Csík basin and slopes of the Hargita mountains, Romania.

Agricultural use

50 hectares mixed organic farm with arable land (5ha), grasslands & cattle for milk and meat.

Involved partners

A small family farm, relying on the labor of family members and one additional employee. They are members of a small cooperative funded by five farmers from the village.

Duration

Six years minimum tillage (min-till), ten years organic, many generations farming family.

Goals

The farm focuses on organic milk production on grasslands and self-produced fodder. They cultivate organic crops on their arable land, employing regenerative farming techniques. A key priority is to use nature-friendly methods and to enhance soil health. These techniques aim to increase humus content, improve water retention, strengthen soil structure, and biology as well as biodiversity. While carbon sequestration is a beneficial by-product, it is becoming an increasingly important consideration in their decision-making process.

© Gergely Rodics, ACNT

How it works

They practice regenerative agriculture while fully adhering to the standards of certified organic production, employing the following methods:

- **Min-till arable land cultivation**
- **Cover crops**
- **Organic manure**
- **Crop diversification**
- **Glyphosate-free approach**
- **Rotational grazing**
- **Water retention lakes, swales, and trees**

Permaculture practices in vegetable gardening, such as planting trees and bushes, creating wet habitats, and following keyline design principles, where the land structure allows.

These integrated practices not only promote sustainability and ecological health but also support the farm's goal of enhancing biodiversity, improving soil health, and mitigating climate impacts. **Funding/financing:** CAP direct payments and organic scheme payments, planned: eco-scheme **"environmentally beneficial practices in arable land."** Meanwhile, the farm is economically more successful than neighboring farms, as they have better harvests, especially in drought years, and additionally save on fertilizers and fuel.

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4.2. RESTORATION OF A PEATLAND (FEN) IN BAISOGALA, LITHUANIA

Demonstration restoration of a peatland (fen) in Baisogala: Reshaping intensively used agricultural land to meet climate change mitigation.

Location

5 ha former fen (peatland), drained and used as perennial grasslands for haymaking and grazing *(pastureland)* in the boreal biogeographical region, Radviliškis district municipality, Lithuania.

Agricultural use

Before rewetting, the drained peatland and surrounding areas on mineral soils were used as intensively managed perennial grasslands for fodder production and grazing. At present, the rewetted area is used as wet grassland (dominated by Phalaris arundinacea) for fodder production.

Involved stakeholders/partners

Foundation for Peatland Restoration and Conservation (LT), Animal Science Institute of Lithuanian University of Health Sciences (LT), Greifswald Mire Center (DE), Michael Succow Foundation Partner in Greifswald Mire Center (DE).

Duration

Restoration: 2020–2022 (as a paludiculture site, it is ongoing).

Goals

- Establish the first paludiculture site in Lithuania.
- Implement the rewetting of a formerly drained peatland in an intensively used agricultural area to stop the degradation of fen peat and minimize CO_2 emissions from dry peat. Annually – production of fodder from wet grassland biomass for cattle and horses.

© Michaela Kadavá, CSO

How it works

- Investigation of the site features.
- Soil surveys of the site, estimation of GHG emissions.
- Fundraising to ensure financing from private donors.
- Preparation and approval of reclamation reconstruction project.
- Reshaping and destruction of drainage structures.
- Coordination and construction permit obtained.
- Works carried out in summer 2021 – reconstruction of the mouth of the collector, installation of a sluice regulator.
- Water level regime – maintained close to the surface of the peatland throughout the year, except in the second half of the summer when it is lowered to the surface of the ditch.
- Water level and vegetation monitoring.
- The Animal Science Institute of the Lithuanian University of Health Sciences is carrying out paludiculture, the cultivation of reed canary grass as fodder for beef cattle and horses.

Measures addressing carbon storage/ climate mitigation

The greenhouse gas emission site type *(GEST)* approach was developed by the Mire research group of Greifswald University *(Germany)* to assess GHG *(CO_2 and CH_4)* emissions from degraded and rewetted peatlands using vegetation as a proxy *(Couwenberg et al., 2011)*. Approximately ~95 t CO_{2e}/year emissions will be reduced from the area, achieving a total in a 29-year period of ~2,500 t CO_{2e}.

Measures addressing biodiversity, water, soil

The restored peatland ecosystem will be able to restore part of the ecosystem services lost due to drainage, such as climate mitigation, maintaining biodiversity, and improving the quality of water bodies by reducing the amount of nitrogen compounds entering the surrounding surface waters, contributing to lowering eutrophication of Baisogala ponds and Kiršinas stream flowing into the Nevėžis River.

Funding/financing

The project was funded thanks to the contribution to CO_2 reduction provided by Tamm GmbH *(Germany)* and the Zero Waste 2020 Festival *(Lithuania)*. Since 2024, similar initiatives in Lithuania have been supported by launching a new agriculture measure, "Enhancing the GHG Absorption Capacity *(by Restoring the Hydrological Regime of Peatland Soils)*". The measure is administered by the Ministry of Agriculture of the Republic of Lithuania and financed by the EU Recovery and Resilience Facility instrument and the National Budget.

Transferability

This project works as a useful example and model to be transferred to other potential areas, where peatlands can or need to be rewetted. The framework obviously needs to be adapted to a specific area, although the steps to reach the goal can be used from this project.

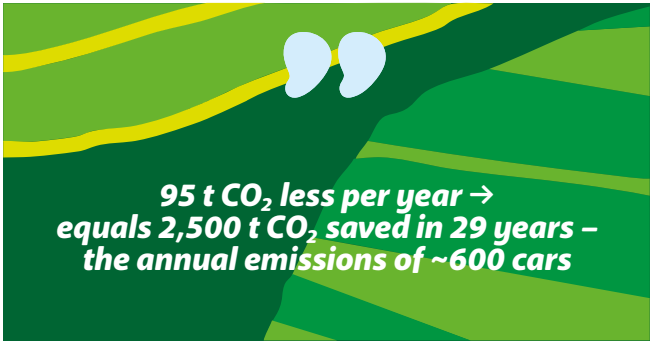
Role of Landcare(-like) Associations

Landcare(-like) associations play a major role in implementing such projects, from helping to communicate such an example to farmers in the first place to helping them through the implementation process: acquiring all the permits, organizing the documentation, and calculating the necessary measures and future emission reductions.

Sometimes such areas are not feasible for raising crops, as you need to buy seed and fertilizer, but they occasionally get wet and the yield is destroyed or minimal. Therefore, landcare(-like) associations could also provide farmers with a trade-off calculation, which could make the decision for rewetting easier.

Further information

https://en.pelkiufondas.lt/baisogala

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4.3. REGIONAL CULTURAL LANDSCAPE MANAGEMENT PLAN IN BRANDENBURG

Regional Cultural Landscape Management Plan

Location

Water-rich cultural landscape waterscape "Havelgebiet", in Continental Biogeographical Region, Brandenburg-Potsdam, Germany.

Agricultural use

Grassland, arable land, orchards.

Best practice/main idea

- Peatland and soil management and damming *(peatlands)*.
- Promotion of arable fallow land.
- Preservation and further development of open land areas (*dry grassland, arable fallow land)*.
  Preservation and revitalization of old orchards.
- Promotion of structural elements (hedges, tree rows, copse)

Involved stakeholders/ partners

Farmers, nature conservation organizations, scientific institutions, municipalities.

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Duration

September 2020 to December 2022, implementation ongoing.

Goals

Overall goal of retaining water within the landscape, conserving the cultural landscape.

- Goal 1: Strengthening of ecosystems
- Goal 2: Collaboration and communication
- Goal 3: Formation of agricultural cooperatives
- Goal 4: Agri-environmental education measures/public relations

How it works/activities

Four goals divided into eight fields of activities:

1. Preservation and further development of the cultural landscape

- Creation of model areas for agroforestry
- Climate-resistant tree selection for agroforestry
- Organization of tree sponsorships
- Recognition of AFSs as a compensation measure
- Enable biotope connectivity through flower strips
- Regional production of flowering mixtures

- Mowed material transfer and roll-out perennial mats for creating flower strips
- Realization of fallow fields and old grass strips
- Grazing of open land areas
- Creation of hedges, rows of trees and copses
- Cultivation of hedges with edible fruit

2. Keeping water in the landscape
- Water retention in the landscape *(water management)*
- Establishment of a cooperation for machinery-sharing "Maschinenring"
- Presentation of bog-friendly machine technology
- Installation of weirs in over-dammed fen areas

3. Cooperation/communication with authorities, science, and organizations

4. Cooperation/communication with stakeholders in the region

5. Collective approaches for the joint implementation of agricultural nature conservation measures

6. Direct marketing initiatives

7. Agri-environmental education

8. Raising awareness of biodiversity in agriculture

Measures addressing the climate
- Retaining water as long as possible within the landscape, especially from winter flooding, at least until April 4.
- Establishment of AFSs to improve the microclimate and to protect the soil from erosion.

Measures addressing biodiversity, water, and soil
- Soil-conserving farming with protection of insects with the use of a double-blade mower, with a mowing height of at least 10 cm.
- Multi-annual flower areas for soil rest, improvement of soil structure, and biodiversity.

Funding/financing
- European Agricultural Fund for Rural Development *(EAFRD)*.
- Agricultural cooperatives project "Kollektive Modelle zur Förderung der Biodiversität" *(KOMBI, Collective models to promote biodiversity)*, funded by the German National Ministry for Environment and regional ministries of participating regions.

Transferability
The project measures are transferable to any other region similar to Brandenburg.

Role of Landcare(-like) Associations

The Landcare(-like) associations acts as coordinator of the different measures and stakeholders and organizes funding for implementing the measures.

Further information

https://www.lpv-potsdamer-kulturlandschaft.de/

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5. POLICY RECOMMENDATIONS

> ***To promote climate-friendly farming, farmers need legal security and clarity concerning regulations and funding as well as a long-term perspective.***
>
> Corinna Friedrich, project leader

1 Ensure long-term legal and administrative support for climate-friendly farming

Provide long-term legal recognition and support for sustainable farming systems *(e.g., agroforestry, peatlands with paludiculture, extensively managed grasslands)* enables farmers to make secure, future-oriented investments.

Align regulations and funding mechanisms across agriculture, environment, forestry, and water sectors ensures coherence and clarity.

Ensure administrative tools *(e.g., specific land use codes or map layers in the integrated administration and control system)* support and recognize diverse and nature-integrated land uses without threatening the status of farming land.

2 Provide integrated and holistic advisory services

Establish robust advisory systems *(e.g., Landcare associations)* that extend beyond compliance-based guidance, offering farm-level support on ecological, economic, and management aspects that support the transition to climate-friendly farming.

These advisory systems include a wide range of advisers, including NGOs, experienced farmers, and independent consultants who are qualified to deliver practical and context-specific sustainability advice for farmers.

3 Strengthen soil protection requirements

Implement clear, regionally adapted rules to prevent soil erosion, maintain soil cover, and promote diverse cropping systems.

Ensure that basic agricultural practices *(e.g., soil cover, plowing dates, crop rotation)* are effectively regulated to preserve long-term soil health and productivity.

Harming practices such as the drainage of peatlands are excluded from subsidies in the long run.

4 Support climate and biodiversity measures via annual incentives

Include annual support schemes for environmentally beneficial practices such as:

→ Maintenance of species-rich grasslands
→ Establishment and upkeep of AFSs
→ Farming with high water levels on organic soils

5 Provide multi-annual environmental commitments

Design agri-environmental and climate measures that are:

→ Long-term (e.g., 12+ years)
→ Financially rewarding, reflecting public goods and additional effort
→ Structurally supportive of whole-farm sustainability transitions

Encourage broader participation through bonuses for farmers adopting multiple or large-scale measures.

6 Promote sustainable extensive grazing through targeted payments

→ Use coupled payments to support grazing systems that align with ecological goals, such as free-range or grass-fed livestock.
→ Prioritize support for locally adapted and environmentally resilient livestock breeds.

7 Provide start-up funding for transition practices

→ Provide initial investment support for sustainable systems, such as agroforestry, including planning, planting, and protective infrastructure, tailored to ecological complexity and benefits.

8 Strengthen and develop regional value chains

→ Invest in market development and research for climate-friendly agricultural products, particularly from agroforestry, extensive grazing, and paludiculture biomass.
→ Support short supply chains and local processing to enhance economic viability and regional resilience.

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For more detailed recommendations, you can find the following focus papers at www.landcare-europe.org:

"Extensively Managed Grasslands as Natural Carbon Sinks"

"Healthy Soils as Natural Carbon Sinks"

"Agroforestry Systems as Natural Carbon Sinks"

"Peatlands with Paludiculture as Natural Carbon Sinks"

Deutscher Verband für Landschaftspflege