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Carbon Farming CE

TESTING CARBON FARMING BUSINESS MODELS

DELIVERABLE D.2.2.1

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Carbon Farming CE

CONTENT

INTRODUCTION AND SCOPE OF THE TASK

Deliverable D.2.2.1 Testing carbon farming business models report is related to work package 2, which is focused on testing carbon farming cooperation model in 9 Central European countries. The testing of cooperation model will be used for the development of transnational carbon farming business model procedures and to upscale the business model approach.

According to the Carbon Farming CE project's main mission, because there is a huge potential of carbon farming but is still underused in Central Europe, the project wants to change this and make regions more familiar with the concept, by adapting and testing various farming techniques and business models, and developing a monitoring tool for transnational, standardised carbon sequestration.

To better understand and describe business models in the field of carbon management, it is necessary to have a picture of the nature of value creation, the motivations of farmers and buyers/consumers, the relationships between the interacting parties, the resources required, the market processes, the financial returns, the management issues and the sustainability aspects.

While there is a fairly extensive and detailed literature and empirically based knowledge base on agrotechnical methods, a significant challenge is to properly group, classify, structure and evaluate carbon farming business models, especially in a way that is meaningful, applicable and understandable for farmers, which is one of the main objectives of our project. It should also be stressed that the implementation of farming practices and the development and operation of related business and cooperation models are two areas that are closely interlinked and mutually influential.

Recently, several research studies and projects have focused on the evaluation of business models. Generally speaking, the categorisation of models is partly related to the way in which farming performance is measured (and farmers get paid) and partly to the composition and motivations of the partners involved and collaborating in them.

In the case of our project, we focus primarily on the nature of the collaboration between the partners involved, with a focus on the actor who takes the lead in initiating, creating and implementing the model.

From this approach we can also observe several types of cooperation between economic actors, as in many cases the process remains within the agri-food value chain, in other cases actors from different economic sectors cooperate with each other, while in other cases governmental organisations are the initiators and main facilitators of the models, or are led by professional organisations and projects whose main interest is in knowledge transfer and advisory support.

As previously stated, the existing body of literature pertaining to the subject is increasing in both scope and size, it is rarely region-specific, and although an increasing number of carbon farming initiatives and credit schemes are appearing on the market, many of them are global or (hyper)local initiatives. The information that is available for these is frequently inadequate for the purpose of making a precise judgement regarding a specific construction, scheme or system. Therefore, the identification, development and testing of business models of cooperation in Central European context (whether already existing, in the development stage or planned) have been identified as a priority for the CFCE project. In the course of testing, we paid particular attention to the tasks of the partners working together in a given model, the way and the effectiveness of cooperation and the associated difficulties and challenges. This approach is believed to be the most efficient method of utilising experience gained.

2.1. The concept and methods of transnational testing of carbon farming business models

The fundamental premise of this undertaking of CFCE project is the testing of a business model in each participating country. The testing of the business models is facilitated by project partners and every test include a minimum of two stakeholders (e.g. farm-SME, or farm-school). Following the testing phase, a transnational peer review was set to be conducted by local experts from the field of carbon farming. The focus of this review is on the development of transnational procedures for the creation of a carbon farming business model. The outcome of this process is summarised in this report, which also provides a foundation for a step-by-step guide, designed to advise farmers and agricultural advisors on how to select and establish an appropriate carbon farming business model. The utilisation of the guide is intended to facilitate the mainstreaming of the carbon farming business model, thereby contributing to the sustainability of carbon farming initiatives.

As a preliminary measure in the testing phase, the project partners were required to identify a pertinent carbon farming model within their respective countries with which they could establish some form of affiliation. This can range from the initiation and launch of a new type of cooperation, to the establishment of a link and be involved with an existing cooperation, to the assumption of an external support and evaluation role. Examples of each of these roles can be seen later in this report, as project partners took up diverse roles in the cooperation models tested in our project. The testing period was initially planned to last for a period of one year, with the activities to be conducted during this time being planned by the partners. A template was developed for the partners to document the testing process, its content and timing. The model descriptions in this report are partly based on this documentation.

At the conclusion of the testing period, each partner prepared an evaluation of their model in a standardised, common structure. The evaluation comprised the following principal components:

- basic information (e.g. the type of cooperation model, the role of the CFCE project partner, the main approach to monitoring and verification of performance)
- the expected and achieved impacts (environmental, economic, social and organisational) of the cooperation model
- the introduction of the cooperation, including the involved partners and their roles and activities during the testing period
- a summary of the carbon practices used
- lessons learnt: the main benefits, strengths and weaknesses and challenges of the model

The transnational peer review has been carried out by one expert in each country. In each instance, the testing reports and evaluations prepared by the partners were reviewed by the expert in the country concerned, within the context of the project as a whole, and provided feedback on the cooperation model. The peer review covered the main aspects of the cooperation model, the role of the stakeholders, the evaluation of the results achieved, the long-term viability of the business model and its potential for improvement The project partners then used the peer feedback to finalise their case descriptions.

Following the finalisation of the test briefs, the case studies outlining the various cooperation models have been summarised in the initial version of this report. The objective of the process was to synthesise the precise operational mechanisms, the strengths and weaknesses of the different models in a coherent, transparent and easily understandable way, as well as the main lessons learned from the testing period. Following the completion of the draft report, it was subjected to peer review by the same experts, with a particular emphasis on ensuring that regional perspectives were given due consideration. This report has thus been constructed and finalised on the basis of the feedback from said experts.

2.2 Types of cooperation in carbon farming business models in Central Europe

Identifying potential methods related to setting-up carbon farming cooperation model was descried in Deliverable D.2.1.1 Carbon farming business model approach guide. Taking into consideration a potential set of methods and based on the “INITIATOR ROLE”, the following types business models could be formed:

Farmer-led cooperation model

Farmers are the driving force behind these models, using carbon storage techniques to make their products more sustainable. Farmers focus directly on consumers, explaining and communicating to them about the sustainable farming techniques they use (e.g., ways to increase carbon storage in the soil). Farmers use an "awareness approach" to encourage environmentally conscious consumers to pay more for sustainable products.

Testing experiences:

- Farmers’ association led CF cooperation in Emilia-Romagna (IT)

Within the agri-food chain cooperation model

In this type of cooperation, the agri-food sector companies are initiators of the cooperation with the purpose to make their business more sustainable. To achieve their sustainable goals, they set-up business cooperations with low-carbon farmers. Companies use their products marketing campaigns to explain to their customers how they are contributing to climate mitigation in the agri-food sector and at the same time increase awareness among consumers about more sustainable food production. The added value to their products then partly flows to the farmers receiving a higher price for their products or receiving a direct payment for their additional efforts.

Testing experiences:

- Josephbrot Carbon Balance Model (AT)
- Carbon-smart flour cooperation model (SI)

Outside the agrifood chain cooperation model

More and more companies and organisations focus on including climate and sustainability goals in their business models. Many are already increasing their efforts in terms of sustainability, but sometimes it is impossible for them to become climate neutral due to inevitable emissions. Some of the companies are looking for alternatives to compensate for these emissions. Known practices include planting trees or investing in more sustainable energy production/use. However, there are also opportunities on a local scale within cooperation of the agri-food sector.

Testing experiences:

- BlackSoil – Regenerative farming system for carbon sequestration (HU)
- Carbon farmer label (SK)

Government-led cooperation model

Governmental organisations and authorities, including local and regional authorities and multi-regional or multi-country federations, have an important role to play in promoting and supporting carbon farming, creating the necessary legislative environment, motivating conditions, rewarding mechanisms, boosting innovation, transferring the knowledge needed to apply it, raising awareness and communicating its values to the wider public. One important area of relevant government actions is the regulation of carbon credit markets, to ensure that the amount of carbon sequestered in the soil due to various farming practices is monitored, measured, validated and sold on local or global markets in a verified, reliable and transparent manner.

EU / CE perspective: The Common Agricultural Policy offers a number of programmes and funding opportunities for farmers interested in carbon farming. The BISS (Basic Income Support for Sustainability Scheme) includes basic farming techniques that have a positive impact on soil health in the Conditionality Standards. Almost all Member States have developed practices to support soil carbon sequestration techniques in the framework of eco-schemes under the Strategic Plan. The agri-environment schemes also include thematic groups of standards and associated financial compensation for regenerative and/or carbon farming. Under Pillar II measures, farmers can apply for support for the purchase of machinery, knowledge transfer, training, technical advice, demonstration farm programs, which often include elements related to carbon farming.

Testing experiences:

- CAP Eco-scheme (CR)
- Government-Research Partnership for Carbon and Nutrient Management Model (GR-CaNM) (PL)

Knowledge and innovation transfer oriented cooperation model

There are numerous instances around the world when different partners collaborate to carry out a specific "climate-project," which aims to create a carbon farming and climate protection program with the intention of operating sustainably beyond the development stage. Typically, they also help local communities with sustainable development advantages, such as supplying clean drinking water, preserving forests, enhancing health, or generating jobs locally. Examples under the H2020 program at the EU level include ClimateSmartDemo, ClimateSmartAdvisor, and others. These projects are led by AKIS actors from academia, research, and advisory services. Numerous other initiatives are likewise predicated on the carbon credit business model.

Testing experiences:

- LeguNet x Carbon Farming (DE)
- Carbon Farming transfer of knowledge and experience (CZ)

Overview of the tested models, also indicating the type of cooperation:

Short title	Country	Territorial	Evaluation	Coop type	Partner role	Ag practice
Josephbrot	Austria	Regional	Result	In agri-food	Init, implement	A1, A2, B1, B2
Eco-scheme	Croatia	National	Action	Government	External	A1, B1, B2, C1
ZERA	Czech R	National	Result (?)	Knowledge	Init, implement	A1, B2, C1
LeguNet	Germany	National	Action	Knowledge	Init, implement	B2
BlackSoil	Hungary	National, EU	Result	Out agri-food	Implement	A1, B1, B2, C1
Agape	Italy	Regional	Action	Farmer led	External	B1, B2, C1
GR-CaNM	Poland	National	Action	In agri-food	Implement	A1
CF label	Slovakia	Nationa, EU	Action	Out agri-food	Init, implement	B3, C1
C-Smart flour	Slovenia	Local, regional	Result	In agri-food	Init, implement	B1, B2, C1

TESTING RESULTS

In order to summarise and evaluate the experience of the tested models, it is of paramount importance to review the factors that can potentially strengthen and hinder the implementation of cooperation. In this chapter, these factors are discussed in detail, with a focus on the relevant aspects of each test.

3.1. Main motivations for joining a carbon farming cooperation model

A more detailed description and analysis of the cooperation models selected and tested by the CFCE project demonstrated that different actors join such cooperation models with more or less similar incentives. However, the specific characteristics of a given model may show significant differences depending on the actors involved, the actors' understanding of carbon farming (as it is important to ascertain whether the primary objective of the model is carbon sequestration or whether it is designed to achieve a more extensive and multifaceted environmental and economic impact), or the monitoring mechanism of the model. In the ensuing discussion, these primary motivating factors will be examined, where relevant, with a particular emphasis on the distinctions between models and their predominant drivers.

ENVIRONMENTAL/ECOLOGICAL FACTORS

The majority of the models that have been examined have enumerated a number of positive environmental impacts that serve as motivation for the partners involved, as the primary inspiration for initiating and sustaining the collaboration was the positive environmental impacts of promoting awareness of effective carbon farming practices.

The anticipated environmental impacts naturally encompass improving the quality of soil, that is to say, enhancing (and in many cases, restoring) soil health and soil fertility and addressing the degrading consequences of conventional tillage practices. A significant element of this factor is carbon sequestration. Carbon sequestration is a vital aspect in the mitigation of climate change impacts, as it contributes to the reduction of carbon dioxide levels in the atmosphere. Furthermore, the enhancement of humus content within the soil has been demonstrated to promote increased soil fertility, as well as improved water and nutrient retention, thereby fostering favourable conditions for robust plant growth. Higher levels of organic carbon in the soil improve water retention and reduce the effects of drought.

The emphasis placed directly on carbon sequestration varies between different cooperation models. In numerous instances, it is regarded as an integral component of sustainable food production, one that is in harmony with the environment and does not involve the depletion of natural resources. In other instances, it constitutes a component of government-backed initiatives, in Central European context predominantly within the framework of eco-schemes under the CAP strategy plans, and is executed in an action-based manner. These schemes can range from comprehensive to specific to carbon farming, as exemplified by the Croatian and Polish cooperation model. It is evident that initiatives and models which regard the generation of carbon credits as both a viable prospect and an attainable objective in a results-based manner, whether in the present or in the future, will undoubtedly accord this aspect a significantly higher degree of importance.

Carbon farming practices have the potential to contribute to the minimisation of synthetic inputs, thereby reducing the overall reliance on these chemicals. In addition to reducing polluting emissions, this effect subsequently translates to significant energy savings, as the production and application of synthetic fertilisers are energy-intensive processes. Moreover, in consideration of the role of this mechanism in the context of climate change mitigation, it is important to acknowledge its contribution to the reduction of greenhouse gas emissions. As stated by the majority of cooperation models, this component is also a motivating factor.

Carbon farming practices promote diverse farm landscapes, supporting various plant and animal species and fostering a more resilient ecosystem. This biodiversity ensures that agriculture systems can withstand pests, diseases, and changing climate conditions more effectively. The farming practices themselves, the crop rotation and the choice of crops can also have a direct positive impact, as it was demonstrated with the increasing biodiversity through inclusion of highly diverse specialty pulses in crop rotation (German cooperation model), or with the possibility of increasing demand for rare cereal varieties, multiplying its environmental benefits (Austrian cooperation model).

ECONOMIC FACTORS

Overall, the testing process identified four main economic drivers for participation in co-operative models:

- Reducing costs in the longer term
- Using financial incentives and subsidies (e.g. eco schemes, carbon credits) for environmentally friendly/Sustainable farming practices and for reducing risk /change management
- Realise market benefits, better positioning of products
- Diversification, building economic stability, reduce exposure to external dependencies

Carbon farming practices reduce the need for system inputs. Cost savings can be achieved by reducing the number of field operations (leading to a reduction in machinery and fuel use), using alternatives to synthetic fertilisers and pesticides, and reducing reliance on these costly chemical inputs. Overall, cost reduction can lead to increased farm profitability. However, most cooperation models emphasise (and this will be discussed in more detail in the next section on challenges) that these savings are mainly realised in the long term. In the early stages (possibly years), the burden on farmers may increase due to various investments required for carbon practices or temporary yield losses due to technology change.

In addition, farmers can seek financial support to cover the costs of implementing carbon farming practices through different financial incentives. Existing, targeted state subsidies and eco-schemes provide financial assistance in order to reduce costs, to boost market competitiveness, and to enhance agricultural resilience against climate change and pests. Using these funds, farmers can also experience less risky, more resilient, and profitable farming - with potential entry into carbon credit markets. Improved agricultural practices under eco-schemes enhance the resilience of farming systems against pests, diseases, and climate change, leading to more consistent yields and reducing financial risks. For example, the introduction of a payment scheme for the management of cover crops is identified as a key element in the successful implementation of this technique. One concrete example tested in two countries are the eco schemes under the new CAP, that provide farmers with additional financial incentives for adopting sustainable farming practices. The model tested in Poland and in Croatia is closely aligned with government policies and subsidy programs that reward farmers for adopting sustainable practices. Through eco-scheme payments and carbon farming incentives, farmers who implement carbon and nutrient management strategies can access direct financial support. This kind of support is lowering the financial risk during the transition period to regenerative practices.

An important motivating factor in this respect is the potential for carbon credits. These credits can act as an incentive for farmers to adopt carbon farming practices in addition to the efforts aimed at direct climate mitigation and soil restructuring. It is also likely to motivate farmers who might otherwise be discouraged by the fact that the results of applying these practices are not immediate. Carbon credits could provide an extra financial benefit, and are included in two models, in Hungary and in the Czech Republic. However, the main focus of the Czech model is on knowledge sharing and raising awareness of sustainable practices. In Hungary, it is also part of a system which provides various inputs and advisory services in a one stop shop manner. Managing the complex and burdensome transition to regenerative or environmentally friendly practices by adopting a system that is providing more transparency and an integral approach to change management. This approach has the effect of lowering the barrier to entry for carbon insetting and (in line with other support mechanisms) lowering the financial risk during the transition period to regenerative practices.

It was asserted that the market value of the final product is enhanced by the application of carbon practices. The food industry is becoming more aware of the importance of purchasing products which reduce their carbon footprint. Market demand is gradually increasing, initially driven by large food industries already committed to this process. There is also a growing consumer demand for sustainably produced goods, and farmers who produce carbon-neutral products can command premium prices. The German model demonstrates this aspect clearly. The diversification of the farmers' income strains by establishing new markets and marketing channels, with increased prices for the valuable products, parallel with establishing marketing opportunities for food processing companies and gastronomic enterprises by offering innovative products and increasing awareness of the context with environmental questions in consumers. In addition, the knowledge transferred can increase the acceptance of a higher price and/or trigger the use of a specific label. In this way, a win-win situation between climate change mitigation and agriculture can be achieved. The models were also tested in three countries (Slovenia, Croatia, Germany) by asking consumers whether they would be willing to pay more for food produced using environmentally friendly methods. The results of the questionnaires disclosed the willingness to pay more for a known environmentally friendly product. These results are not representative and there is no guarantee that respondents would actually pay the extra for these products, but in general they are a good indication of the validity of this incentive. The Austrian case shows that setting a carbon sequestration standard will stabilize previously available production capacities and yield prices. It may further increase the popularity of the bakery's brand, which might result in higher sales and production quantities, which will in turn increase cultivated areas of rare cereal varieties. In this best case scenario, both the farmers and the bakery will benefit economically.

To increase resilience to economic fluctuations in single commodity markets, it is recommended that farmers consider diversifying their income streams by including agroforestry, livestock or alternative crops (standard elements of carbon farming practices). This diversification has been shown to stabilise farm incomes and provide new economic opportunities (as it was tested in Slovenia, Austria and Germany). In some places, the need for stability has already been clearly articulated, for example in Italy, within the context of the region's agricultural and food industry, there is an increasing interest among farmers' associations in implementing more sustainable agricultural and land management practices. Farmers who adopt climate-smart practices are more likely to maintain consistent income streams, even during adverse weather conditions. This long-term economic stability helps ensure the viability of rural economies and provides a foundation for sustainable growth.

SOCIAL FACTORS

It is evident that one of the most important social benefits of the tested models is the raising of awareness and the education of farmers in relation to regenerative agriculture practices, with a view to facilitating the availability and feasibility of these practices on a broader scale. The majority of the cooperation models has been demonstrated to encourage enhanced training and awareness among advisors and farmers with regard to sustainability. The cooperation models can promote a culture of sustainability and adaptability by encouraging farmers to continuously learn and adopt innovative practices. Parallel with that, the cooperation is able to raise public awareness of carbon farming, and environmentally friendly land use while producing high-quality food products, building public trust and support for sustainability (e.g. German CM). In many models (e.g. Poland, Czech Republic, Italy, Hungary) the core of the model is advice, mentoring, and knowledge exchange. It encourages discussions between experts and farmers and promotes techniques that increase soil carbon while cutting greenhouse gas emissions. For example, the Czech approach involves creating personalised plans for individual farms, encouraging active involvement from both farmers and experts, and enabling theoretical knowledge to be more effectively translated into practical use. The collaborative approach fosters knowledge exchange, facilitating the effective transfer of best practices, and accelerating the adoption and wider implementation of regenerative techniques. Increased and intensified communication also helps building trust, mutual understanding and long-term relationships through the whole value chain. The built-up business cooperation(s) could also serve as a blueprint for others supporting carbon farming.

Other possible positive social impacts include:

- Collaborative models help to build a steadily growing community/network of regenerative farmers.
- From a social point of view, it is worth mentioning that the preservation of pastures and landscapes is essential for maintaining traditional farming practices and the cultural heritage of rural areas.
- Collaboration models that reach out to the general public can also further increase the social acceptance and appreciation of carbon farming techniques and regional, sustainable production and economy.
- Responsive companies can demonstrate to their buyers their commitment to environmental issues.
- For farmers, participating in the program brings not only financial but also community and social respect.

3.2. Main challenges identified during the design and tesing the cooperation models

The variety of models selected for testing by the project partners allowed us to evaluate many aspects and to identify the main challenges of carbon farming implementation based on the experience of the design and testing phase. In order to ensure the future uptake of different cooperation models, it is of paramount importance to identify the critical factors that are key to the expansion of carbon farming. The following categories of key challenges can be highlighted based on our nine test cases:

- Technical and economic challenges
- Uncertainty of results for farmers/ no guarantee of SOM increase; difficulties with verification, reporting and monitoring
- Regulatory and administrative barriers
- Knowledge gap
- Coordination of the cooperation model, communication

TECHNICAL AND ECONOMIC CHALLENGES

Radically changing the way we farm is fraught with risk, as it involves a combination of technical, economic and long-term return on investment factors. It could make farmers reluctant to adopt new carbon farming practices.

First, the negative effects of changing agricultural technology need to be mentioned. Although in many cases not significant for established farming systems, in the early years, it is estimated that the implementation of the new practices will result in a yield reduction of between -10% and -20%. The lower production levels may be due to a number of factors, including challenges in implementing the practices (e.g. timing, need for specific machinery and lack of expertise). However, this effect is highly context dependent, as demonstrated by the conflicting results in our two cases. In Italy, a potential escalation of phytophagous insect and weed populations was highlighted. In particular, it was noted that no-tillage does not fully control perennial weeds, so the use of herbicides or deeper tillage may be indicated to control weeds. On the contrary, in the Croatian cooperation model, the eco-scheme measures have not led to increased problems with weeds and pests.

Introducing new carbon farming practices can also be difficult due to environmental factors and local conditions. The type and physical characteristics of the soil can present a challenge to the implementation of this model. As an example, in certain regions of Italy, clay soils present particular challenges in terms of tillage, as they tend to be more difficult to access during cultivation, especially in high humidity conditions. The presence of cover crops can exacerbate these problems. If not properly managed, these challenges can lead to a deterioration in the physical properties of the soil, particularly its structure. Extreme weather events such as heavy rainfall, drought and high winds can also undermine the effectiveness of carbon farming methods. For example, soil erosion caused by water or wind can reduce organic carbon levels, negating the effect of these efforts. Droughts can slow the growth of cover crops, limiting the amount of carbon stored in the soil. Our Polish case shows how weather events can affect the full implementation of planned practices. For example, although manure incorporation was carried out according to the recommended schedules, variations in weather conditions occasionally affected the optimal timing of some activities, such as straw incorporation, which was slightly delayed due to unforeseen rainfall.

It is important to recognise that farmers may face significant up-front costs in adopting carbon farming practices, with no guarantee that these investments will yield tangible returns in the early years. Surface tillage or cover crop management requires specialist equipment, which can be expensive. This can be a significant barrier for some farmers who may not have the financial resources to make such an investment, for example in a seeder suitable for sowing on no-tilled soils. The Italian model shows that, due to the high cost of machinery, many farmers (especially small farms) need contractors to carry out many of the necessary operations. In these cases, the possibility of efficiently applying some good practices is drastically reduced, as some operations need to be carried out in a very timely manner, depending on weather and soil conditions, and this cannot be guaranteed with a subcontractor. Economies of scale can be a general barrier, as in some cases the cooperative model is not available to smaller farms. In the Hungarian case, for example, there is a limit on the size of the entry area and the model is not available beyond a certain size and structure of the farm area. The implementation of emission reduction techniques on smaller farms may be difficult and/or not financially viable under certain circumstances. For smaller farms with limited resources, investment can be a significant barrier, especially in the early stages when the costs of transitioning to regenerative farming may exceed the returns. This initial financial burden could be a challenge for farmers who do not have the resources to fund the changes. This is why, especially today, when farmers are often forced to learn new practices due to the effects of the climate crisis, financial incentives were prominently highlighted in the previous chapter.

In general, carbon farming practices produce results over a relatively long time horizon, in addition to significant and sometimes radical changes. The protracted return on investment, in conjunction with the necessity of a long-term commitment and the potential for difficulties during implementation, has the possibility of contributing to farmer dissatisfaction. In the Hungarian model, farmers join the carbon programme for a ten-year period. A decade is a lengthy period during which many things can happen that could have a negative impact on the farmer, while joining the model requires a long-term decision and a strong commitment. In the contemporary context of economic and environmental uncertainty, this option is not universally appealing for farmers.

In order to provide a concise overview of the technical and economic aspects, it can be stated that one of the most significant challenges in almost any cooperation model is the identification of appropriate carbon farming practices that are tailored to the specific circumstances of each farmer. Consequently, numerous models tested in the CFCE project emphasise the mitigation of financial and professional/agro-technical risks during the transition period, thereby facilitating the adoption of these sustainable practices by farmers. In addition to the pivotal function of advisory service provision, these models encompass partners that play a key role in knowledge dissemination, along with various research institutions and organisations responsible for knowledge production (e.g. Hungary, Italy, Poland).

UNCERTAINTY OF RESULTS FOR FARMERS / NO GUARANTEE OF SOM INCREASE; DIFFICULTIES WITH VERIFICATION, REPORTING AND MONITORING

Carbon farming practices aimed at increasing soil carbon content may not always deliver consistent results. As it was mentioned in the previous section, some practices might prove less effective depending on soil types or climatic conditions, which could lead to disappointment. This issue assumes particular significance within the framework of result-based cooperative models. The absence of a "guarantee" of outcomes constitutes a pivotal element for farmers, given that an augmentation in soil organic matter (SOM) levels is indispensable for the issuance or sale of carbon credits.

Considering the above, the most substantial and immediate risk is the inability to enhance carbon levels. In the event that farmers (along with intermediaries) are unable to enhance soil carbon content, the issuance and subsequent sale of carbon credits becomes impossible. As proposed in the Italian case, it would be useful to exempt farmers from penalties in certain circumstances if they can prove that they are following the required practices and that the practice is exceptionally inapplicable. Consequently, a medium-term evaluation of the implementation of carbon farming practices by authorities would be a more appropriate approach.

It is acknowledged that the measurement methods and procedures themselves contain some uncertainty, even for established methodologies. The long-term commitment required for the model, coupled with its latent inefficiency, has the potential to lead to disappointment. Consequently, the perception of carbon farming as a less profitable endeavour over time may be shaped by the actions of a subset of farmers participating in the model, namely those who are innovative and early adopters, and who do not perceive the model in its entirety. As mentioned in the previous section, there are difficulties associated with rising costs of the transition to carbon farming practices, which are often compounded by the costs of monitoring. It is evident that this fact serves to compound the risk associated with this particular aspect. The Hungarian model shows the importance of a robust MRV system, accompanied by a clear and well-defined methodology.

Action-based models have been shown to present certain challenges in this respect, even if not to the same extent as result-based approaches. As the Croatian experience shows, in the absence of regular and systematic monitoring of carbon stocks and the positive environmental impacts on subsidised areas, it will be challenging to justify the financial investment in eco-schemes. It is also important to consider the issue of the complexity of monitoring and data collection. In our eco-scheme centered Polish case, monitoring the effectiveness of the implemented practices, particularly in terms of soil quality, carbon sequestration, and nutrient management, proved to be more complex than anticipated. Although CFCE project partner IUNG-PIB played a critical role in assessing the potential for carbon sequestration and using the INTER-NAW program for nutrient management, collecting accurate, reliable data from the participating farms was challenging.

REGULATORY AND ADMINISTRATIVE BARRIERS

A significant challenge confronting diverse carbon farming cooperation models pertains to the issue of regulation and the associated administration. Specifically, there is currently no comprehensive regulation of the carbon markets, and also the different frameworks supporting the dissemination of carbon farming practices (most prominently the eco-schemes under the CAP Strategic Plans in Central European context) is subject to ongoing evolution and debate, as evidenced by the contentious discussions that ensued following the greening ambitions of the Common Agricultural Policy.

In relation to models that seek to generate carbon credits (Hungary, possibly Czechia in the future), one of the most critical issues identified during the testing relate to the need for a certifying body to guarantee credits and establish a system to define and monetise the value of carbon credit acquisition per farmer. Secondly, the challenge of implementing carbon credits at the farm level is identified. While the necessary carbon credits can be procured on a global scale, the implementation of such credits would be more feasible if they were tradable exclusively within the EU. The existence of clearer regulations is vital in order to incentivise farmers to implement carbon farming practices by adopting carbon credits. A further issue that must be addressed is that of the transparency of carbon markets. It can be challenging for farmers to fully comprehend how to obtain credits in these markets, the relevance of those credits, and their potential applications. In the context of Hungary, the prevailing sentiments among farmers are characterised by a degree of apprehension with respect to the prospective marketability of future carbon credits.

In the longer term, as the Hungarian model shows, the amount of new carbon that can be sequestered in these areas is expected to decrease, rendering the business model less attractive. Concurrently, there is a possibility that other agricultural subsidies may include carbon sequestration practices as a mandatory component, which could pose a problem with regard to additionality.

In the context of government-led models, it has been observed (especially in Poland) that the process of applying for tenders and maintaining records can present a significant challenge for some older farmers seeking subsidies. It is also important to acknowledge the considerable variation in the cost and complexity of implementing various eco-schemes. Some farmers have expressed concern regarding the bureaucratic processes associated with application submissions, inspections, and payments, perceiving these procedures to impede operational efficiency.

Frequent changes in state subsidy allocation methods can pose a significant problem, as selecting and directing agricultural production is a long-term process for individual farmers. Moreover, the potential for carbon farming to be perceived as less lucrative in the absence of future subsidies could adversely impact its adoption.

KNOWLEDGE GAP

A considerable knowledge deficit has been identified, with some negative attitudes and biases that are deeply entrenched within it, many times manifesting in a general lack of understanding about carbon farming and its various components. As previously discussed in the preceding section, the intricacies of regulation and the carbon credit market present significant challenges in terms of comprehension, further compounded by their perpetual state of evolution. Concurrently, awareness of specific carbon farming practices remains limited, and knowledge regarding their effectiveness and appropriate implementation is not sufficiently disseminated or not reaching the target group.

In the Croatian context, the AIO project team employed a questionnaire as a data collection instrument. The results suggest that while there is a strong awareness of the impacts of climate change, there is insufficient promotion and communication regarding Croatia's low-carbon strategy and carbon farming in general. A significant proportion of Croatian farmers continue to utilise traditional agricultural techniques that have been handed down through generations. They often exhibit reluctance to adopt novel methods and technologies. For those willing to adopt new practices, the process of transitioning from conventional agricultural methods can present numerous risks - mainly the ones we summarised in the section about technical and economic difficulties.

In Poland, resistance to new practices among farmers was also detected. Despite the continuous efforts of partners in the cooperation model to educate farmers about sustainable farming practices, a degree of resistance to adopting new methods was observed. Farmers, particularly those with extensive experience in conventional farming, exhibited reluctance to adopt practices such as the immediate incorporation of manure, the cultivation of cover crops, and diversified crop rotations, as promoted within the eco-scheme.

The Czech experiences further illustrate that switching to regenerative agriculture and the implementation of carbon practices requires identifying the right technologies and practices that suit the specific conditions of each farm. This process demands considerable time, expertise, and commitment from farmers, making it challenging. Nevertheless, there are also examples of the inverse scenario. In the Italian model, it was the cooperative representing farmers that initiated the cooperation.

A considerable number of models that have been tested have attempted to overcome these issues by employing various, otherwise non-existent or not known, supportive, knowledge sharing instruments. In Hungary, Demeter Bio offers a comprehensive suite of services, encompassing regular soil sampling and evaluation and carbon credit administration, input materials, advisory service, digital farm management tools, acting as a one-stop-shop for farmers. These services are optional, but can be advantageous for those in the initial stages of familiarising themselves with regenerative agricultural practices. In the context of Poland, a fundamental benefit of the GR-CaNM model lies in its emphasis on equipping farmers with the necessary knowledge and competencies. The implementation of this model is accompanied by a range of training programmes, educational workshops, and advisory services. The overarching objective of these initiatives is to facilitate a comprehensive understanding of, and capacity for the adoption of, sustainable agricultural practices among farmers.

As indicated previously, the scarcity of knowledge extends to the domain of carbon markets. It is challenging for farmers to acquire a comprehensive understanding of the functioning of carbon markets, the overall business model, and the process of acquiring and utilising their credits. This is further compounded by the necessity to learn radically new practices, many of which are not familiar to them. This situation is further compounded by the sense of insecurity.

It is imperative to acknowledge the pivotal role that customer awareness plays in comprehending the merits of carbon farming practices. This awareness encompasses their environmental benefits and their capacity to ensure the provision of safe, healthy and quality food. This latter aspect was more important in the Slovakian case for the customers than environmental benefits. Many models lay significant emphasis on the customer side, with various actions. In Germany, by forwarding knowledge about beneficious interactions between diversification of crop rotation by growing specialty pulses and carbon sequestration to different stakeholders like consumers, food processors, farmers, policy makers, students and researchers, the model built-up and consolidated value chains. In Slovakia and Slovenia, different labels for products were initiated, and the Austrian model also planned targeted marketing towards customers. Despite respondents in a number of countries, as indicated through responses to questionnaires administered by our partners, expressing a willingness to pay more for products coming from farms practicing carbon farming methods, this is contingent on several other factors. Increasing prices without providing consumers with sufficient evidence that their purchase has a verifiable impact on the environment could potentially result in consumers seeking out more affordable alternatives.

THE COORDINATION OF THE COOPERATION MODELS

A number of issues have been identified in the course of the testing of various cooperation models relating to the smooth, seamless operation of the model. These issues become particularly evident in models involving a greater number of actors, such as inadequate coordination or insufficient communication between the actors. In the Polish case, the GR-CaNM model is a collaborative endeavour amongst several key partners, with each playing an essential role in the testing and development of sustainable carbon farming business models. Some serious coordination challenges were experienced during the testing period, and there was sometimes limited or delayed involvement or interaction from key partners.

In Austria, the cooperation model that was initially proposed has been shown to be too complex and impractical when applied to an agri-food chain comprising 20 different supplying farms for a bakery. The cooperation model turned out to be complicated in terms of technical details for farms growing non-mainstream crops on small-scale fields, as accuracy as well as workload, and therefore costs of cooperation increased. The involvement of a legal control body is also uncertain as well as the level of detail of controls, so the finalised cooperation model is broken down to single-farm level for farmgate marketing.

The Slovenian model posits that in order to reach a greater number of consumers, there is a necessity for collaboration between the partners (in this case, the flour producer and the retail supermarket chain store). During the testing phase, an increase in quantities of flour sold through supermarkets seems to be justified. However, in order to maintain this increase, it is recommended that stakeholders engage in more profound coordination.

Title	**A model of conservative agriculture in Emilia Romagna – Italy**	**Eco-schemes for Carbon farming**	**Knowledge and experience transfer of the Carbon Farming CE project**	**leguNet-Carbon Farming**	**Josephbrot Carbon Balance Model**	**Carbon-smart flour cooperation model**	**Government-Research Partnership for Carbon and Nutrient Management Model (GR-CaNM)**	**V3 BlackSoil – Regenerative farming system for carbon sequestration**	**Carbon farmer label**
Evaluation method	Action based	Action based	Result based (?)	Action based	Result based	Result based (?)	Action based	Result based	Action based (?)
Model type	Farmer-led	Government led	Project led	Project led	WITHIN the AGRI-FOOD CHAIN	WITHIN the AGRI-FOOD CHAIN	WITHIN the AGRI-FOOD CHAIN	Outside the AGRI-FOOD CHAIN	Outside the AGRI-FOOD CHAIN
Partner	Rinova	AIO	Zera	ÖBG Naturland	BFA	KIS	IUNG-PIB	MATE-TG	No Gravity
Country	Italy	Croatia	Czech Republic	Germany	Austria	Slovenia	Poland	Hungary	Slovakia
Technical and economic challenges									
Yield reduction	+	+ +	+	+	+	-	+	+	+
Environmental factors and local conditions (e.g. extreme weather, specific soils)	+ +	+	+ +	+	+	+	+	+	+
Significant up+front costs, need for investment	+ +	+	+ +	+	-	-	+	+	+
Long return on investment, long+term commitment	+	-	+	-	-	+	-	+ +	+
Economy of scale, not viable/available for small farms	+ +	-	+	-	-	+	-	+ +	+
Uncertainty of results for farmers, MRV									
Risk of the inability to enhance carbon levels	+	-	+ +	-	+	-	-	+ +	+ +
Uncertainty of MRV methods	+	-	+	-	+ +	+	+	-	+
Collecting accurate, reliable data	+	+	+	-	+ +	-	+ +	-	+
Regulatory and administrative barriers									
Lack of clear regulation	-	-	+	-	-	-	+	+	+

Transparency of carbon markets	-	-	+	-	-	-	-	+ +	+
Changing mandatory components pose a problem with regard to additionality.	+	-	+	-	-	-	-	+ +	+
Administrative burdens (applying for tenders and maintaining records)	+	+ +	-	-	+	+	+ +	+	+
Frequent changes in state subsidy allocation	-	+ +	-	-	-	+	+	-	-
Knowledge gap									
General lack of understanding	+ +	+ +	+	+	+	+	+	+	+
Reluctance to adopt novel methods and technologies	+	+ +	+	+	-	-	+ +	-	-
Transparency and understanding of carbon markets	+	-	+	-	-	+	-	+ +	+
Lack of an integrated support mechanisms	-	+	-	-	+	+	-	-	+
Customer awareness	+	+	-	-	+ +	+	-	-	+ +
Coordination and communication challenges									
Limited or delayed involvement or interaction of key partners	-	-	-	-	-	-	+ +	-	-
Complexity of partnerships, need to build more integrated approach	+	+	-	+	+ +	+ +	+	-	+

- : not challenging, not relevant

+ : minor challenge

+ + : significant challenge

Abbreviations:

Carbon farming practices

A.1 Use of manure, biogas slurry, compost or biochar for fertilization

A.2 Relocation of harvest residues, for animal nutrition not needed forage crops (grass-clover) to another field

B.1. Additional cultivation of cover/catch crops instead of fallow

B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release

B.3 Intercropping strategies in orchards and horticulture

B.4 Systems of agroforestry with interactions of the agricultural and the forestry part

C.1 Reducing tillage to different extents

C.2 Peatland restoration

C.3 Conversion of arable land to grassland or forest

C.4 Liming effect for aggregation of Corg and clay minerals

Carbon sequestration monitoring

- Visual indicators of the main physical, biological and chemical soil properties
- Development of pedotransfer functions (PTFs)
- Set of indicators related to C dynamics
- Not relevant (no monitoring)
- Other…

3.3. Datasheet of the national testing cases

Josephbrot Carbon Balance Model

Country: Austria
Territorial coverage: Regional
Cooperation type: Within the Agri-food chain
Evaluation of performance: Result based
Partner's role: Initiator and implementer
Farming practices: A1, A2, B1, B2

The main expected positive environmental impact of this model was that the carbon balance of 20 farms which supply a successful bakery can improve through the implementation of, or improvement of previously implemented carbon farming techniques. Reporting about their positive effect might encourage other agri-food companies to set similar standards for their producing farms. The positive change brought about by a carbon sequestration standard may lead to an increase in demand for rare cereal varieties, multiplying its environmental benefits. Regarding the expected economic benefit, setting a carbon sequestration standard can stabilize previously available production capacities and yield prices. It may further increase the popularity of the bakery's brand, which might result in higher sales and production quantities, which will in turn increase cultivated areas of rare cereal varieties. In this best case scenario, both the farmers and the bakery will benefit economically. The expected positive social impact is that the cooperation will further increase the social acceptance and appreciation of rare cereal varieties, carbon farming techniques and regional, sustainable production and economy through transparent and understandable information processing and labelling. Expected positive impact on the organisation is testing, re-evaluating and development of existing humus balance method and calculating tool. Cooperation business model turned out to be too complicated and not practical on an agri-food chain level with 20 different supplying farms for a bakery.

Carbon farming practices:

A.1 Use of manure, biogas slurry, compost or biochar for fertilization, A.2 Relocation of harvest residues, for animal nutrition not needed forage crops (grass-clover) to another field, B.1. Additional cultivation of cover/catch crops instead of fallow, B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release

Main benefits:

Knowledge exchange; Sharing resources; Established trust between participants

Main challenges:

Technical and investment challenges; Lack of institutional and technical capacity. Conflict of interest.

Carbon Farming transfer of knowledge and experience

Country: Czech Republic

Territorial coverage: Regional, National

Cooperation type: Knowledge transfer oriented (project led)

Evaluation of performance: Result based

Partner's role: Initiator and implementer

Farming practices: A1, B2, C1

The business model focuses on knowledge transfer and advisory services to support regenerative farming, led by ZERA - the Agricultural and Ecological Regional Agency. The main aim is to help farmers adopt carbon farming methods that improve soil fertility, water retention, and biodiversity while reducing reliance on synthetic inputs. These practices, such as applying compost, growing cover crops, and reducing tillage, bring important environmental benefits – improving soil health, capturing carbon, and helping to tackle climate change. However, switching to regenerative farming can be financially challenging for farmers. The upfront costs can be high, and the benefits may take time to show. To address this, the model takes local climate and soil conditions into account and suggests suitable techniques to make the transition easier. From a financial perspective, farmers can save money in the long run by using fewer synthetic fertilisers and reducing field operations. Carbon credits could provide an extra financial benefit, but the main focus of the model is on knowledge sharing and raising awareness of sustainable practices. On a broader level, the model helps spread awareness of sustainable farming, encourages collaboration among different stakeholders, and contributes to food security by improving soil resilience. To test and refine the model, data is collected through close cooperation with farmers, soil sampling, and regular monitoring of soil organic carbon levels. The process starts with an initial round of soil sampling to assess indicators related to carbon dynamics. At the end of the growing season, samples are taken again, and the differences in carbon levels are analysed. This helps evaluate how effective each technique is under specific climate and soil conditions. Key activities include farm visits, soil testing, tailored management plans, and ongoing feedback between advisors and farmers. This hands-on approach ensures that the recommended methods are practical and suited to each farm's conditions. The core of the model is advice, mentoring, and knowledge exchange. It encourages discussions between experts and farmers and promotes techniques that increase soil carbon while cutting greenhouse gas emissions. For farmers, the model provides affordable and sustainable solutions that improve productivity while reducing environmental risks. More widely, it supports environmentally friendly farming, strengthens food security, and helps farming communities adapt to climate change. The carbon farming model is designed to be scalable and adaptable, ensuring the long-term success of regenerative farming for both farmers and society as a whole

Carbon farming practices:

A.1 Use of manure, biogas slurry, compost or biochar for fertilization, B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release, C.1 Reducing tillage to different extents

Main benefits:

Advisory support; Field trial demonstration; Capacity development; Carbon credit potential; Increased recognition, credibility

Main challenges:

Knowledge gap; Technical and investment challenges; Reduced short-term profitability; Long-term return on investment

Future sustainability: Yes (P) | Transferability: Yes (P)

(P means that the project partner also plans to participate in sustaining / transferring the model).

LeguNet x Carbon Farming

Country: Germany
Territorial coverage: National
Cooperation type: Knowledge transfer oriented (project led)
Evaluation of performance: Action based
Partner's role: Initiator and implementer
Farming practices: B2

ÖBG Naturland conducted a knowledge transfer oriented and project-led cooperation model, which combined the activities of the international project Carbon Farming CE and the national German projectateleguNet. Certain C/N ratios of soils can only be maintained if - with increasing carbon input by carbon farming techniques - also nitrogen is brought into the system. Furthermore, micro-organisms in soil benefit from additional nitrogen, and - as recent investigations have shown - died off and left over micro-organisms are the best source for stable carbon in soil. The above mentioned fact is presented and explained to wholesalers and retailers of specialty legumes, food processors, gastronomic businesses and consumers to raise awareness of the importance of crop rotation diversification as a means of carbon farming. In addition, the knowledge transferred can increase the acceptance of a higher price and/or trigger the use of a specific label. In this way, a win-win situation between climate change mitigation and agriculture can be achieved. The questionnaire conducted by ÖBG disclosed the willingness to pay more for a known environmentally friendly product. By forwarding knowledge about beneficious interactions between diversification of crop rotation by growing specialty pulses and carbon sequestration to different stakeholders like consumers, food processors, farmers, policy makers, students and researchers, the value chains can built-up, consolidated and strengthened, by holding presentations at common practical cooking events, writing articles, releasing them online and in print media too.

<u>**Carbon farming practices:**</u>

B.2 Diversification of field crop rotation

<u>**Main benefits:**</u>

Better market price; Increased knowledge; Improved reputation; Local food chain strengthened; Networking.

<u>**Main challenges:**</u>

Technical barriers.

<u>**Future sustainability:**</u> Yes (P) | Transferability: Yes (P)

CAP Eco scheme in Croatia

Country: Croatia
Territorial coverage: National
Cooperation type: Government led
Evaluation of performance: Action-based
Partner's role: External support
Farming practices: B1, B2

The Agricultural Institute Osijek (AIO) tested a government-led cooperation model with the Ministry of Agriculture and OPG Mirko Miladinović, a 56-hectare organic farm. OPG MM focuses on processing, sales, and seed production, marketed under the "Ceres" brand. The government model tested CAP eco-schemes, with carbon sequestration monitored through soil analysis. The Agency for Payments in Agriculture provided financial incentives for achieving environmental goals, while the farm implemented eco-schemes like additional cover crops and crop rotation diversification. The cooperation model offers a well-rounded approach that helps the environment, supports farmers, and benefits society as a whole. The model can be sustained and expanded with similar incentives and monitoring systems in the future. Sustainability and viability will be achieved in terms that the AIO, as already part of the government-led model, using eco-schemes that follow carbon farming practices. AIO's project team administered a questionnaire to over 200 members of the public, most of them with high education and employed in various agricultural companies or family farms they do not own. Gathered data suggests the concept of carbon farming is not at all familiar to 24% of participants and only 35% of participants knew about Croatia's low-carbon strategy.

Carbon farming practices:

B.1. Additional cultivation of cover/catch crops instead of fallow, B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release, C.1 Reducing tillage to different extents

Main benefits:

Policy feedback; Improved soil; Reduced pollution; Better water retention; Increased climate and pest resilience; Lower input costs; Better market competitiveness; Carbon credit potential; Increased knowledge; Improved reputation; Local food chain strengthened;

Main challenges:

Traditional mentality; Administrative barriers; Monitoring burdens; Technical barriers.

Future sustainability: Yes (P) | Transferability: Yes

(P means that the project partner also plans to participate in sustaining / transferring the model).

BlackSoil – Regenerative farming system for carbon sequestration

Country: Hungary
Territorial coverage: National, EU
Cooperation type: Outside the Agri-food chain
Evaluation of performance: Result based
Partner's role: Implementer
Farming practices: A1, B1, B2, C1

BlackSoil is a carbon credit programme in Hungary, introduced by a small company "Talajreform" (Soil reform), initially specialized on marketing cover crops and advisory support for various sustainable farming practices. The main aim is to help European farmers convert their lands to regenerative agriculture and earn extra money with carbon sequestration, by assisting them during the transition period and connecting them with companies looking for verified, high-quality carbon credits. The change of soil carbon stocks is measured by sampling soil regularly at the same spot. The in-field and laboratory tests give a complete overview of the health of the soils (soil carbon stocks, Haney soil health score, water infiltration, bacteria-to-fungi ratio etc.) and shows the progress made and the room for improvement. If carbon stocks from Year 2 are larger than they were in Year 0, the carbon sequestered is validated. Continuous soil cover, minimized soil disturbance, cover crops and adaptive grazing are the main practices recommended to speed up sequestration. MATE Tangazdaság, Hungarian project partner entered the BlackSoil programme with two separate farming locations and technologies, one is arable crop production and the other is forage production combined with grazing. BlackSoil experts were interviewed, questionnaires for farmers prepared, common trainings implemented. There are plans for upscaling the model in the next step.

Carbon farming practices:

A.1 Use of manure, biogas slurry, compost or biochar for fertilization, B.1. Additional cultivation of cover/catch crops instead of fallow, B.2 Diversification of field crop rotation, C.1 Reducing tillage to different extents

Main benefits:

Carbon credit potential; Advisory support; Knowledge exchange; Capacity development

Main challenges:

Programme accreditation; Technical and investment challenges; Long-term return on investment

Future sustainability: Yes (P) | Transferability: Yes (P)

Farmers' association led CF cooperation in Emilia-Romagna

Country: Italy
Territorial coverage: Regional
Cooperation type: Farmer-led
Evaluation of performance: Action based
Partner's role: External support
Farming practices: B1, B2, C1

Farmers, farmer association, farmer cooperative organisation and project partner RI.NOVA are part of this CF collaboration. The lead role is taken by the farmer (AGAPE Farm) which functions in the cooperation model with the application and evaluation of conservative practices to enhance its productivity and agronomical benefits. In particular, the implementation of carbon farming practices such as "cover crops" and "minimum tillage" were evaluated to enhance soil quality and reduce SOM degradation. The model is to be developed further within the agri-food chain focusing on farms operating under conservative agriculture in the Emilia-Romagna region (Italy). The farmers' association (Capa Cologna) are increasingly embracing carbon farming practices to enhance sustainable production and carbon sequestration. The association offers advisory services and technical support to help the farmer implement conservation agriculture practices effectively.

Cooperative organization company OP Grandi Colture, as trader, has the key role of maximizing the selling price of products and is planning the purchase of carbon credits from those farms that implement carbon farming techniques to offset their carbon footprint when carbon credit certification will be more established in the market. RI.NOVA has the role to facilitate cooperation and knowledge transfer between researchers (e.g., University of Bologna), farmers' association and trader interested in carbon sequestration.

Carbon farming practices:

B.1. Additional cultivation of cover/catch crops instead of fallow, B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release, C.1 Reducing tillage to different extents

Main benefits:
Improved soil; Increased climate resilience; Lower input costs; Higher yield (long term); Better market price; Carbon credit potential; Increased knowledge; Improved reputation; Cooperation between actors

Main challenges:
Investment in machinery; Weed control; Suitability on certain soil types; Decreased yield (short term); Carbon credit “penalty”;

Future sustainability: Yes (P) | Transferability: Yes (P)

Government-Research Partnership for Carbon and Nutrient Management Model (GR-CaNM)

Country: Poland
Territorial coverage: National
Cooperation type: Within the agri-food chain
Evaluation of performance: Action based
Partner’s role: Implementer
Farming practices: A1

The GR-CaNM Model is an initiative designed to foster sustainable agriculture in Poland by optimizing carbon and nutrient management. This model is built on a collaborative framework that brings together governmental institutions, research organizations, and the agricultural sector, integrating scientific knowledge with practical solutions to enhance environmental protection and agricultural resilience to climate change. GR-CaNM promotes sustainable practices such as reduced tillage, crop rotation, the use of organic fertilizers, and improved nutrient efficiency. By focusing on soil carbon sequestration, greenhouse gas reduction, and water resource conservation, the model serves as a cornerstone of sustainable farming strategies. *The expected benefits include improved soil fertility, reduced erosion, enhanced biodiversity, and better water quality. Economically, the model supports farmers by lowering production costs, increasing farm efficiency, and providing access to financial incentives under the Common Agricultural Policy. Socially, GR-CaNM strengthens rural communities by fostering knowledge-sharing, empowering farmers, and improving livelihoods.* Through the integration of innovative technologies, strong institutional collaboration, and adaptability to local conditions, this model holds significant potential for broader implementation and replication in other regions. GR-CaNM exemplifies the effective fusion of agricultural policy, scientific research, and on-the-ground farming practices, driving a long-term transformation toward climate-neutral and resilient agriculture.

Carbon farming practices:

A.1 Use of manure, biogas slurry, compost or biochar for fertilization, Development and implementation of the fertilization plan; Incorporation of straw into the soil

Main benefits:

Knowledge exchange; Capacity building; Policy feedback; Access to CAP support; Enhanced monitoring; Building trust

Future sustainability: Yes (P) | Transferability: Yes (P)

Carbon-smart flour cooperation model

Country: Slovenia
Territorial coverage: Local, Regional
Cooperation type: Within the agri-food chain
Evaluation of performance: Result based
Partner’s role: Initiator and implementer
Farming practices: B1, B2, C1

Flour is an important staple commodity in Slovenian households, widely used in various dishes and pastries. The Agricultural Institute of Slovenia (KIS) currently produces and sells flour from locally grown wheat and spelt, with the use of conventional production practices. To evaluate consumer acceptance of flour with a reduced carbon footprint, KIS conducted an online and physical questionnaire. The approach is named Carbon-smart flour, suggesting the interest in receiving feedback on the consumer acceptance of flour products with lower carbon footprint. In total, 22 complete responses were received. Results indicate that 83% of respondents consider flour important for their household. Almost 50% of consumers are aware of its carbon footprint, while 42% remain undecided on this topic. Potential reductions in carbon footprint could be achieved through sustainable agricultural practices, use of renewable energy, improved packaging solutions and especially through short supply lines (i.e. local flour chains). Market analysis suggests that 83% of respondents would pay a premium for flour with a reduced carbon footprint. However, when asked how much more they are willing to pay, 54% would accept a 10% price increase, 8% of respondents would be willing to pay up to 30% more, and 33% were unwilling to pay more, indicating a deviation from previous 83% consent. Verifying reduced emissions through independent certification or CAP-compliant documentation is seen as crucial for consumer trust in the Carbon-smart flour model. Implementing carbon-smart practices could enhance farm profitability by increasing product value and unlocking CAP and CRCF funding opportunities. However, this is seen as an obstacle by the consumers, reducing their willingness to pay higher prices for the flour. In the end, the analysis also shows that awareness of food-related emissions may also stimulate the demand for other agricultural products that are produced with more sustainable practices.

Carbon farming practices:

A.1 Use of manure, biogas slurry, compost or biochar for fertilization, A.2 Relocation of harvest residues, for animal nutrition not needed forage crops (grass-clover) to another field, B.1. Additional cultivation of cover/catch crops instead of fallow, C.1 Reducing tillage to different extents (above practices were tested at infrastructure centre of KIS)

Main benefits:

Increased market price; Better market potentials; Consumer awareness raising; Credibility increased.

(potential benefits)

Main challenges:

Certification mechanisms needed; Clear labelling; Transparent communication; Uncertainties of carbon credits;

Future sustainability: Yes (?) | Transferability: Yes

Carbon Farmer label

Country: Slovakia
Territorial coverage: Regional, National, EU
Cooperation type: Outside the agri-food chain
Evaluation of performance: Action based
Partner's role: Initiator and implementer
Farming practices: B3, C1

The main focus of the Carbon Farmer label is to recognize and reward farmers who engage in carbon sequestration practices, such as reforestation, regenerative agriculture, and sustainable land management. The farmers and food producers require higher and more stable income sources to enhance their financial well-being and strengthen their resilience. The new market differentiation through the label can help differentiate products in the marketplace, enabling farmers to sell their goods at a premium to consumers who are willing to pay more for sustainably produced items. This added value could make it economically viable for more farmers to adopt low-carbon practices. This, in turn, would enable them to invest in and improve their farming and processing practices. Additionally, consumer awareness campaigns regarding the environmental impact of food choices could encourage a shift toward more sustainable consumption habits. Furthermore, a willingness to pay a premium for products with a lower greenhouse gas footprint could create synergies within and also outside the value chain. In the cooperation, each member had a separate role in the testing of the Carbon Farmer label introduction at the market. While PD Krakovany farm has long-lasting experience with regenerative agriculture, actually they lead this initiative in the Slovak Republic, they provided ingredients produced within the Regenerative agriculture for bakery operated by BA Solar,s.r.o. (poppy, flour) and No Gravity provided the blueberry produced in 2024 with the experimental CF techniques and was responsible for the initiation and also for the evaluation and monitoring activities.

Carbon farming practices:

B.3 Intercropping strategies in orchards and horticulture; C.1 Reducing tillage to different extents

Main benefits:

Improving consumer awareness; Capacity development; Complementing resources

Main challenges:

Reluctance to change; Lack of supportive policies; missing certifying/monitoring authority; Technical and investment challenges; Lack of institutional and technical capacity

Future sustainability: Yes | Transferability: Yes

FINDINGS OF THE PEER REVIEW GROUP SESSION

In accordance with the transnational peer review process, national experts were invited to the subsequent project meeting in Gödöllő. During this meeting, the primary conclusions of the testing period were corroborated by the experts (some of whom were present in person, while others participated remotely) and representatives of the project partners, who collaborated in groups during the session dedicated to this topic. In order to facilitate reflection, the groups were not tasked with evaluating the business models, but rather with assessing the motivations and challenges from the perspective of key stakeholders in different business models: farmers, advisors, researchers, government agencies and market entities. It is our contention that this methodology was the most efficacious in terms of producing the final project outputs, particularly the guide, which is to be primarily targeted at farmers and advisors.

4.1. Motivations

From the standpoint of farmers, who are central actors in every model, a high number of factors have been confirmed and highlighted in terms of motivations. In the farmer-led model, the production and sale of nature-friendly, low-carbon products is identified as a key element, with the potential to provide a competitive advantage and a price bonus. Furthermore, the pursuit of cooperation and autonomy among farmers is recognised as an important factor in the implementation of this model. It has also been suggested that a more favourable work-life balance may serve as an additional motivating factor. In the case of within the agrifood chain model, it may be posited that the cultivation of local-level collaboration constitutes a pivotal incentive. Beyond local connections, the establishment of partnerships within the whole supply chain represents a further significant element. The better price, the improvement of market position and the increase of added value could also be important arguments for joining this carbon farming business model. A prime example of such motivating factors can be found in the realm of participation in short supply chains. Regarding the outside agri-food chain cooperation, the most attractive incentives for farmers may be primarily financial incentives and, to a lesser extent, possibly reputational benefits. As part of this process, the testing of different evaluation and carbon measurement systems and procedures, as well as the exploration of alternative income-generating channels, could act as a further catalyst for participation. The primary motivator for engagement in the government-led business model is the provision of stable, predictable and continuous support, primarily through the Common Agricultural Policy or similar initiatives. A further salient benefit of this model pertains to the fact that the agricultural (carbon) practices integrated into the ongoing government programmes tend to be more reliable, professionally validated, and consequently can be more readily applied by farmers with a greater degree of confidence. Within the knowledge transfer-oriented model, farmers' primary motivation is to acquire knowledge regarding novel techniques with which they are not yet familiar, and to receive assistance in implementing these practices. Ultimately, the focus is on the accumulation and subsequent exchange of knowledge and experience, even within an intergenerational context. The aforementioned factors are also pertinent to the improvement of soil conditions, the maintenance of which will possibly result in an enhancement of yields over an extended period.

The impetus for advisors across various models can mainly be twofold: to facilitate community building and to support active measures to combat the ongoing degradation of land and the environment. For advisors operating within farmer-led models, the provision of support for such initiatives, or even the raising of awareness about them, has been identified as a relevant motivating factor. This is particularly the case when clients in such models are found to be more receptive to sustainable and innovative practices and related knowledge. In the context of the within agri-food chain model, the most compelling incentive may be the establishment of a system of effective cooperation and successful production. In the government-led model, the primary objective is to assist farmers in attaining community/policy objectives and adhering to the requisite rules and regulations. In knowledge-transfer oriented projects, advisors can play a pivotal role, the nature of their work inherently predisposing them to participate.

For researchers in general, the primary motivation for adopting different business models can be to disseminate and implement research findings more widely. The farmer-led model has been identified as a particularly attractive option for the implementation of on-farm research, in terms of facilitating access to empirical data and also the establishment and consolidation of farmer-researcher networks. These factors can apply to models both within and outside the value chain, while there can also be an incentive to transform research results into real market products. In government-led models, researchers assume a number of pivotal roles, including the preparation and implementation of policy changes, and the evaluation of the economic impact of interventions. The improvement of support mechanisms and programmes, as well as the dissemination of research results at national and regional scales, have been identified as areas of potential motivation for scientific parties. It is evident that, within the knowledge transfer model, these entities assume the primary role in knowledge production, for whom the validation of results and methodologies is of paramount importance.

In the domain of carbon farming, government agencies can possess a number of overarching objectives, both in the model it has initiated itself, but also by joining other models, as they can gain important information on the functioning and operation of those different models. The primary objective of government in all models is to achieve carbon-related policy goals and to address systemic problems. The subject is pertinent at both the European level, with regard to the setting of climate targets, the CAP targets, the creation of carbon markets and regulations, as well as in the context of a given country, aiming for the regeneration of degraded soils, or additionally, it may encompass the social promotion of carbon-neutral practices and products. Nevertheless, it may be beneficial for government agencies to engage with other models. In the farmer-led model, for instance, this represents a valuable opportunity for the collection of empirical data on the progress of various interventions. This data can then be used to plan future interventions and, potentially, to review current programmes and schemes. It is beneficial for agencies to explore the expectations, needs and experiences of the various actors involved in different models, both within and outside the agri-food value chain.

For the various market entities (sellers, buyers, traders, food processors), a clear motivation is that there is an anticipated and expanding demand for carbon neutral, environmentally friendly products. For these actors, farmer-led partnerships or cooperation within the value chain are of particular importance, as they can increase cooperation towards both producers of raw materials and customers. The forging of connections with producers can facilitate access to inputs of the requisite quality at competitive prices. Furthermore, it should be noted that this also provides great opportunities for the differentiation of market products and the acquisition of more in-depth market information. In the context of partnerships that operate outside the agri-food value chain, the peer-review process confirmed that brand building constitutes the primary motivation.

4.2. Challenges

In addition to the motivations, the transnational peer review groups examined the various challenges from the perspective of the main actors in the cooperation models. In the farmer-led model, the primary challenge confronting farmers pertains to the marketing of their products and the communication of added value. A further significant challenge has been identified as the knowledge gap, which refers to the limited understanding of carbon farming technologies and practices. Moreover, unfavourable impressions of carbon farming, in conjunction with the unpredictability of outcomes, have the potential to constitute an issue. In the case of the agri-food chain model, the latter uncertainty was also highlighted, complemented by regulatory and administrative constraints. In the case of cooperation outside the agri-food chain, coordination and stakeholder relations management can be problematic, as is dependence on remote, external entities. In the context of government-led models, the primary impediments may be identified as a deficiency in knowledge concerning anticipated carbon practices and the presence of administrative challenges. It has been determined that coordination and communication between actors can constitute a major challenge in knowledge transfer-oriented projects. Furthermore, the protracted nature of realising the benefits from CF practices can also be a considerable hindrance.

In the case of advisors, the peer review did not identify any challenges or barriers that were particularly specific to a particular business model. This can be justified to some extent by reference to the nature of advisory service provision. For market entities, the challenges specific to the models are also limited in scope, although a few can be identified. In the context of cooperation within and outside the agri-food chain, these challenges include the volatility of carbon credits, the potential lack of interest in carbon neutral products, and the limited awareness among customers of the trademarks and logos that distinguish these products.

In contrast to the previous two actors, the peer review process in relation to government agencies has validated a number of challenges, both horizontal and specific to different business models. A common challenge for the state in all business models (in line with and consistent with the motivations) is to enforce and implement the various European, regional and national policies (e.g. EU Green Deal, F2F Strategy), in particular to support the halting of soil degradation. Government actors may face a number of difficulties with the farmer-led model(s). One is the difficulty of regulation and standardisation due to the diversity of grassroots initiatives. This can also make it problematic to target possible support programmes, subsidies, which need to find a diverse target audience while providing a stable environment, i.e. conditions cannot change too quickly. For models within and outside the agri-food value chain, the demand for and awareness of different certification schemes was highlighted, as well as the difficulty of reconciling different business and government goals and objectives. Difficulties in data collection in the model outside the agri-food chain also contribute to these problems. Governments may also encounter problems with self-initiated models, mainly due to a lack of professional support and feedback from different stakeholders. In knowledge transfer-oriented projects, the main problems for government agencies are keeping up with the latest scientific knowledge and obtaining good quality monitoring data.

There are also many challenges for researchers in the different cooperation models. In farmer-led models, the scale of collaboration and the size of farms can be limiting, as researchers tend to focus on larger farms. There is also a limited amount of time to implement and possibly adapt the models, which also limits the use of research results or, more generally, the possibilities of sustainability certification, or generates additional costs. For models both within and outside the agri-food value chain, the feasibility of business models and the value proposition of scientific data and results for other actors and agribusinesses is also a challenge. In addition, it may be difficult to certify the results in terms of better practices or GHG reductions in the within the agri-food chain model, whereas in the outside the agri-food chain model, certification and verification is the main issue for research entities. In the government-led model, researchers have great difficulty in coping with political priorities and changing, unstable policy orientations, while at the same time having to find the best practices that best fit the actual policy. This is often in a context where there are many actors to interact with. The main challenge for knowledge transfer projects is the translation of research results into a context where there is a need for continuous interdisciplinary dialogue with other stakeholders, while in most cases the opportunities (actions, workshops) for this are limited.

In summary, there are a number of actions that are not dependent on large structural systems and that can be taken by different stakeholders to have an impact, in order to make carbon farming and carbon farming practices and business models more mainstream. Easy access to know-how, especially how to set up a trademark/logo scheme, or how to start a short food chain system. Formal and practical cooperation support elements, some kind of local cooperation supporting basic infrastructure or toolkit (including platforms, communication tools, pre-defined agreements) can also be beneficial. It is imperative that clear, simple and regularly updated information regarding the EU carbon legislation and the logic behind general carbon credits is provided, including news updates and price traceability. It is vital to establish knowledge bases and enhance existing repositories that connect practices relevant to carbon farming with government support programmes and funds (e.g. the CAP-tivate knowledge base, which was developed under an Erasmus+ project). There is an increasing number of R+D projects that are established through collaboration between various stakeholders, predominantly researchers, consultants and farmers. However, there is a necessity to enhance the visibility of carbon farming-related initiatives and to expand the range of farmers involved. It is evident that tools, procedures, and methodologies that prove beneficial to farmers are equally advantageous to advisers. Consequently, it is imperative that advisers are granted access to these resources.

ANNEXES

Final testing template

Name, country of respondent :

Title of the CF cooperation model:

Type of cooperation model:

- ❍ Farmer led cooperation model
- ❍ Cooperation model WITHIN the AGRI-FOOD CHAIN
- ❍ Cooperation model OUTSIDE the AGRI-FOOD CHAIN
- ❍ Government led cooperation
- ❍ Project led cooperation (Knowledge transfer oriented)

Your institute's role in the CF cooperation

- ❍ Initiator
- ❍ Initiator and implementer (internal partner in collaboration)
- ❍ Implementer (internal partner in collaboration)
- ❍ External support
- ❍ No role, just observing and evaluating
- ❍ Other…

Status

- ❍ Functional (on-going)
- ❍ Pilot (prototype)
- ❍ Concept
- ❍ Other…

Territorial coverage of the CF cooperation

- ❑ Local
- ❑ Regional
- ❑ National
- ❑ EU level

- ❑ Global

Main approach of monitoring and verification of performance

- ❍ Result based
- ❍ Action based
- ❍ Hybrid
- ❍ Not relevant
- ❍ Other…

Abstract

Short summary for publication

Summary of interests for setting-up and testing the model:

Expected positive environmental impact

Expected economic benefit

Expected positive social impact

Expected positive impact on the organisation

Other aspects of interest

Summary description of involved partners and how the partnership was developed and tested

Partners

Partner name	Partner type	Partner description

Type: Farmer; Farm advisor; Researcher; Government Agency; Local action group; Food processor; Short supply chain buyer ; Wholesale buyer; Input supplier; Carbon credit project; Certification organization; Financial institute; Insurance institute.

Role of partners in the cooperation

Activities carried out by the partners

You may refer to your tracked records in cfce_a22_progress_planning_monitoring.xlsx

Summary of Carbon farming practices used and tested

Carbon farming practice

- ❑ A.1 Use of manure, biogas slurry, compost or biochar for fertilization
- ❑ A.2 Relocation of harvest residues, for animal nutrition not needed forage crops (grass-clover) to another field
- ❑ B.1. Additional cultivation of cover/catch crops instead of fallow
- ❑ B.2 Diversification of field crop rotation, including undersowing, intercropping and mulching practices, leaving crop residues in the field, incorporating crops with distinct root development and root exudate release
- ❑ B.3 Intercropping strategies in orchards and horticulture
- ❑ B.4 Systems of agroforestry with interactions of the agricultural and the forestry part
- ❑ C.1 Reducing tillage to different extents
- ❑ C.2 Peatland restoration
- ❑ C.3 Conversion of arable land to grassland or forest
- ❑ C.4 Liming effect for aggregation of Corg and clay minerals
- ❑ Other…

Carbon sequestration monitoring

- ❍ Visual indicators of the main physical, biological and chemical soil properti
- ❍ Development of pedotransfer functions (PTFs)
- ❍ Set of indicators related to C dynamics
- ❍ Not relevant (no monitoring)
- ❍ Other…

CF practice description

Summary of achieved environmental, economic and social impacts

As you have already provided information about the expected impacts, here you may also highlight any elements, events, which were not realized entirely in accordance with the envisioned process.

Environmental impacts

Economic impacts

Social impacts

Organizational impacts

Summary of lessons learnt

Benefits of cooperation

Strengths

- ❑ Knowledge exchange
- ❑ Capacity development
- ❑ Sharing resources
- ❑ Complementing resources
- ❑ Established trust between participants
- ❑ Other…

Cons/Barriers of cooperation

Weaknesses

- ❑ Knowledge gap
- ❑ Technical and investment challenges
- ❑ Reduced short-term profitability
- ❑ Long-term return on investment
- ❑ Inadequate pricing
- ❑ Lack of institutional and technical capacity
- ❑ Additionality, high baseline
- ❑ Other…

Assessment of potentials for tested model sustainability and transferability

Can the model be sustained in the future?

- ❍ Yes
- ❍ No

If yes, will your organization take part in the sustainability?

- ❍ Yes
- ❍ No

If yes, how sustainability will be achieved?

Can the model be transferred to other potential stakeholders?

- ❍ Yes
- ❍ No

If yes, will your organization take part in the transferability?

- ❍ Yes
- ❍ No

If yes, how transferability will be achieved?

Web link(s) of photos/videos:

URL(s) of web pages:

Web link(s) of user testimonials:

Web link(s) of other sources:

Web link(s) of other file attachments:

Peer review template

Peer review expert questionnaire template for the evaluation of cooperation model testing

The type classification of the cooperative model is consistent with the described operation of the model

- Yes
- No

If not, which other type would the model be classified in, or what would need to be added to ensure a clear classification? (or whether classification is even possible) (max. 1000 character)

…

Are the impacts/benefits of the co-operative model clearly and thoroughly explained?

	Yes	No	If not, what are the other possible impacts?
Environmental impacts			
Economic impacts			
Social impacts			
Organizational impacts			
Other benefits			

Are all partners mentioned and their roles clearly described who have an important role to play in testing the cooperation model??

- Yes
- No

if not, which stakeholder involved should be (better) presented?

…

Is the role of the partners involved in the cooperative model and their activities during the testing phase adequately described?

- ❍ Yes
- ❍ No

If not, which partner's role and activities should be further specified and how?

…

Is the presentation of carbon farming practices (agricultural practices used during the testing period that may result in carbon sequestration) adequate?

- ❍ Yes
- ❍ No

If not, which aspect/practice should be specified/elaborated on?

…

Would the cooperation model work with a wider range of carbon farming practicies? (e.g. restricted grazing is only relevant for livestock farmers)?

- ❍ Yes
- ❍ Partly
- ❍ No
- ❍ Further tests would be needed

Is the verification and monitoring methodology appropriate for the functioning of the model?

- ❍ Yes
- ❍ No

if not, what changes would be necessary?

…

Do you agree with the listed and explained benefits of the cooperation model?

- ❍ Yes
- ❍ Partly
- ❍ No

If partly, or no, which benefit(s) do you disagree with or what is still missing?

…

Do you agree with the listed and explained weaknesses/barriers of the cooperation model?

- ❍ Yes
- ❍ Partly
- ❍ No

If partly, or no, which weakness(es)/barrier(s) do you disagree with or what is still missing?

…

Can the financial sustainability and business considerations of the model be assessed?

- ❍ Yes
- ❍ Partly
- ❍ No

If partly, or no, which considerations do you disagree with or what is still missing?

…

Overall assessment of the cooperation model

- ❍ Poor/Not viable
- ❍ Weak/Hard to scale
- ❍ Satisfactory/Niche
- ❍ Good/Good potential for upscaling
- ❍ Excellent/Best practice

In details (including viability, sustainability, transferability, max. 2000 character):

…

Suggestions, recommendations, comments on the ***development and scaling up*** *of the cooperation model (max. 1500 character)*

…