



eip-agri
AGRICULTURE & INNOVATION

Climate-smart agriculture

Solutions for resilient farming and forestry



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This brochure has been produced within the framework of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), which was launched by the European Commission to promote innovation in the agricultural and forestry sectors and to better connect research and practice.

This publication follows up on the work of numerous [EIP-AGRI Focus Groups](#) and [workshops](#) on themes related to climate-smart agriculture. All results from these events can be found online via www.eip-agri.eu and on the [thematic webpage on agriculture and climate change](#). For more details on the Operational Groups and other innovative projects featured in this brochure, please see the [EIP-AGRI project database on the EIP-AGRI website](#).



► Climate-smart solutions for a resilient agriculture and forestry

The realities of a changing climate are increasingly affecting European farming and forestry. Drought, changes in rainfall patterns, extreme weather events, pests and diseases or an increasing occurrence of forest fires all affect farm and forest productivity, food production and farmers' incomes.

Climate-smart agriculture (CSA) is an approach that can help farmers and foresters increase productivity and incomes in a sustainable way. It also helps to build resilience and adapt to the effects of climate change, and contributes to climate change mitigation by reducing or removing greenhouse gas emissions. Climate-smart practices can focus on ways to reduce emissions in livestock production, to reduce farm inputs (such as fuels, energy, pesticides, mineral

fertilisers) for more resource-efficiency, or to keep carbon stored in the soil. Making farming systems more diverse can also make them more resilient in the face of climate change.

This brochure highlights a number of EIP-AGRI Operational Groups and other innovative projects in which farmers and foresters are developing and testing climate-smart practices that address local challenges, thus helping to build a more resilient European agriculture and forestry.

► Read more about the [European Commission's strategy for climate-neutrality by 2050](#), with the [European Green Deal](#) and the [Biodiversity and Farm to Fork](#) strategies at the heart of this commitment.





► More sustainable solutions in the [EIP-AGRI brochure 'Sustainable livestock farming'](#) and the Focus Groups on [Reducing emissions from livestock farming](#), [Grazing for carbon](#), [Permanent grassland](#) and [Renewable energy on the farm](#).

► Reducing farm emissions

Livestock production significantly contributes to [agricultural greenhouse gas \(CH₄, N₂O\) and ammonia emissions](#), which affect the climate, our ecosystems and human health. This is mainly caused by fermentation in the digestive systems of ruminants, manure decomposition, and an over-application of (synthetic) fertiliser.

While the agricultural sector has already made great efforts to reduce these emissions ([see recent figures in the Agri-food Data Portal](#)), climate-smart

practices can further help farmers to lower their climate footprint while improving productivity and saving costs. Extensive farming systems, sustainable manure management and optimising livestock diets can contribute to lowering on-farm emissions. Cost-efficient precision farming tools can allow farmers to apply fertiliser more efficiently. Sustainable grazing methods that store carbon in the soil and prevent CO₂ emissions, using local feed, and creating more circular systems on the farm can reduce the need for external inputs of fuel, pesticides and fertiliser.





"Through innovation and training with good practices, we want to help European farmers convert to a more sustainable production that is climate-friendly and also economically viable."

- Low Carbon Feed coordinator José Castro -



Reducing the climate footprint of dairy sheep

To improve the climate footprint of dairy sheep farms in the Spanish Basque country and Navarra regions, an Operational Group is optimising their on-farm energy-efficiency by introducing more circularity, saving costs in the process. Participating farms are producing their own energy through solar panels and by turning biomass from feed production into biofuel that is used to heat the cheese factory boilers. The generated electricity is shared between the farm, the cheese factory, the homes of two farmers and an agritourism facility.

Farmer Felix Ajuria: "Getting the right information helps a lot: we are testing a digital tool that lets us monitor and analyse our energy use through our mobile phones at any time. A separate computer tool calculates our carbon footprint. We know how much energy we produce and consume. This allows us to manage our climate footprint, and adapt our energy consumption to periods of energy production. So far we have managed to reduce our energy use by 20%. This saves money but it also enhances the market value of our quality cheese, which is a Denomination of Origin Product. It helps us to show our consumers that livestock producers do contribute to more sustainability."

► More information?
Check the [EIP-AGRI database](#)



Low-carbon feed from crop waste

By converting crop residues from rice and citrus fruits into nutritious feed for small ruminants, the LIFE project Low Carbon Feed aims to reduce greenhouse gas emissions that would come from burning these by-products. The new feed also causes goats to emit between 8 and 22% less methane.

► <https://lifelowcarbonfeed.com/en>



► The [iSAGE project](#) works with farmers to make the European sheep and goat sectors more sustainable and profitable, and more resilient to climate change.

► Through knowledge exchange, innovation and good practices, [Horizon 2020 thematic network BovINE](#) addresses challenges for the European beef farming community. It specifically helps to reduce the sector's environmental footprint, by lowering emissions and reducing leaching to improve water quality.

► [Thematic network NUTRIMAN](#) focuses on innovative nutrient management and recovery, to improve bio-based fertiliser technologies and applications from organic resources, for more resource-efficiency.



► Carbon farming for healthy soils

Agriculture has an enormous potential to store organic carbon in soils, plants and trees, reducing CO₂ emissions that contribute to global warming. Healthy soils help to mitigate the effects of climate change and lead to better yields, more biodiversity and improved ecosystem services. Farm practices such as agro-ecology, conservation farming, using crop rotations and cover crops, or keeping permanent pasture can help capture CO₂ in the soil in the long term.

In many innovative projects, farmers and researchers are testing climate-smart practices that optimise the carbon balance in farming systems, reduce inputs (fuels, pesticides, fertiliser) and have benefits for agricultural yields. Precision agriculture creates more opportunities to monitor soil carbon content and make more efficient use of water, fertiliser and other resources.



Finnish carbon farmers take climate action

Together with over 100 Finnish farms, the Carbon Action Platform develops climate-friendly, regenerative farming practices that accelerate soil carbon sequestration. "Soil carbon sinks are one of the most effective climate solutions we have", says farmer and Platform board member Juuso Joonas. "Our farmers work with researchers, advisers and food companies to test carbon practices that are suitable for their farms. This includes increasing soil organic matter by adding manure or organic fertiliser, minimal tillage, crop rotations and cover crops, or selecting crops that increase yields."

Farmers receive training, attend demonstration events and get peer support from a network of experienced 'carbon farmers'. Results from on-farm trials are used to develop a carbon calculator to monitor soil carbon changes. "By measuring,

scientifically verifying and monitoring results, Carbon Action also contributes to the development of possible compensation mechanisms that reward farmers for sequestering carbon, for instance through governmental or market compensations", Juuso says. "This may motivate them and stimulate the adoption of carbon-smart solutions in Finland and elsewhere, to revitalise ecosystems while producing nutritious food for people."

► More information: www.carbonaction.org



► The Baltic Sea Action Group, coordinator of the Carbon Action Platform, actively cooperates with the 4 per 1000 initiative, which encourages farming techniques that store organic carbon in agricultural soils, reduce atmospheric CO₂ and actively help to mitigate climate change.



- ▶ The EIP-AGRI Focus Group ‘[Moving from source to sink in arable farming](#)’ focused on long-lasting carbon storage to contribute to climate change mitigation. More soil solutions in the Focus Groups on [Soil organic matter](#), [Non-chemical weed management](#), [Fertiliser efficiency](#), [IPM for soil-borne diseases](#), [Nutrient recycling](#), and [Circular horticulture](#).
- ▶ The EIP-AGRI workshop ‘[Cropping for the future](#)’ identified solutions for crop rotation and crop diversification. Watch the video to see how [Dutch farmer Matté Eikelenboom](#) applies crop diversification on his farm.



“The project has helped us understand more about sterile brome issues and we hope to be on top of the problem on the farm before the project ends.”
 - Gareth Brown, focus farmer in the Operational Group -



Co-designing measures for grass weed control in arable systems

Conservation agriculture (CA) can improve sustainability and labour efficiency, and reduce production costs. However, many Irish farmers have been reluctant to adopt CA techniques because they can cause a rapid spread of grass weeds, especially in a wetter climate (with wetter soils).

To show the effectiveness of CA methods, including integrated weed management with crop rotations and cover crops, an Irish Operational Group has set up a network of farmers, researchers, advisers and industry to co-design the best grass weed control measures to use in these systems.

Project leader Michael Hennessy (Head of Crops Knowledge Transfer, Teagasc): “We let farmers see first-hand how problematic grass weeds can be controlled sustainably in different cropping systems. Maximising farmer-to-farmer knowledge exchange can support a better understanding of the grass weed issues, which can stimulate the wider adoption of CA techniques on Irish tillage farms.”

▶ More information?
 Check [the EIP-AGRI database](#)





► More on diversified farming systems in the EIP-AGRI Focus Groups on [Mixed farming systems](#) and [Agroforestry](#)

► Benefits from diversified farming

Introducing diversity into farming systems can make them more resilient to climate change effects. Mixed farming, agroforestry or silvopastoralism, or applying crop rotations and crop diversification can help to distribute risk and make it easier to cope with a failed harvest, for instance due to extreme weather events. Mixing productions also allows farmers to diversify their sources of income and satisfy a wider range of consumer demands.

Diversified systems improve soil structure due to a diversity of root systems. This optimises nutrient cycling, reduces leaching, increases infiltration and boosts soil organic matter, which is important for a healthy crop production. Trees on farm land serve as carbon sinks. Diversified crops increase biodiversity and benefit pollinators, improve pest management and weed control, reducing the need for chemical fertilisers or herbicides. Bringing legumes into rotations also helps to capture more nitrogen, reducing the need to use mineral N fertiliser, and this can also bring more protein self-sufficiency in feed production.

Mixed farming systems allow farmers to use resources more efficiently by using crops and grassland to feed animals and by fertilising the fields with manure from their own or other local farms. This reduces the need for imported feed, which is more climate-friendly and saves costs. While diversified farming systems can be more complex to design and require more knowledge, taking harvest income and other benefits into the total balance shows that they can be more profitable in the long run.





Chickens tackle weeds in Portuguese vineyards

Both for organic and conventional farmers, weed control in vineyards, orchards and between lines of horticultural crops is a challenge. Weeds under the vine rows or in the vegetable lines can reduce growth and affect yields, but mechanical weed control is not always easy to perform. Portuguese Operational Group CMOBILE is bringing chickens into the field, to control the weeds and avoid having to use synthetic herbicides. The animals are kept in specially designed mobile parks that allow them to graze the weeds but prevent them from damaging the crops. They also eat snails and other pests that could cause damage.

Luís Mendes, BIOPROTEC: "The chickens help to solve the weed problem in a sustainable way. They also add organic matter through manure, and provide additional sources of income through low-cost egg and organic meat production."

► More on Operational Group CMOBILE / GMOVEL [in the EIP-AGRI database](#)



Did you know...

► Horizon 2020 thematic network [AFINET \(Agroforestry Innovation Network\)](#) has published a number of [factsheets with practical solutions from the field of agroforestry](#). FP7 project AGFORWARD has published leaflets on agroforestry [innovation](#) and [best practices](#).



"The pigs on the farm love to root in the soil. We get about 95% soil preparation from this. This improves the self-seeding of new forest."

- Swedish farmer Kjell Sjelin -



Demonstration network for on-farm climate resilience

EU LIFE project SOLMACC has set up a network of demonstration farms in Sweden, Germany and Italy to test farming practices that help farms become more climate-resilient and climate-friendly. All farmers have tested on-farm nutrient recycling, crop rotations, reduced tillage, and agroforestry.

► Read more details in the [EIP-AGRI inspirational idea](#) or on <https://solmacc.eu/>



► A German Operational Group is growing soybeans for feed and food, in mixed cultivation with winter wheat and silage maize. This avoids land competition while increasing the protein content of the crop and boosting biodiversity. [Read more](#)



► An [Operational Group](#) is introducing [agroforestry](#) to Austria by testing new growing methods on six arable pilot farms. A network for knowledge exchange will boost awareness on the benefits.



► Supporting the transition to climate-smart agriculture

Adapting climate-smart farm practices to local conditions is necessary to improve the resilience and the environmental, social and economic performance of the farm. Sharing practical solutions through peer-to-peer knowledge exchange, on-farm demonstrations, different forms of collaboration with others in the value chain, pioneer farms, and good advisory support can help farmers in the transition towards more sustainable, climate-smart farming systems.



Farmers collaborating for Living Soils

Biodiverse soils that are rich in organic matter have an enormous potential to tackle climate change effects. To speed up the adoption of solutions that improve soil fertility, French project Living Soils is making sure that farmers are on board.

Project manager Gaëtan Jestin: “In collaboration with agricultural cooperatives and businesses, we motivate our farmers to collaborate in farmer working groups and give them technical support, ranging from trainings and field visits to experimental field trials.

We support farmers in implementing regenerative practices, such as cover crops and reduced tillage. We are also developing methods to measure carbon stocks in the soil, so that the benefits for ecosystem services can be economically valued. This will give farmers a complementary income for their climate-friendly agricultural practices.”

More info on:
<https://solsvivants.org/> and
www.earthworm.org



European pioneers on a Mission for healthy soils

The Horizon Europe Mission ‘Caring for soil is caring for life’ aims to make 75% of European soils healthy by 2030. This mission will help to unlock the potential of soils to mitigate climate change, support biodiversity, ecosystem services and agricultural yields. To reach this ambition, the mission wants to combine research and innovation, training and advice, and demonstrate good practices by using “living labs” and “lighthouse farms”.



More inspiration on the Horizon

Several Horizon 2020 projects are exploring solutions for resilient and climate-smart farming systems:

- ▶ Multi-actor project [STARGATE](#) develops methodologies and decision support tools to make farming more resilient to climate change, through micro-climate and weather risk management.
- ▶ [AGROMIX](#) and [MIXED](#) both support the development of efficient and resilient agroforestry and mixed farming systems across Europe, with close involvement of farmers and researchers.
- ▶ The candidate [European Partnership on 'agro-ecology living labs and research infrastructures'](#) will support farmers in the transition to sustainable farming practices that are climate-friendly and beneficial to ecosystems. It will do so by delivering ready-to-adopt practices that are tailored to real-life, local conditions, and that have been co-created by different stakeholders in a network of living labs.



Moving towards climate-friendly farming

- ▶ [In an Irish Operational Group](#), 25 innovative farmers are introducing sustainable measures on their farms, sharing knowledge and experience for more sustainability and profitability.
- ▶ [INTERREG project Carbon Farming](#) explores financial and market incentives for farmers who are implementing measures that improve soil quality. The project showcases what business models for carbon farming could look like.
- ▶ The '[Low impact farming](#)' website gives examples of how farmers reduce their pesticide use and carbon footprint, protecting biodiversity and the environment.

Many more projects are leading the way towards more environmentally friendly agriculture. Take a look on the [EIP-AGRI website](#) for more inspiration.



Did you know...

- ▶ [The Common Agricultural Policy \(2021-2027\)](#) will support the needs of European farmers while fostering a sustainable agriculture. "Eco-schemes" will offer financial incentives to farmers to take up climate-friendly practices.



Watch the animated videos on [Agricultural Knowledge and Innovation Systems \(AKIS\)](#) and [Innovation Support Services](#) to see how sharing knowledge and advisory support can help farmers to meet current and future challenges. ◀

