European
Commission

Operationalising an EU carbon farming initiative

Annexes – case-studies

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Abbreviations

ACoGS	Avoided Conversion of Grasslands and Shrublands
AECM	Agri-Environment Climate Measure
AFOLU	Agriculture, Forestry and Other Land Use
AGC	Avoided grassland conversion
API	Application programming interfaces
AU ERF	Australian Emission Reduction Fund
BLKB	Basellandschaftliche Kantonalbank
C	Carbon
CAP	Common Agricultural Policy
CAP2ER	Calcul Automatisé des Performances Environnementales en Elevage de Ruminants
CAR	Climate Action Reserve
CARB	California Air Resources Board
CCOP	California's Carbon Offset Program
CDM	Clean Development Mechanism
CF	Carbon Farming
CH4	Methane
CRF	Common Reporting Format
DAC	Development Assistance Committee
DEFs	Default Emission Factors
DKW	Wetland Restoration RDP measure in Denmark
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EC	European Commission

EEA	European Environment Agency
EES	Ecosystems and Ecosystem Services
EF	Emission Factor
EIA	Environmental Impact Assessment
EIP-AGRI	Agricultural European Innovation Partnership
ERF	Emission Reduction Fund
ESPG	Environmentally Sensitive Permanent Grassland
ETS	Emissions Trading Scheme
EU	European Union
FAO	Food and Agriculture Organisation
FAO-WRB	FAO World Reference Base for Soil Resources
FaST	Farm Sustainability Tool
FiBL	Research Institute of Organic Agriculture
FLBC	Ferme Laitière Bas Carbone
GAEC	Good Agricultural and Environmental Conditions
GDNL	The Dutch Green Deal
GEST	Greenhouse Gas Emissions Site Type
GHG	Greenhouse Gas
GHGI	Greenhouse Gas Inventory
GIS	Geographic Information System
HNV	High Nature Value
IACS	Integrated Administration and Control System (CAP data system)
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
JRC	Joint Research Centre
LBC	Label Bas Carbone

LENs	Landscape Enterprise Networks
LPIS	Land Parcel Identification System
LUCAS	Land Use/Cover Area Frame Survey
LULUCF	Land Use, Land Use Change and Forestry
MF	MoorFutures
MM	Maxmoor
MRV	Monitoring, Reporting and Verification
MS	Member State
MtCO2 eq	Metric tonnes of carbon dioxide equivalent
N	Nitrogen
N_2O	Nitrous Oxide
NGOs	Non-Governmental Organisations
NIR	National Inventory Report
OECD	Organisation for Economic Cooperation and Development
PC	Peatland Code
PCF	Portuguese Carbon Fund
PFSI	Permanent Forest Sink Initiative
PIU	Pending Issuance Unit
PRP	Polish RePeat Project
RBCF	Result-based Carbon Farming
RBP	Result-Based Payment
RDP	Rural Development Programme
REDD+	Reducing Emissions from Deforestation and Forest Degradation. Mechanism developed by Parties to the UNFCCC to reduce deforestation and forest degradation in developing countries.
RPP	Restoration Projects in Poland
RS	Remote sensing

SDGs	UN Sustainable Development Goals
SOC	Soil Organic Carbon
UNFCCC	United Nations Framework Convention for Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association
VCU	Verified Carbon Unit
Verra	(see VCS)
WFD	Water Framework Directive
WSL	Swiss Federal Institute for Forest, Snow and Landscape research
WTO	World Trade Organisation
WWF	World Wildlife Fund

Glossary

Action-based carbon farming: a scheme where a farmer or landowner receives a payment for implementing defined management actions, independently of the resulting impact of those actions.

Agroforestry: the practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or livestock production systems to benefit from the resulting ecological and economic interaction

Farm carbon audit tool (audit tool): a computer model that calculates a farm's GHG emissions and/or carbon sequestration based on input data that summarise the farm's management others. They can also calculate other outputs, including sustainability indicators such as nutrient runoff or emissions intensity.

Hybrid approach/model: a scheme that uses a combination of result-based and action-based payments on the same parcel of land.

Peatland: land that contains peat in the sense of a histic horizon (e.g. mires, moors, meadows). A histic horizon is a soil layer near the surface which, when not subject to drainage, consists of poorly aerated organic material which is water saturated (or would be in the absence of drainage) for 30 consecutive days or more in most years.

Result-based carbon farming: a scheme where a farmer or landowner receives a payment for reducing net GHG fluxes from their land, whether that is by reducing their GHG emissions or by sequestering and storing carbon. A result-based approach requires a direct and explicit link between the results delivered (e.g. GHG emissions avoided or carbon sequestered) and the payments that the land manager receives. It differs from the more familiar action-based schemes, where the farmer is paid for complying with very specific farming practices or technologies, which have been selected by the managing authority for the assumed climate mitigation benefits.

Annex I

PEATLAND RESTORATION AND REWETTING

A CARBON FARMING CASE STUDY

Table of Contents

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Summary and recommendations

Context: As the world largest natural terrestrial carbon store, peatlands are key for combating climate change. Intact peatland plays an important role for the carbon cycle, climate mitigation and provision of ecosystems services due to their role as a permanent water-locked carbon stock and ongoing sink. However, years of unstainable land management practices have resulted in peatland degradation limiting their ability to provide effective climate regulation services. Currently, degraded peatlands emit 2 Gt CO_2/yrs, and are responsible for almost 5% of global total anthropogenic CO_2 emission. From peatland drainage alone around 220 Mt CO_2 eq. are emitted in the EU per year[1]. Restoration, rewetting and conservation of peatlands are promising carbon farming options due to the high-level potential climate benefits per hectare of peatlands, while ensuring the provisioning of other ecosystem services[2]. However, the use of result-based approaches and schemes for supporting peatland restoration and rewetting are currently limited and wider adoption and upscaling are needed.

Case study's aim and scope: Results-based carbon farming schemes offer a promising way to incentive e.g. governments, authorities and farmers to develop and implement peatland restoration and rewetting projects as they (1) provide a new/additional source of finance to high upfront restoration costs, and (2) provide an opportunity to valorise GHG emissions from large, geographically confined emission sources based on current carbon credit prices.

The case study focuses on avoid emissions from peatlands through peatland restoration and rewetting. Emissions from grazing livestock on drained peatlands is within scope to the extent that this as an eligible activity for crediting.

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[1] Source: Grifswald Mire Centre (2019). https://www.greifswaldmoor.de/files/dokumente/Infopapiere_Briefings/202003_CAP%20Policy%20Brief%20Peatlands%20in%20the%20new%20EU%20Version%204.8.pdf

[2] Source: Joosten et al., (2016). https://assets.cambridge.org/97811070/25189/excerpt/9781107025189_excerpt.pdf

Recommended peatland scheme – summary

Objective: Incentivise restoration of peatlands through mobilisation of carbon finance payments for the avoided emissions.

Scale/coverage: Considering foreseen CAP support, a peatland carbon farming scheme is only viable where full restoration of peatlands on already degraded marginal agricultural land is possible. Minor changes to water table and partial rewetting without restoration can be considered but will most likely not yield sufficient credits for a competitive return on land and business case. The MS specific implementation of the restrictions for ploughing and drainage of peatlands (under GAEC 2) is decisive for the business case of many peatland projects.

Climate actions: For a start, a scheme should target avoided emissions of CH_4 and CO_2 resulting from restoration of water levels and vegetation. While undisturbed peatlands constitute a continuous carbon sink, it is considered non-anthropogenic by most standards and hence not an eligible activity. The build of the carbon stock in the period immediately after restoration takes 20-50 years and is initially hardly measurable. Until data and measurement systems can detect this build up, the carbon removal part of peatland restoration is not recommended as basis for crediting.

Design principles: There are different go-to-market models that can be applied, depending on the nature of the potential link to what market or type of buyers and the role and responsibilities that farmers, the scheme administrator and governments are willing and able to manage. If a scheme is created to provide offsets for national compliance within the non-ETS sector, a more elaborate system with decentralised responsibilities, a central registry and a more market-linked role of farmers is more suitable. However, for voluntary niche CSR based offsetting, a much smaller set up can be operated and driven by a group of researchers, leaving limited administrative and project development work on farmers. However, with the rising attention of governments and the EU on the potential for peatland restoration as a GHG mitigation measure, the framework conditions that shaped the existing schemes may change, and new designs must be developed.

MRV: It is not possible or necessary to conduct on-site, continuous monitoring producing primary data as emission factors are well correlated to water table, land use and vegetation. Therefore, most schemes must rely on monitoring of indicators, while relying on baseline data from trials and surveys in similar climatic settings. Reporting and monitoring can be conducted at project level or by the scheme to save costs, however verification should always be entrusted to third party ‘peatland expert’ verifiers approved by the scheme. All MRV data including site specific emission factors and activity data should be made public and available to scrutiny through e.g. scientific publications, as this will add an additional level of trust and review.

Rewards: Peatland rewetting and restoration deliver many benefits in addition to GHG mitigation. However, GHG benefits are recommended for crediting. Many buyers will pay a price premium for the higher quality and additional co-benefits of peatland credits, in particular if these originate from a site in an area of commercial relevance to the buyer. This is so even if the co-benefits are not quantified and verified. Any new peatland carbon farming scheme would be recommended to focus on GHG benefits until experience and methodologies from existing scheme on quantification and monetisation of co-benefits can be adopted.

Funding and governance: In the pilot phase and considering current credit price levels, any new scheme must rely on other complementary sources of funding than carbon market finance from sale of offsets or credits. Cash flow will be an issue for most landowners participating in a peatland carbon farming scheme, so upfront funding is crucial. Switching to ex-ante crediting to raise climate finance upfront cannot be recommended as most compliance schemes does not allow this practice. However, some hybrid models using carbon credits as instalments on zero interest loans are being explored and may prove feasible.

Overarching considerations: Provided that a given MS or region would naturally host several extensive peatlands, the feasibility of a peatland carbon farming scheme should be considered upfront and focus on a few key issues such as profitability of marginal agricultural land on drained peat soils, availability of country specific data on peatlands (activity data and emission factors) and interest of farmers and private investors. Where these elements are conducive and information available, a feasibility assessment could be initiated.

Recommendations regarding scheme design

Scope and coverage. The main objectives of the peatland schemes should be rewetting and restoration of drained peatlands in order to secure climate mitigation objectives. The rewetting and restoration of peatlands comes with numerous co-benefits linked to ecosystem services including nature, biodiversity and water protection. However, the quantification and monetization of these benefits is not a pre-requisite for a successful scheme. It is recommended to target a peatland carbon farming scheme at marginal and drained agricultural land on peat soils and target full rewetting and restoration or appropriate paludiculture as main eligible activities. For piloting or to reduce implementation time for frontrunner projects, the scheme should also target potential restoration projects where few landowners are involved and where partial or full public ownership is existing or possible.

Scheme feasibility. Any potential peatland project must first identify the presence of a peatland layer currently subject to drainage but preferably with a thickness of more than 50 cm. Without an exposed peat layer or a very shallow peat layer a project or scheme is not feasible. In order to identify/screen for suitable sites the land use and land profitability must be considered following a three-pronged approach:

- To identify soil types, soil maps or landscape models must be used. Presence of histic soils is a prerequisite, but presence of current drainage (pipes or ditches) is also needed.
- To identify land use, maps, agricultural statistics and/or satellite and drone imagery can help, but it requires Geographic Information System (GIS)/Remote Sensing (RS) expertise for data preparation and interpretation. Relevant authorities should be involved early on.
- To screen for sites with a potential business case for restoration or rewetting, land profitability must be estimated (including current CAP payment entitlements). It will take simple economic modelling to determine the total carbon financing that would ensure sufficient funding of a restoration project. Specifically, density and amount of avoided emissions and various pricing scenarios can then help determine the extent of possible sites with a positive business case.

Before setting out for mapping and assessment of vast areas it should be noted that for many non-boreal geographies, peatlands are few and far between. Experts will be able to determine peatland from landscape analysis and simple rainfall and groundwater data. Applying nationally relevant emission factors (EF) will then allow for initial estimates of GHG potential from carbon farming. It is recommended to analyse 3-4 larger peatland restoration areas, which are commercially viable for a full restoration. The analysis should include, as part of a feasibility study, economic considerations including potential pathways, areas, and price levels, as for the Peatland Code (PC).

At a later stage, within the governance and operation of a scheme, individual project level development of restoration and rewetting will require detailed high-resolution mapping and assessment of parameters such as soil type, vegetation, water regime, including rainfall and groundwater dynamics. This is specialist work requiring researchers or technicians.

To support the early phase of scheme design, investors and regional or national governments should consider setting up a dedicated carbon fund that could provide guarantees for projects that receive advance payments and provide inputs to setting up a market platform. The carbon fund can be designed in several ways as explained in more detail under markets considerations later in this guidance. A public-private-partnership carbon fund may serve this purpose and guarantee the first three years of credits at a fixed price, with permission to sell on/transfer credits.

Additionality and leakage considerations. While additionality is crucial to maintain the integrity of a scheme, more rigorous rules might lead to lower willingness from project owners to participate. In many cases, the additionality of a restoration project can be determined by an assessment of its profitability in the absence of climate finance but with the access to CAP pillar 1 payments. Leakage cannot be standardised other than through a minimum percentage of leakage calculated as a deduction of the impact quantification as is used in some standards, and it is necessary to account for leakage on a project-specific basis (von Unger et al., 2019).

As concerns permanence risk, it is recommended to apply ensure use of long-term land contracts, use land deeds actively and other legal measures. This should be combined with mandatory buffer accounts to guarantee issued credits. Existing peatland schemes set a low (10-30%) buffer account.

Governance structure: The scheme should be governed by a secretariat and supported by a technical advisory committee and a stakeholder or steering group inviting in farmers, investors, authorities and interest organisations. The technical advisory committee of experts and researchers should actively guide and support the e.g. development of rules, practices and standards for baselines, additionality, risk buffers, MRV and insurance pricing and sale of credits.

Result indicators. Project level result indicators serves as a basis for establishing result-based payments and should ideally be defined early on. Indicators might entail GHG emissions, water table height and/or abundance of vegetation types. If a scheme is developed in the context of a Rural Development Program or supporting CAP implementation, scheme level indicators will be needed to be devised in close coordination with relevant authorities. It is recommended to further explore possible sustainability indicators at project level to include price premiums for offsets that entail broader socio-economic or environmental co-benefits.

Co-benefits and sustainability indicators

If possible, one, more or all co-benefits should be quantified and monetised to allow for charging a price premium. There are two options for monetising co-benefits, and both can be applied:

- *Bundling* is grouping multiple ecosystem services (ESS) together in one complete package to be sold as a single credit. This option might be useful if only one ESS can be commodified. However, additional EES could allow for charging higher premium prices.
- *Layering* refers to a scheme where payments are made for several, distinct EES which are then sold separately. Layering in only possible where EES can be commodified individually and where a market demand exists. Layering should however be carefully quantified to avoid potential double-counting.

Monitoring, Reporting and Verification (MRV). It is not feasible or cost-efficient to measure data on-site in the restoration area in real time for all indicators continuously, so schemes would have to rely partially on modelled data, spot checks and reference data. These data should be obtained from inventory operation, local researchers and other projects.

A core project-level indicator will concern avoided emissions and sequestered carbon; therefore, emission and removal factors must be established early on. Defining so called default factors will be a key responsibility of the technical advisory committee (covered under governance). This process should be open and inclusive and ensure the assessment and evaluation of data and factors used nationally for peatlands (or used internationally in geographies with similar climate and landscape).

- Emission and removal factors should be determined for each land category and for each peatland *state* within each land category.
- Emission factors could be determined by using proxies or reference data and supplemented by direct measurements in the project areas. It is suggested that best practice would be to publish the research behind proposed emission factors as a scientific paper in a peer reviewed journal, in order to have scrutiny and transparency.
- For early, pre-EF assessments, scheme owners can assume an annual peat decomposition rate of 1 cm.

It is recommended to consult the National Inventory Report (NIR) and the submitted reporting tables (CRF tables submitted to the UNFCCC) to identify approaches, maps and data used, classification of soils and use of emission factors. Also, data should be shared for modelling purposes e.g. at EU level.

Lastly, it is recommended to strive for consistency in data approaches, classifications applied, and in annual work cycles between national inventory makers and scheme owners. There are currently no rules or guidelines in place within the EU or internationally that supports establishing exchange of data, however by 2023 the European Commission will release a standard for Carbon Removals which may address some of these issues. In general, scheme owners should observe policy developments in the EU and abroad on this matter, and encourage domestic inventory compilers to proactively address the issue.

In order to quantify results, the monitoring system should be constructed to match the selection of result indicators and the metric for estimating and reporting results. Matching monitoring systems and result indicators is an exercise that requires technical expertise, but it is key to a functioning scheme.

Monitoring indicators should be developed for monitoring peatland rewetting and restoration projects. The Greenhouse Gas Emissions Site Type (GEST) method is the most developed indirect technique (by the researchers behind MoorFutures but also applied with modification by other peatland initiatives and schemes) to quantify GHG emissions.

Regular evaluation, reviewing and improvement of the scheme to assess progress towards objectives and improvement of the peatland scheme are recommended. This scheme evaluation, which is quite separate from the scheme's MRV system, could focus on impacts, effectiveness, practical feasibility, efficiency, equity and sustainability of a peatland scheme, or adapted to other carbon farming schemes.

Reward. It is recommended to quantify and monetise avoided CO_2 and CH_4 emissions as the basis for calculating the reward to the landowner. In addition, it can be considered to map and document non-carbon benefits in order to add mark-up on price compared to European emissions allowances or voluntary markets.

The unit price will usually be higher than market prices for allowances and existing initiatives that have either applied cost-based pricing or relied on project specific price negotiation between project owner, developer and buyer (which allows for factoring in a price premium for non-carbon co-benefits). If there is little compliance demand and no transparent and free markets setting prices, it is recommended to use one of these two approaches. Pricing of voluntary market units (Verra, REDD+) may be used as inspiration or benchmark, because some buyers will compare European peatland restoration credits to credits available from these schemes.

Markets and payments considerations. Taking account of questions such as who owns, issues, markets, prices, transfers and uses the generated credits constitutes market design and should be carefully assessed as peatland credit markets are still few and nascent, and the credits are not yet accepted at compliance markets regulated under UNFCCC rules or EU legislation. The recommended approach to market design is outlined in the scheme platform model (model 1, see case study) which entails projects that are developed by and later run by the scheme owners on behalf of the landowners. As scheme owners in this model are actively involved in all decision processes alongside the deployment of accredited developers where necessary, the model allows for the simplest decision-making process as well as providing the highest level of flexibility for expansion. The model is particularly well suited to small scale and early testing in a situation with limited upfront funding and restricted access to carbon markets. In more regulated environments, where peatland restoration can already contribute to GHG target compliance, the other presented models are better suited.

As part of market design, buyer restrictions should also be considered in view of potential reputational, integrity or price setting implications. Restrictions could be on:

- An important market restriction is recommended for on-sale/trading of units, unless a national and linked registry exists.
- Restrictions may also target certain types of buyers (per sector, industry, geography).
- Conditional access to credits should be based on merit. Conditionalities could, for example, prevent any company with unabated emissions from owned, leased or in-supply chain wetlands from acquiring units.

Considering the above, it is recommended to start with targeting potential buyers with local presence or commercial interest in peatlands or rural landscapes, e.g. global/foreign companies with branch offices/clients in the area, or food, outdoor equipment, timber or tourist businesses.

The common and well-established practice of carbon markets is to tie the **payment** to the issuance and subsequent transfer of the credit from the project owner to the buyer. However, it is recommended to consider both ex-ante and ex-post payments/crediting in the design phase but only to apply ex-ante if tied to low interest upfront loans without instalments where credits constitute payback. Also, this approach may exclude credits from national or international voluntary or compliance markets. To link markets and compliance schemes, it is necessary to prepare and test ex-post crediting.

Farmer engagement, training and advice. Farmers (and landowners) should be engaged more to ensure increase buy-in and take-up. Key elements include creating economic incentives for farmers/landowners by ensuring that peatland rewetting and restoration is more profitable than the status quo and could be presented as a new component to their business. Training and advice to farmers should be provided that facilitate farmer learning, capacity building and business opportunities. Further, training for accredited entities or companies conducting validation and verification procedures should be scaled up to address the limited number of such entities capable of conducting such procedures within peatland.

Promoting CAP alignment. It is recommended to explore options for alignment between peatland restoration and rewetting schemes and the CAP, to ensure adoption, upscaling and enhanced monitoring of the peatland schemes. Several options could be explored including (i) potential phasing out of CAP direct payments for drained peatland to ensure coherence between agricultural, peatland and climate policies; (ii) guarantee that farmed wet peatlands (e.g. used for paludiculture) are eligible for CAP payments from Pillar 1 and Pillar 2; or/and establish result-based CAP payments schemes promoting climate mitigation benefits and provision of ecosystem services by setting attractive incentives for both carbon and non-carbon co-benefits.

Overall conclusion: Avoidance of emissions from peatland drainage is an important mitigation options with significant co-benefits for provisions of ecosystem services. Designing and operation a result-based carbon farming peatland scheme is a promising and feasible way to incentivize government, authorities and farmers to take effective and efficient climate actions in the EU. Learning from and building on already operational sub-national and national result-based payment peatland scheme and programmes in the EU can facilitate scheme development and upscaling in the EU.

1. Introduction

This case study provides analytical insights and guidance on how to set up and operate result-based carbon farming scheme on organic soils in a European context. It focuses on reducing emissions from peatlands through peatland restoration and rewetting excluding organic carbon in mineral soils and grassland (which are covered in other case studies (see case studies Maintaining and Enhancing Soil Organic Carbon on Mineral Soils – Annex III – and Managing Soil Organic Carbon on Grasslands – Annex V). However, grazing on drained peatlands is included in this case study to the extent that the schemes covered have allowed this as an eligible activity for crediting.

The case study provides lessons learned and builds on existing results-based payment initiatives and schemes on peatland restoration and rewetting in the EU, which offer real-word experiences on design and implementation options for the operationalisation of peatland schemes in an EU Carbon Farming context. The most relevant examples are the MoorFutures (MF) in Germany, launched in 2011 in Mecklenburg-Western Pomerania as the first German federal state; the Peatland Code (PC) in the United Kingdom (2015); max.moor (MM) (2017) in Switzerland; and the Dutch Green Deal (GDNL) (2017)[3]. A common feature of all these schemes[4] is that they have been developed for domestic or regional use and a voluntary demand - but are at different phases of implementation and operation. We also draw on experiences from mini wetland and peatland restoration projects in Poland (RPP) and a wetland restoration Rural Development Programme (RDP) measure in Denmark (DKW) to take account of the breadth of learning relevant to peatlands. The suggested scheme design builds on these, supplemented by discussions with stakeholders and interviews with existing scheme developers and policymakers[5] to understand how they have overcome barriers, and drawing on conclusions regarding opportunities and solutions going forward. The observed practices and highlighted successful approaches should however be understood as examples that are the result of a specific context and should not be taken as readily scalable and widely applicable proofs of concepts.

Note on peat(land) terminology

The case study is designated for non-experts and it applies the term *peatland* to all land that contains peat in the sense of a histic horizon, not distinguishing between mires, moors, meadows etc. A histic horizon is a soil layer near the surface which when not subject to drainage consists of poorly aerated organic material which is water saturated (or would be in the absence of drainage) for 30 consecutive days or more in most years (e.g. see soil classification of FAO-WRB). The histic horizon may remain even if the land is drained but will degrade and eventually disappear. Therefore, drained agricultural land with a histic horizon but with no visible signs of saturation due to the drainage is included under the term peatland as used herein. The term '*wetlands*' is only used when referring to UNFCCC reporting or GHG inventories, but quite confusingly this term has been defined politically to refer to a residual land use, i.e. all land that has been actively rewetted but does not qualify for other UNFCCC land use categories. Wetlands remaining wetlands (that have never

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[3] See Chapter 10.

[4] It should be noted that throughout this document we refer to these case examples as initiatives or mechanisms interchangeably notwithstanding how they label themselves; and we refer to individual mechanisms using the abbreviations listed after each in the above text.

[5] See list of interviews (Chapter 11) and workshop participants (see Chapter 12).

been drained, not the rewetted peat extraction sites) are not relevant for this case study. As a governing principle IPCC land use categorisation is respected and used when referring to other land. Peatlands are a subset of carbon rich soils and organic soils but are not synonymous, as also gleysols and podzols among others can have significant carbon stocks with a distinct histic horizon. Countries have different thresholds and definitions for labelling organic soils and peat soils. Therefore, detailed peatland typology or specific national wording (mires, meadows, bogs, fens, moor) is only used when reference to specific initiatives demand it. For more detailed explanations and reference on peatland terminology, see Joosten, Tanneberger and Moen (2017).

2. Exploring options and approaches

a. Peatland case study context

1) Why peatlands are important for climate change mitigation

Over centuries European peatlands have been drained and degraded for agriculture, forestry and peat extraction purposes (Peters and van Unger, 2017; Joosten et al., 2016). Such land management practices were driven by opportunities to produce agricultural and forest goods for expanding markets and thus wealth from otherwise unproductive land. In the Nordic countries for example, peatland drainage was largely a government driven policy to mitigate the socio-economic crises related to poverty, emigration and unemployment in the 1940s (Kløve et al., 2017). However, peatland drainage and degradation is not a one-time event, but a **permanent condition** unless it is stopped by rewetting or/and restoration.

When peatland is preserved and kept wet it plays an important role for the carbon cycle, climate mitigation, biodiversity and provision of ecosystem services, due to its role as a permanent water-locked carbon stock and ongoing sink. Some preserved and managed wetlands have controlled water levels and are not fully saturated at all times. The water saturation in the soil creates **anaerobic conditions** and leads to incomplete decomposition of vegetation, which gradually accumulates carbon through the formation of peat.

Globally, degraded peatlands emit 2 Gt CO_2 per year, and are responsible for almost 5% of total anthropogenic CO_2 emission (Joosten et al., 2016). From peatland drainage alone, the EU's peatland-related emissions are around 220 Mt CO_2 eq. per year – the second largest after Indonesia and more than the EU total emission from enteric fermentation (Greifswald Mire Centre, 2019). Peatland degradation limits the ability of peatlands to provide effective climate regulation services and **restoration, rewetting and conservation of peatlands is therefore an urgent and necessary priority in mitigating climate change**, as well as in safeguarding the provisioning of other ecosystem services (Joosten et al., 2016). The IPCC Special Report on Climate Change and Land (2019) points to the 'irreplaceability in relevant time frames of carbon dense primary ecosystems. Of these, globally, peatland stores significant amounts of carbon[6], and more than 95% of the total peat stock is located in the temperate, boreal and subarctic zones of the northern hemisphere, such as Europe[7] (Joosten et al., 2016).

In the EU, degraded peatlands are responsible for 5% of total EU GHG emissions in 2017 (Greifswald Mire Centre, 2020) and thus an AFOLU sector key category with significant GHG mitigation potential.

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[6] **Error! Main Document Only.**

[7] https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/organic-soils

Figure 1. Peatland map of Europe illustrating the spatial distribution of peatland/organic soils.

Note: For more details see Tanneberger et al. (2017).

Source: Tanneberger et al. (2017)

Northern and eastern Europe holds extensive areas of drained and degraded peatlands, and as much as 99% of EU peatland emissions originate from just 16 Member States. Thus, the potential for avoiding large amounts of GHG emissions is concentrated here through restoration of drained and degraded peatlands (Joosten et al., 2015; Bonn et al., 2014).

As the negative consequences, such as GHG emissions, **land subsidence and loss of biodiversity** have become more pronounced, scientifically proven and communicated, peatland rewetting goals, actions, standards and methodologies are developing. Global voluntary carbon standards offer dedicated wetlands standards that include peatland rewetting, such as the Verified Carbon Standard[8] (VCS). However, despite policy research, political appraisals and legislative provisions recognising the importance of peatlands, peatland drainage and degradation is continuing across the EU (Peters and van Unger, 2017; von Unger, 2019[9]).

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[8] https://verra.org/

[9] https://www.dehst.de/SharedDocs/downloads/EN/events/Peatlands_Joosten.pdf?__blob=publicationFile&v=1

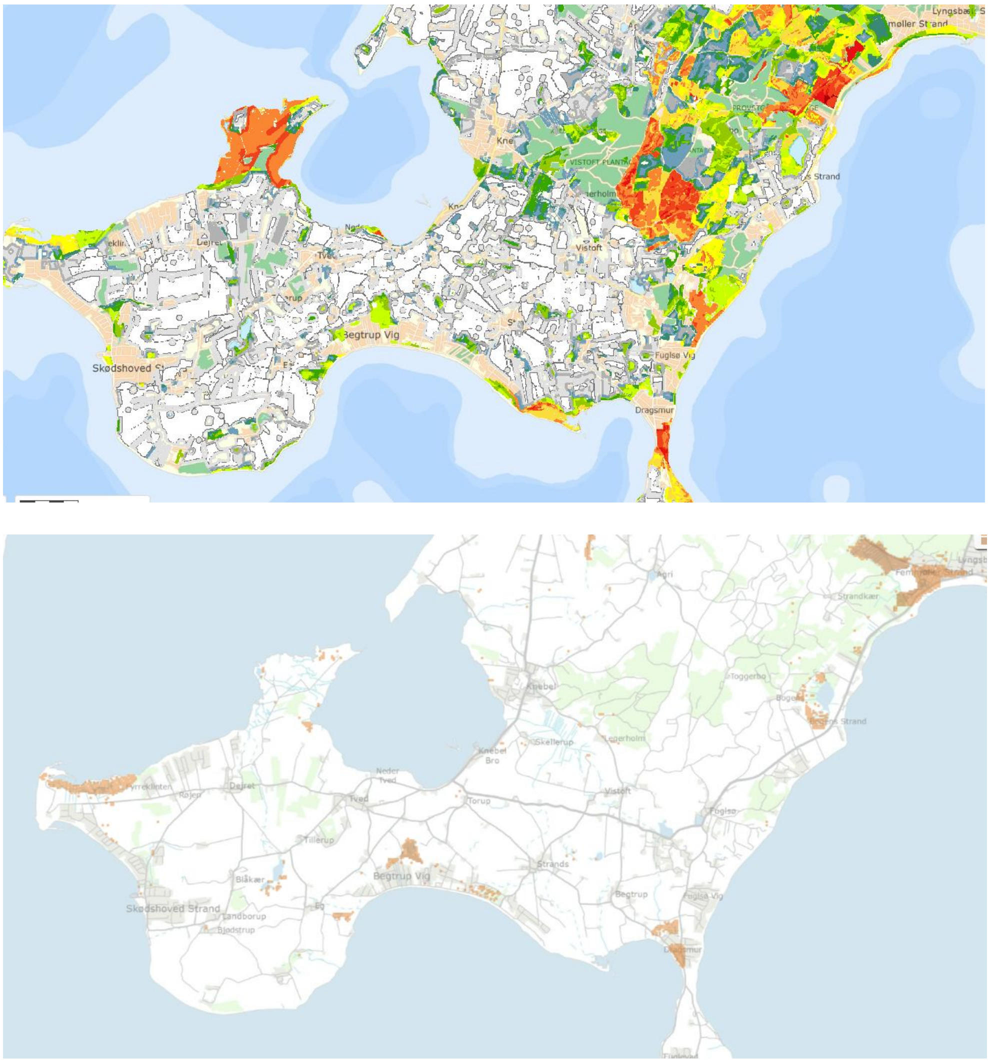
2) Technical potential for peatland rewetting

At a strategic national level, estimating and locating potential for peatland rewetting depends on availability and quality of data on **soil types, land use and land profitability** (BfN, 2020). A preliminary top-down, centralised estimation of the technical, economic and implementation potential for peatland rewetting can be produced from maps and emission factors. Using a GIS application and multi-layer analysis, in combination with emission factors corresponding to and applicable to the land categories identified through mapping, can yield quantitative estimates. Data necessary for the preliminary national level identification of land areas are:

1. Soil mapping of existing peatlands;
2. Soil mapping of open ditch, piped, or no drainage; and, where water table is regulated. the water table height;
3. Existing land use; none, forest, peat extraction, grazing and cropland (with tillage);
4. Conservation status or restrictions imposed by national legislation, Ramsar, Habitat, Birds or Water Framework Directives; and
5. Commitments/entitlements for area-based CAP payments.

The above data are usually not available at centralised or EU level for all Member States, and searches for data will need to be national and include searching databases and research programmes serving objectives other than climate change mitigation, such as land management, nitrogen or phosphorous regulation, and historical maps. Fine-resolution data will allow for field level identification of potential at national scale in a top-down process. All EU countries have datasets for national distribution of organic soils/peatlands – either GIS data or proxy data (Tanneberger et al., 2017). The availability of such data provides the opportunity to identify areas most suitable and with the highest technical potential for peatland rewetting and restoration. However, there is no existing metric or algorithm that can be applied to identify areas for cost-effective peatland restoration for an entire Member State or the EU. However, the Land Parcel Identification System (LPIS) can organise and overlay several geographical data layers, and already holds data on land use, and many landscape features, as required by the Common Agricultural Policy (CAP). Similar to the high conservation value area classification and mapping, an algorithm can be established that combines several data layers and can be used to identify suitability for peatland rewetting; with consistent Emission Factors (see Chapter 5 below), gross potentials could be produced. The main barriers to this would be data ownership, federalised data structures, and lack of soil maps and high-resolution geophysical and drainage maps. An example of two LPIS map layers with suitability classes for High Nature Value (HNV) areas and soil classification is shown in Figure 2.

Figure 2. Map examples from Denmark of two relevant existing map layers in the LPIS system



Note: The top map represents the land classification of suitability for designation as HNV, with red being highest value. The map below shows the soil map with 6-12% peat being light brown and >12% dark brown.

Source and data viewer:
http://miljoegis.mim.dk/cbkort?&profile=vandprojekter and
https://arealinformation.miljoeportal.dk/html5/index.html?viewer=distribution.

For the subnational or local level mitigation action covered in this case study extensive and comprehensive data is often not required and rarely feasible. None of the initiatives covered found their locations using a national level mapping using above mentioned data, but the GEST method developed by MF experts has been used to map potential at sub-national scale[10], with appropriate modification. The GDNL did not conduct a top-down mapping of potential before identifying the region Friesland as a

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[10] See for example Jensen et al., 2010: https://www.researchgate.net/publication/287637367_Assessment_of_climate_impact_of_peatlands_in_Schleswig-Holstein

starting point, instead intrinsic expert knowledge of landscape and soils, pro-active NGOs and political circumstances led to this. For the MM, the sites and potential for the national inventory was identified 20 years before the start of the initiative by a federal level process not linked to MM or climate mitigation at all, while the current implementation of protection measures are at cantonal level. For all initiatives, expert knowledge, maps of landscape or biodiversity, land availability and political circumstances seem to steer project location rather than a preliminary mapping of detailed potential. **As peatlands cover a rather small area, and their formation is defined by landscape feature and water, for smaller scale schemes experts will often know or be able to locate relevant peatlands, and with field surveys and use of existing emission factors be able to make gross estimates of implementation potential at field level.**

Highest and most cost-effective potential for peatland rewetting and restoration projects is found where intensive, low-yield arable cropping with low profitability takes place on land that would preserve or accumulate peat in the absence of human intervention. As arable farming on nutrient rich fens is typically very profitable due to high yields, potential sites will often include acid upland peats or very wet fens where drainage is expensive and/or difficult. With current costs of emitting GHGs and no direct pricing of other societal costs related to peatland drainage, such lands will only make up a small share of the total area of potential restored peatlands (in the EU). In short, the business case for rewetting remains highly dependent on market prices on land and the value and income generated from the crops harvested. On more profitable and high-yielding land, the **opportunity costs and income foregone will be prohibitive** for peatland restoration projects under current conditions. As such, the profitability of agriculture on peatlands again depends on absence of the internalization of the cost of climate change.

Conducive strategic decision-making at national or federal level to promote or enable result-based payments for peatland rewetting has been absent for most of the initiatives, but nonetheless remains a decisive factor for scalability and for fostering more initiatives. Availability of relevant geographical and land use data or the preparation of systems to map and monitor these is a major barrier that cannot be addressed at the level of the individual initiative. In many Member States, the authority to map and manage environmental or agricultural data does not lie with the Ministry responsible for Climate Change Action, nor with the entity responsible for Greenhouse Gas Inventories (GHGIs). This constitutes a barrier for provision of data and for reporting and accounting of emissions and removals from peatlands in GHGIs. All Member States report values for the IPCC 'wetlands' category, but the quality and spatial resolution of data varies significantly (Barthelmes, 2018).

Box 1. Connecting peatland projects to national GHG inventories

National Greenhouse Gas Inventories (GHGI) as submitted by all member states and the EU to UNFCCC annually, should hold estimates of emissions and removals (of CO_2, CH4 and N2O) from peatlands and other organic soils within the territory of the Member State. According to IPCC GPG, Peatlands (in IPCC terminology 'Organic Soils' and 'Wetlands') are to be reported under either of the LULUCF sector land categories (CRF sheets 4A-E, and under Agriculture for methane from ditches and N2O) corresponding to its primary use, as long as the peatland is drained and used. If a peatland is rewetted and restored as near-natural state wetland, it should be reported in the sheet for the land category Wetlands (CRF 4E). For each land category, activity data and emission factors are the basis for estimating the total emissions and removals in CO_2 eq.

In principle, any peatland restoration project that estimates impact on GHG emissions, would in a similar manner map and stratify the land that is restored into categories that would share characteristics and then apply emission factors to each of these plots. Hence, in principle the reporting by Member States of peatland rewetting in a reporting period would be the sum of all project level activities. And likewise, the potential areas suitable for rewetting, and thereby also the technical GHG ER potential from rewetting, would depend on the area reported as peatlands under each of the reporting categories (forest land, cropland, grassland, wetlands, settlements and other land).However, the link between project level restoration activities and national level GHGIs is more complicated. Several key questions have been raised (which pertain not only to peatlands, but to subnational carbon farming schemes in general):

1. Does the GHGI detect the project level activity? Is there any line of communication or information sharing? If there is no direct connection, it seems that project level activities will not be detected and reported.

2. Are activity data as used by projects and the GHGI consistent, comparable and transparent? Are the same land categories, vegetation classification and reporting scales used? The more diverse the approaches, methodologies, categories, classifications and scales used, the more complicated and demanding it will be for GHGI teams to compile estimates into a common reporting framework.

3. Are Emission Factors established based on solid data and are they widely applicable and comparable or not? In many Member States, data for establishing country specific EFs is still missing and default Emission Factors from IPCC are applied (see examples in Ch 4 on MRV). Such EFs can only serve as a very conservative basis for project level crediting activities, reducing the economic efficiency of the project. On the other hand, consistent use of emission factors as compared to proxies and estimates across project level activities will streamline and solidify reported numbers at national level.

Whenever a 'no' is the response to the above questions, the complexity of reporting increases, driving up the time needed for data management and recalculations.

Ideally, GHGI teams would publish guidelines for project developers and scheme owners on how best to address the above issues in each respective Member State, as reporting systems, data management practices and federal or local level authorities differ between Member States. Across the initiatives, there is no common or tested approach for the above issues. In fact, most of the schemes are not currently sharing data with the GHGI, and there is a strong risk that the restoration activities are not reported in the GHGI with actual data (see more under Chapter 4 on MRV). In Denmark, the DKW includes a simple Excel tool compiled by the GHGI team where data and reporting categories consistent with those reported are provided for project developers to use. This is an example of good practice that could be extended to other Member States.

Policy context

In an EU Climate Policy Context, restored peatlands in the reporting category wetlands will only count towards compliance targets from 2026, as stipulated in the LULUCF Regulation (841/2018) and will only have to be reported from 2021. The drained peatlands under management are already reported under forests (FL), cropland (CL) or grassland (GL), and count towards the 2030 EU emission reduction target following the LULUCF no-debit rule.

As is also covered later in more detail, only GDNL and partially the PC were motivated by a national level climate policy mandate to achieve GHG emission reductions from restoration of peatlands. In fact, none of the initiatives serve as official national or regional level climate mitigation measures for peatland restoration, and climate policies at EU, national and regional/federal level have only framed and influenced design of the scheme in Netherlands and in the early days of the PC (2011-2015). Of the existing schemes three got started based on a need to raise funding for restoration of peatlands, in the absence of public money for such work in the aftermath of the financial crisis. The **carbon market and climate finance** were identified as a source of funding, but the climate change mitigation impact was not listed as the main driver.

Looking ahead to EU level climate neutrality in 2050, and the potential role of sinks and the LULUCF sector in achieving a balance between emission and removals, provides a glimpse of the key role of peatland restoration. With inclusion of wetlands in GHG accounting by 2026, and the possibility of removals credits to offset residual emissions in other sectors, climate policy could very well frame future result-based schemes for peatlands in the EU. Climate Policy is a likely driver of future schemes, much more than has been the case for the initiatives set up in the period 2010-2020.

Role of peatlands in the CAP and other key EU and international legislation

The EU Common Agriculture Policy (CAP) is the cornerstone of EU policymaking in agriculture and therefore relevant in a peatland conservation and degradation context, as most of the drained peatlands in continental Europe are under agricultural use. In certain Member States, substantial peatland areas under managed forests, and here national legislation and EU Environmental protection policies will be key. Peatland restoration is consistent with a wide variety of EU and international policy initiatives and agreements. Table 1 offers an overview of EU legislation and policies most relevant for the protection, use, and restoration of peatlands in the EU. Most of these are implemented through national legislation.

Table 1. Overview of peatland relevant EU legislation and policies.

Policies and legislations	Description of relevance related to peatland
Ramsar Convention on Wetlands11	A global scale Convention providing a framework for the national action and international collaboration for the conservation and use of wetlands and peatlands and their resources particularly related to the protection of specific ecosystems. The Convention promotes country action to minimize peatland degradation, restoration and improve management practices of peatlands (and other wetland types) being significant carbon stores or ability to sequester carbon.
Convention on Biological Diversity (CBD)[12]	Peatland was firstly put on the agenda at the Convention on Biological Diversity in 2004 and mentioned peatland as valuable ecosystems as habitat and for carbons storage and sequestration. The Convention provides a framework for national and regional action, and international cooperation and use of wetlands and their resources. The Aichi Biodiversity Targets are of special relevance for peatland restoration and conservation, as well as climate change mitigation (e.g. Targets 5, 11, 14 and 15)[13].
Kyoto Protocol (under the UN Framework Convention on Climate Change (UNFCCC))	During the first commitment period of the Kyoto Protocol (KP), incentives for peatland rewetting were limited due to accounting complexity and voluntary actions, and most countries were reluctant to account for land use activities, including peatland, in their national GHG budget. However, in 2012 during COP17, Wetland Drainage and Rewetting (WDR) was included as an activity under the KP with the aim to make the rewetting of peatlands more easily accountable. This gave legitimacy to peatland restoration as a climate mitigation activity on organic soils. During the second commitment period (2013-2020), UNFCCC expanded the number of mandatory activities with Forest Management and the "Wetland drainage and rewetting" was added as a voluntary activity. The IPCC 2014 report provides guidance on how to report and account for peatland emission.
Decision No. 529/2013/ER[14] LULUCF Accounting Rules	Following the Wetland Drainage and Rewetting in the KP, the EU aligned its own LULUCF accounting rules with the international standard. Under the new EU rules, accounting for GHG fluxes from Cropland Management and Grazing Management are to become mandatory from 2021 and onwards. Accounting for GHG fluxes from Wetland Drainage and Rewetting remains voluntary with Member States given the opportunity to prepare and maintain annual accounts to reflect GHG fluxes from this activity. This decision is the first step towards the inclusion of Cropland Management and Grazing Management in the EU emission

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[11] https://www.ramsar.org/

[12] https://www.cbd.int/

[13] https://www.cbd.int/sp/targets/

[14] https://op.europa.eu/en/publication-detail/-/publication/5327fa89-e78d-41bd-9465-2974d473a1a5/language-en

	reduction commitments. This new mandatory accounting results for accounting for most peatlands in a more indirect way, as the 90% of the drained peatlands are drained for agriculture (and thus fall under Cropland or Grazing Land Management) or Forestry (which has been mandatory since 2013). Currently, there is an absence of LULUCF in the EU ETS and the scheme under the Effort Sharing Decision (ESD).
EU Habitat Directive[15]	Together with the Birds Directive, the EU Habitats Directive is the backbone of the EU's nature conservation policy with its Natura 2000 sites. The Directive has a focus on biodiversity and habitat protection of natural and semi-natural peatlands.
EU Biodiversity Strategy 2020[16]	The aims to *"halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020"* and includes a "restoration target" to restore minimum 15% of degraded ecosystems (European Commission, 2011). However, the 2015 mid-term review of the Strategy found not significant progress towards achieving this target, and that it requires effective land management practices.
Natura 2000 (1992)[17]	The Natura 2000 network of protected (semi-)natural habitats stretches across the 28 EU Member States. The policy has a positive impact on biodiversity and habitat protection of natural and semi-natural peatlands in a relatively good condition in the EU. Peatland and wetland conservation feature prominently, and Natura 2000 is a strong protection regime for peatlands (Peters and von Unger, 2017).
Water Framework Directive[18]	The WFD makes few references wetlands/peatlands, despite a key role of peatland restoration for the achievement of WFD objectives. The preamble (No. 8) includes a cross-reference to a Communication to the European Parliament by the Commission on the wise use and conservation of wetlands. It mentions the necessity of wetland protection as part of the act's common principles (No. 23). Furthermore, it promotes the importance of peatlands as buffer habitats, however, peatlands are not recognised as an independent water body. To ensure peatland restoration measures strengthen the status of peatlands in the WFD could provide an opportunity.

Sources: Nordic Council, 2015; Joosten et al., 2015; Kløve et al., 2017; Peters and von Unger, 2017; IPCC, 2014; European Commission, 2015.

Under the 2014-20 CAP[19], Good Agricultural and Environmental Condition (GAEC) cross-compliance requirements apply to Pillar 1 direct payments and Pillar 2 environmental land management payments, include Member State defined standards for riparian buffer strips, soil cover and prevention of soil erosion, all of which could apply to managed/drained peatlands. Financial penalties are applied if breaches are

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[15] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm
[16] https://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm
[17] https://ec.europa.eu/environment/nature/natura2000/index_en.htm
[18] https://ec.europa.eu/environment/water/water-framework/index_en.html
[19] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en

detected. The only explicit reference to peat and wetlands is in the obligation for Member States to designate Environmentally Sensitive Permanent Grasslands within Natura 2000 sites (and an option to do so outside these sites), which means arable peatlands are not covered explicitly. In Pillar 2, at least 30% of the EAFRD contribution to each Rural Development Programme (RDP) must be allocated to a specific group of measures including those for agri-environment-climate, environmental (non-productive) investment, Natura 2000 compensation payments and organic farming. The eligibility requirement for Pillar 1 direct payments that the land must be 'maintained in a state which makes it suitable for grazing or cultivation' effectively excludes restored peatland. The 2014-20 CAP payments and rules have been found in reality to maintain high land prices and a basic income for farmers of peatlands, making restoration activities that involve ceding all conventional agricultural activity a difficult business case (Peters and von Unger, 2017; interview carried out for this project – see Chapter 11). It has been pointed out that prioritising AECMs specifically for peatland and wetlands while ensuring financial visibility and compensation, as well as advisory services and support for farmers could provide an opportunity for reducing GHG emissions in the LULUCF sector and achieving GHG emissions target via the CAP (Peter and von Unger, 2017; Nordic Council of Ministries, 2015).

The 2012-27 CAP could remedy this by making rewetted peatland soils and paludiculture eligible for direct payments (Pillar 1) and defining clearly what is the threshold level of 'appropriate' protection of wetland and peatland required under the proposed GAEC 2 standard. Above this baseline, mitigation activities tailored to organic soils, including water level management could be promoted as eco-schemes fully funded by the EAGF and by environmental land management payments, investment support and other measures co-financed by the EAFRD (Pillar 2). It will be very important to ensure that the needs for peatland rewetting, and the interventions and budget allocations to meet these needs are clearly programmed into Member States' CAP Strategic Plans, before these are approved.

It should be noted, that all the initiatives covered in the case study have developed their projects outside of the CAP, and factor into the restoration business case loss of eligibility for direct payments under Pillar 1 for the restored peatlands. As explained later, all initiatives very early on in their development process came to this conclusion, and therefore there is limited input from interviews and initiative material on how an initiative could be set up within the CAP or while maintaining eligibility for direct payments. EU agricultural policy has thus served as a driver in the sense of significantly limiting how and where initiatives could be set up.

b. Choosing an approach

There are two main decisions which are fundamental for setting up result-based carbon farming schemes for peatland restoration. The first is the **type(s) of GHG mitigation action that is envisioned and the second is the decision to seek carbon marked funding for the restoration.**

Climate change mitigation approaches

Acting to conserve or increase the already enormous carbon stock in EU peatlands and to halt the ongoing losses of carbon to the atmosphere is necessary and urgent. As listed and explained in Joosten, Tapio-Biström & Tol (2012), there are three main approaches for addressing climate change mitigation for peatlands:

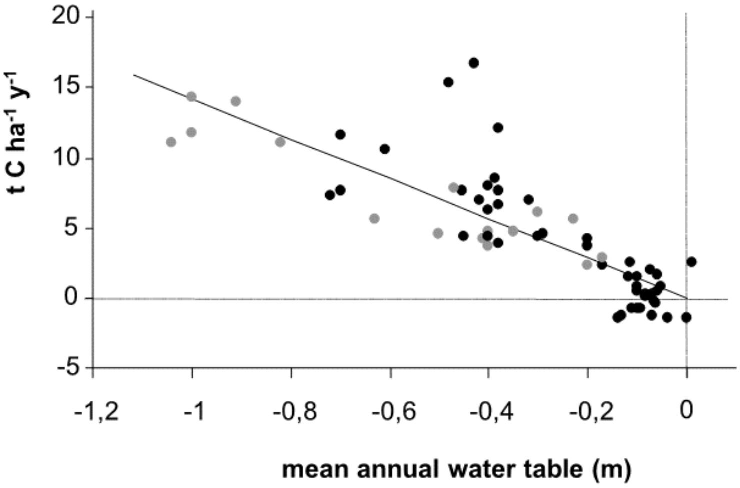
1. Keeping wet peatland wet, either by conservation or through paludiculture;

2. Rewetting and restoration of drained peatlands; and
3. Adapting the management of drained peatlands in productive use that cannot be rewetted.

Further, for degraded, abandoned drained peatlands, hazard control can also prevent occasional (but high emission) peat fire events. All result-based carbon farming initiatives mapped in Europe adopted approach 2, with some opportunity for specific adaptation management (approach 3). Interviewed experts and participants all mention the amounts of instant, measurable and additional emission reductions as the rationale behind this approach. The variables determining GHG fluxes for peatlands explain this.

The two variables determining GHG dynamics at a peatland site are the existence of a ‘histic’ horizon (for simplicity, a peat layer) and the water table, both current and possible future, as shown by the Couwenberg-curve published by experts form the MF team ten years ago (see Figure 3) (Couwenberg et al. 2011). The curve is based on tropical peatlands, but arctic, boreal and temperate peatlands would show a similar curve.

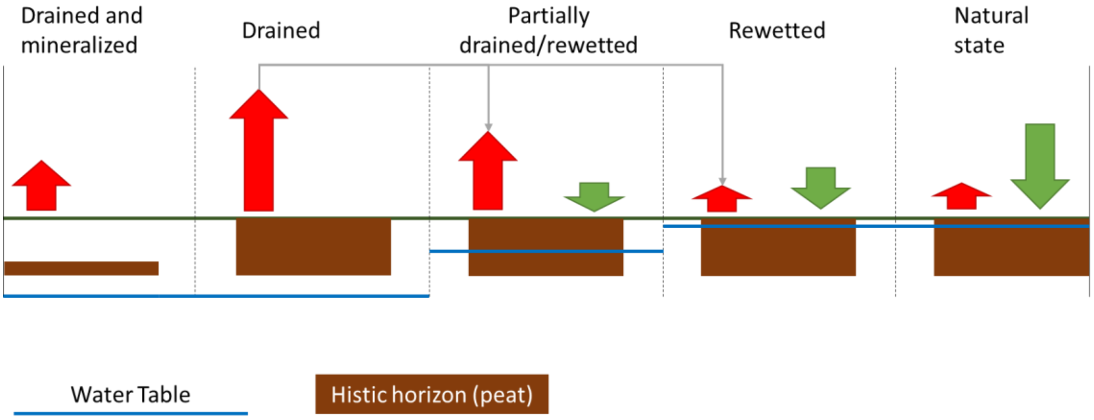
Figure 3 The Couwenberg curve.



Source: Couwenberg et al., 2011

In recent work on upgrading of peatland reporting in Germany, a GHG emission response function linking water table data from dip wells across the country to emissions for different land uses is the centrepiece, and is used to estimate emission factors for combinations of land use, soil type and water table (Tiemeyer et al., 2019). The simplified illustration below (Figure 4) shows the principal links between emissions and removals (shown as red and green arrows, respectively), water table height and peat layer.

Figure 4. Simplified schematic representation of principal combinations of peat layer exposure due to water table height and typical emissions and removals.



Note: Green arrows are removals and sequestration of carbon, while red arrows represent losses of carbon in the form of an GHG emission as CO_2 and/or CH4. Arrow sizes are indicative, and should not be relied upon for any quantification.

Source: own elaboration, 2020.

The history of drainage and management is important, as fully degraded former peatlands with no peat left (‘*drained and mineralized’* in Figure 4) would not qualify for avoided emissions. **Emissions from peat decomposition will continue as long as there is peat that is exposed to toxic conditions.** The CO_2 emissions will only end once the water table is above the peat layer or the peat layer is gone, while some CH_4 emissions will persist. In Figure 4, the impact and role of GHG fluxes can be condensed into two types of climate change mitigation options, namely avoided emissions and carbon sequestration:

1. **Avoided emissions:** full or partial rewetting of peatlands results in almost complete cessation of emissions from oxidation of organic carbon. and the conservation of the remaining carbon. Avoided emissions are most suitable for carbon farming, as they offer immediate, quantifiable and significant climate mitigation impacts. Therefore, avoided emissions from peatland rewetting are the preferred approach of the initiatives reviewed and will be the focus of this case study.

2. **Sequestration:** sequestration of carbon through plant growth and increases in the carbon stock through storage of plant remains under oxygen-depleted conditions is the second option and relates to the green arrows in Figure 4. Over a project period of e.g. 50 years, sequestration may only play a significant role once methane emissions have stabilised and peatland-species vegetation is established. As confirmed by the initiatives covered in this study, sequestration is not a viable option for carbon farming as the realised sequestration fluxes are too small and too variable. To protect existing wet peatlands and their ongoing sequestration, other climate mitigation actions are better explored, such as protected status.

As mentioned, all the initiatives/schemes covered in this report concern mitigation option 1, avoided emissions. Literature and practical evidence from the schemes studied confirms that this is the only option that currently can support a result-based carbon farming scheme for peatland restoration.

Linking climate change mitigation to financing, MRV and governance approaches

At scheme level, there is a close relationship between choice of climate mitigation approach, and different governance and financing approaches and MRV system setup, all of which again reflects the regulatory environment in the designated scheme area. At the strategic level, financing approaches should be considered in light of climate mitigation approaches as this will have implications for the MRV system and several other design elements (see Table 2). **The ability to access carbon finance through issuance of credits for carbon markets hinges on strong, standardised MRV and transparency, and can be seen as the most demanding of a range of financing approaches**. Legislative approaches where the peatland restoration is promoted through rules or support schemes such as prohibition or conservation restrictions will require other, but often fewer, design elements.

Table 2. Overview of suitability of matching financial and climate mitigation approaches.

	Crediting approach	**Conservation approach**	**Regulatory approach**
Sequestration	As results accrue slowly and in small quantities crediting for the sequestration after rewetting is not advisable as a result-based activity. Crediting may be possible for sequestration on large existing natural state peatland, although annual storage per hectare is low. This would require a fundamental change in crediting principles.	Conservation and protection of peatlands not funded by result-based schemes can serve to protect long term sequestration as quantification of results is not needed.	Restricting new drainage of peatlands without compensation in order to ensure sequestration may be a long-term alternative approach beyond the crediting period
Avoided emissions	As results are achieved over short time, are significant and can be consistently estimated using proxies, crediting is a viable option for avoided emissions.	Where MRV or monitoring is not ready or available, conservation funded by management-based payments may be a viable alternative.	Banning or restricting continued drainage of peatlands without compensation will not offer landowners any financial incentive, unless financial penalties for breaches are applied. As estimation is possible for avoided emissions, a regulatory approach can be a fall-back option only

The MF was motivated by a lack of public finance for the restoration of peatlands, and by a motivation to showcase the social and environmental services they offer to society, very much inspired by the forest stock (‘*wald-aktie’*) projects. To avoid degradation and ensure proper restoration, the project developers concentrated around the University of Greifswald in Mecklenborg-Vorpommeren in Northeast Germany started to explore climate finance and carbon markets as a possible source of funding for upfront restoration costs. They also began developing other elements, including metrics, and conducted research necessary to establish data and practices that would allow them to tap into the then nascent voluntary carbon market. Also, via connections and outreach, the MF team where able to work with and exchange experiences with VCS teams, Kyoto Protocol negotiators and IPCC Guidance experts on ‘Wetlands’, making MF a sort of test-lab for how peatland restoration and climate change mitigation could be combined. The MF story is however also an example of a financing approach driving a scheme development process. The MM and PC stories resemble the MF story, in that a pertinent restoration need was recognised much earlier and that other public funding options had been considered but not fully realised by policy[20]. In both initiatives the designated peatlands were identified (at regional level), and what was needed were the design elements that could allow for mobilizing carbon market finance. The GDNL was initiated 3-5 years later than MF and PC and is an example of a financing approach driven development process. In order to allow domestic offsetting between non-ETS sectors, the Dutch government put in place necessary legislation and set in motion a sector-wide consultation process as a call for sector-specific methods that could lead to issuance of credits. Based on inspiration from MF and PC, a group of scientists had done preparatory work on a peatland methodology, and this work was the starting point for a technical advisory committee consisting of NGOs, researchers and other stakeholders which again led to the adoption of the first Green Deal Methodology of all.

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[20] According to mechanism leads, some restoration was and is ongoing for public money in the relevant regions of UK and Germany. The mechanisms are not the last and only resort for peatland restoration.

1. Feasibility, support and enabling development

The importance of government support and stakeholder engagement in enabling and designing peatland schemes cannot be over-emphasised. This includes for example providing advice, ensuring cooperation and prioritise peatland projects.

a. Governance and institutional capacity

Most peatland schemes and standards have a dedicated governance body supervising the activities. However, there are differences in levels of governance, composition of governance bodies, and responsibilities, reflecting different objectives and political contexts. The peatland schemes have all been set up in stepwise processes in changing political and marked environments, and with no continuous oversight structure. The two private-public collaborative schemes PC and GDNL have had stakeholder meetings and advisory boards and technical committees, responsible for e.g. MRV protocol development. Even if such governance systems existed, the scheme owners under these schemes (PC: IUCN, GDNL: a dedicated foundation) have been pivotal for the progress of the scheme development and for coordinating and steering processes concerning key design decisions. For MF and MM, a few dedicated and competent individuals have steered the development process and made the necessary decisions. The applied governance structures are simple, comprising a project steering group and scientific advisory board, both with dedicated terms of reference and regular meetings. This again reflects the piecemeal, innovative development process that most schemes have undergone.

As concerns institutional capacity, the peatland schemes have had very different starting points. At the core of all initiatives are dedicated peatland experts that have been able to manage the technical and scientific complexity themselves. PC and GDNL have been able to rely on governmental or public research institutions, and the multi-partner networks that were mobilised in the early phase contributed with broad and wide expertise and institutional capacity to conducting trials, surveys, economic modelling and other assessments. In both these public-private partnerships, government grants and funded studies allowed mobilisation of resources, e.g. carbon market developers, universities, and legal experts. For MF, no institutional capacity and only limited funding to contract or hire additional capacity was available, and their development path is one driven by insistence and in some cases even voluntary work.

Box 2. Illustrating governance throughout scheme development and operation – who does what to secure a robust scheme?

Developing a peatland scheme: Making difficult decisions

The schemes have all been evolved by a small group of research or NGO 'innovators', having developed governance systems and tools ad-hoc. Both the PC and MF are owned and operated by a group of researchers and NGOs, either as a separate legal entity (MF) or hosted by one pf the partners (for PC, the UK branch of IUCN).

Governments have played a small and secondary role. In the Netherlands (GDNL) and in the early years of the Peatland Code (UK) ministries and regional governments supported the process with funding and branding, as did the regional government of Mecklenburg West Pommerania for MoorFutures. Only for PC did overall national level policy play an active role, and various scenarios and policy papers were elaborated before the setup and governance structure fell into place. Farmers have played a minor role too, mostly as participants in steering groups or in providing input and feedback through farmers' associations.

The robustness of the schemes has been crucial for all scheme proponents, and ensured through a research-based approach, developing methodologies and data from scientific work, international collaboration and knowledge sharing, several PhD and MSc dissertations (for MF), and relying on peer review of all key work. All the covered scheme owners have read each other's work and reports, have met at workshops and shared ideas and experiences. The development processes have not been planned or governed and resemble innovation or testing, nevertheless the lessons learnt, and findings can in future support more government or policy-driven processes, specifically:

- Let science and research guide the process and use peer-review and international collaboration as quality assurance and inspiration;
- Keep and build CF and peatland science topic expertise in the core team;
- Share and publish partial results, data and papers for involvement and transparency; and
- Do not fix governance structures and processes before the scheme is operational; and evaluate it on a regular basis and adapt if necessary.

Operating a peatland scheme

Only the MF have been in operation long enough to have experience of operating the scheme over multiple project development and certificate issuance cycles. However, MF, PC and GDNL have all employed the same two steering instruments, namely a steering/coordination group with all interested parties (local government, farmers, NGOs, businesses and researchers) and a technical/scientific advisory group responsible for methodology and data oversight and development.

b. Advice, knowledge transfer

To ensure successful outcomes of peatland schemes, there is a need to increase advisory and knowledge transfer to the developers of a peatland scheme, authorities, consultants and verifiers and farmers. Developers of a peatland scheme **should draw on experiences and lessons learned from existing schemes and projects** to support the design and processes of the scheme, as well as involving a broad range of stakeholders to ensure diverse perspectives. The existing peatland schemes were developed by a strong scientific expertise related to peatland and carbon markets. Training for **accredited entities or companies performing validation and verification** should be a priority. Peatland (and wetland) accounting and validation methodologies are complex and time consuming, and currently only a limited number of accredited assessors capable of validating peatland projects exist.

Experiences from existing peatland initiatives and peatland studies (e.g. von Unger et al., 2017; FAO, 2017; Cevallos et al., 2019) illustrate that companies operating on the validation and verification market have limited insight and expertise with peatland projects. Therefore, there is **a need to scale up training and advisory services for validation and verification procedures to address the current bottleneck of limited peatland and wetland expertise**. This could potentially speed up the validation of peatland methodologies, increase the implementation of carbon projects at large, and potentially avoid reporting mistakes. This in turn can lower the bureaucratic costs of issuing fines and penalties. It is expected that the more work is done on peatland standards and activities, the more networks of knowledge by developers and validators will be established (Joosten et al., 2015; von Unger et al., 2019; interview carried out for this project – see Chapter 11). Sufficient training for **intermediaries, advisors and consultants** must be an early priority for scheme design to ensure they can provide technical support, innovation and practical solutions to project developers, farmers and credit buyers.

Training and support to **farmers** on peatland management and sustainable farming and land use options for rewetted peatlands, such as paludiculture, should be further explored and communicated to farmers and authorities. Some peatland standards already include educational tools for farmers, such as the MF Service Point provided by the regional authority in Mecklenborg-Vorpommeren (interview carried out for this project – see Chapter 11). However, provision of advice to farmers is limited among all peatland standards and projects included in this case study. To support farmer understanding and uptake, the scheme should hold open meetings to present the method and outline the benefits for farmers, and to give them a chance to ask questions. Scheme developers must prepare information material for farmers to support their learning.

Guidelines and knowledge transfer

Some peatland initiatives have developed guidelines for buyers on rules and requirements to ensure environmental integrity, as well as to avoid double counting issues. For example, the GDNL and the PC provide guidelines on what buyers are expected to do with carbon certificates and environmental reporting guidelines. Additional guidance documents, such as guidance documents for intermediaries and guidance for peatland restoration projects have been developed by the PC, with good results (IUCN, 2015).

Peatland initiatives have combined experiences from the use of existing methodologies, such as Verra’s methodology on “wetland restoration and conservation” or the adoption and adaptation of the MF methodological tools. In the case of MF, methodological tools were developed simultaneously by the same group of people, but with different targets. **Knowledge sharing on best practices for design, implementation and operation of a peatland initiative could be increased to improve knowledge transfer beyond regional initiatives.** This could include the creation of an EU-wide platform for collaboration on methodology, lessons learned and tool development, for example.

c. Farmer engagement

To ensure farmer acceptability and uptake of peatland restoration activities, farmers and landowners could be engaged in the design process and regularly consulted throughout its operation. However, generally the involvement of farmers in the scheme and project development process is limited and often included late in the process. In the PC, peatland initiatives on ground have been used to stimulate interest and awareness in engaging with the PC, in this way encouraging farmers to develop projects independently or with the support of project developers. However, this kind of engagement has primarily been with larger landowners/farmers with significant resources, or institutional landowners already connected to IUCN. **Therefore, there is a need to ensure more extensive engagement with smaller landowners.** Several options for increased farmer engagement are given below.

Creating economic incentives and economic rationality for changing management practices. Creating incentives for farmers and landowners on agricultural land remains challenging due to regulatory and policy barriers. In that context, many landowners have little motivation to stop using peatlands if they stand to lose CAP direct payments. In the case of MF in Mecklenborg-Vorpommeren, conventional agriculture on drained peatland is eligible for such payments at the rate of €300 per ha/year. Therefore, rewetting peatland and taking it out of conventional agricultural production would results in an annual loss of the €300 per ha CAP payment (Interview input, 2020). In Poland, several peatland rewetting projects are currently ongoing. However, they found it challenging to create incentives for landowners to participate. In the UK, Brexit has also constrained landowner and farmer engagement to an extent due to uncertainty about post-Brexit agri-environment schemes, which are promised to be based on the principle of “public money for public goods”, leading landowners to delay decisions on PC projects until it becomes clear whether better terms might be available from a future public scheme. Therefore, **there is a need to create a system where peatland rewetting would be more profitable than conventional agricultural management and to ensure that all policy tools facilitating the ongoing degradation of peatlands are removed.** Furthermore, there is a need to ensure that farmers can manage the transaction and up-front investment costs of setting up on-farm rewetting activities. In the PC, the majority of those putting forward projects to date have been large landowners or NGO institutional landowners who are better able to absorb transaction costs associated with setting up projects and are less likely to perceive contract lengths as a risk. However, smaller landowners are currently not engaging directly with the PC due to the perceived risk and complexity of the process. Instead, engagement with small landowners has mainly been via externally funded facilitators looking to match public funding for restoration projects with private investment via the PC, for example the ongoing Welsh Peatlands Sustainable Management Scheme. In this the Welsh Government acts as an intermediary to ensure greater involvement of landowners.

Ensure farmer/landowner engagement through consultation processes, especially through processes in which farmers can provide practical feedback, identify opportunities and challenges, as well as act as communicators of the scheme and peatland projects. Farmer organisations and farmer support scheme could be scaled up to increase farmer engagement. Further, consultations and leverage of existing farmer networks could increase the awareness of peatland schemes and projects, and their benefits, and ensure that the risks are communicated in a clear and transparent manner that considers the needs of farmers. Current marketing of PC opportunities is not well known in the wider landowner and land management community, but primarily only with farmers and landowners already involved in IUCN. Further, the MF has experienced a lack of engaged farmers as no carbon credits can be supplied under the MF.

Farmers and landowners should be recognised as business partners for them to feel included, informed and motivated and to ensure long-term commitment to the delivery of ecosystem services related to peatland restoration and rewetting. Furthermore, acknowledging farmers for their contribution could be enhanced by portraying them as pioneers in the promotion of peatland activities. This is being developed in Germany with the MoKli21 project, and in the UK via Natural England's Peat Pilot and forthcoming England Peatland Strategy.

Ensure that peatland project cycles consider and accommodate farmers' needs. Long project cycles offering regulatory and income certainty for several years are preferable from a farmer perspective; however, landowners are rarely willing to commit their entire land holding for projects longer than 10-20 years (von Unger et al., 2019; DEHst, 2018b). As the carbon benefits of peatland rewetting projects are long lasting, allowing short-and mid-term peatland projects of 10-20 years might be a window of opportunity for enhanced farmer acceptability and uptake. Peatland standards and projects included in this case study typically have a project duration between 10-50 years, but in several cases re-draining has been prevented beyond the project lifetime through legal obligations in project contracts..

d. Cooperation and stakeholder engagement

Scheme designers should involve broader stakeholder groups, including the wider public through communication. Early involvement and cooperation with stakeholders (and farmers) potentially contributed to the establishment of a trustworthy and transparent framework. The involvement of stakeholders in the methodology development is beneficial for generating methodologies that find good uptake and give ownership over the scheme to the participants. However, the inclusion of cooperation and stakeholder engagement varies between the peatland projects included in this case study. MF has several project partners, who have been involved in part of the legal planning approval procedure. The PC has a steering group that includes a wide range of stakeholders from the public, private and third sectors, including intermediaries such as the Forest Carbon Ltd, which was involved in the initial set-up of the PC. Composition of this steering group was based on a formal stakeholder analysis to ensure representation of all relevant interests in the ongoing development of the PC. In the GDNL, stakeholders (including NGOs and market entities) proposed the peatland methodologies followed by a group expert and public consultation (Cevallos et al., 2019). This **early involvement of stakeholders in the design phase of the project ensures co-ownership, as well as increasing stakeholder buy-in**. In addition, their knowledge/perspective could also support regulators/administrators to design more effective schemes.

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[21] For more information: https://www.greifswaldmoor.de/news-archive.html?page_n57=3&#287

In addition, given that some ecosystem services can create trade-offs (e.g. services such as the paludiculture versus services like flood protection) with multiple actors using and competing for them (Bodin and Crona, 2009) there is a need to involve stakeholders with conflicting objectives and various different expertise's alongside research evidence in the environmental governance processes. This points to a need to include, for example, local and indigenous knowledge as well as scientific and political knowledge across a range of disciplines in the co-production[22] of governance solutions with those who manage the natural environment. Within a science-policy interface project, involving all relevant stakeholders is necessary from the start and often requires the use of a communication expert, to facilitate and mediate through the project's duration. The use of project partners functioning as intermediaries can therefore be valuable in coping with complexity, providing technical support, innovation and practical solutions to project developers, farmers and credit buyers, as well as **support for a multi-party dialogue and communication of the evolving research evidence on peatland** (Bielak et al., 2008).

Intermediaries and brokers were highlighted in the development of the PC as a means expanding the market for peatland restoration to new sellers and buyers in the UK[23]. As a private intermediary, Forest Carbon Ltd has provided support to farmers and land managers on knowledge and skills to validate projects and access to credit markets. Further, they have been able to take on the role of risk takers and commit to buying the carbon credits without knowing the buyers, which has left them with the risk of re-sale. Methods have been trialled in the PC to engage landowners and other stakeholders at landscape scales to develop integrated projects in which "fair prices" for ecosystem services are negotiated between sellers and stakeholders, to build a proposition for potential buyers (Reed et al., 2017). While this approach has not been widely used at present, work is underway to build on Reed et al.'s (2017) "place-based approach", to integrate PC opportunities with ecosystem services from sustainable agriculture and forestry via Landscape Enterprise Networks and the Woodland Carbon Code (Curtis et al., 2020b). MM uses intermediaries to increase the transparency of the standard as well as to provide a more efficient use of the resources dedicated to the operation and promotion of the standard.

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[22] Knowledge co-production refers to the active involvement and engagement of multiple actors in the production of knowledge from various sources in order to find solutions for complex governance problems, in this case of this thesis, solutions to pressing environmental issues on peatland ecosystems and their services, through an facilitated and designed process (e.g. Frantzeskaki and Kabisch, 2016; Voorberg et al., 2014).

[23] http://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/Peatland%20Code%20Pilot%20Phase%20Evaluation%20Report%20%28final%29.pdf

2. Setting scheme objectives and demonstrating additionality

a. Objective setting

Peatland schemes often have both operational and policy objectives. The common operational objective of the schemes covered here is to ensure rewetting of drained peatlands within a given geography, which can be local, regional or even national in the case of GDNL and DKW. The policy objective differs among the schemes; however, climate mitigation benefits are the main policy objective for GDNL only. For all other peatland schemes and projects, **nature, biodiversity and water protection are among the stated policy objectives**, and for DKW priorities between objectives have changed from one programming period to the next.

Definition of objectives further differs between the schemes and projects included in this cases study. GDNL and DKW are both results of national level, policy-driven and top-down processes aiming at delivering a policy measure to address an existing problem. The policy objectives of MF and MM are defined by a small group of researchers to help address an observed environmental problem, in both cases drained peatland not being restored, even if legislation would be conducive and the business case for the landowner attractive (apart from the loss of CAP support). For PC, objective setting is more complicated with a recent shift towards a more devolved responsibility for regional authorities and de-coupling from national objectives. Initially it was hoped that the PC would provide a mechanism to pay for biodiversity alongside GHG emission savings (with a link to UK based Environmental Banking and Biodiversity Offsetting being pioneered in 2005-2015), but biodiversity offsetting metrics were deemed too simplistic to provide reliable enough assessment for the market, so non-GHG co-benefits are now captured qualitatively in PC projects. Government funding has been limited to supporting the IUCN UK Peatland Programme’s role as owner of the PC and exploring different ways of using public funding to leverage private investment via the PC e.g. in the Welsh Sustainable Land Management Scheme.

The GDNL objectives are driven by domestic offsetting, and thus are different from the other peatland standards included in this case study. A peatland methodology was the first to be developed under the GDNL, driven by values for potential GHG reductions by businesses, NGOs (through a climate accord consultation), as well as by the Ministry of Environment. However, practices within peatland are limited and **further assessments are needed to analyse the impacts and expand the methodology beyond being strictly on GHGs to achieve co-benefits**.

b. Additionality

The principle of additionality is an important requirement for offsetting schemes and is an expression of environmental integrity and efficient allocation of climate finance (von Unger et al., 2019; Bonn et al., 2014). Currently, no uniform guidelines exist on fulfilling the criterion of additionality, and peatland schemes apply project-specific additionality tests:

Environmental additionality refers to whether the scheme induced climate mitigation actions that would not have occurred in the absence of the scheme. In general, risk of non-additionality (risk of windfall) is low for peatland restoration and protection.

Financial additionality requires that a project would not be economically feasible without the inclusion of the sale of credits. This partially explains why the majority of peatland projects can pass the financial additionality test. Financial additional criteria may encompass economic incentives that could enhance farmers' and other land users' acceptance of rewetting and restoration of their land. For MM however, landowners do not get any of the project funds as these are directed entirely towards rewetting measures. The PC requires both a financial additionality test as well as an economic alternative test such that carbon finance is required to fund 15% of the project's short and long-term costs (IUCN, 2017; Joosten et al., 2015). Overall, there is a political intention for peatland schemes, but lack of allocated finance.

Regulatory (legal) additionality requires that a project is initiated due to the scheme, rather than due to regional or national policies. In other words, project activities must go beyond what is required by law. Regulatory additionality is one of the simplest tests utilised by the different schemes, but there is evidence to suggest that it can 'punish' farmers that are already operating beyond the requirements of regional environmental standards. Therefore, the regulatory additionality deserves attention, when project sites are located within protection regimes, as well as in regions where peatland climate action was established early on (Joosten et al., 2015; von Unger et al., 2019).

Technological additionality stipulates that there must exist a technical barrier to implementation, i.e. the deployment of a technology that would not have been put in place otherwise. Under PC, can be classified as a barrier test.

Assessing additionality is complex and represents a procedural hurdle. Several stakeholders have illustrated that testing for additionality of peatland projects could be simplified as the risk of windfall, as well as the risk of non-financial additionality, is small within peatland restoration projects. **Standardising requirements or *positive lists*** (similar to the VCS approach under VM0007) **in a way that projects which meet a specific threshold can be considered by default to be additional, could help to alleviate some of the issues associated with project acceptance.** In addition, using an approach where project developers have top-down support in baseline and additionality setting will also take pressure off smallholders that lack the resources to conduct these tests.

In crediting scheme, the baseline represents a level of emissions beyond which mitigation is considered a 'true' reduction in GHGs. **Baseline setting** is done to set the business-as-usual (BAU) scenario and expected level of the result indicator (e.g. level of GHG emission reductions) from different land areas in the absence of a peatland restoration scheme.

Baseline setting can also be done through economic modelling where the BAU would be the project owner's financial state before the introduction of the scheme. This type of baseline setting is relatively simple in that involves a simple cost-benefit analysis such that the payments for **the credits (benefits) would be considered alongside the financial needs (costs)** of the project. The state of payments under CAP, as well as the ongoing discussions around proposed GAEC standards will factor into the economic baseline in that it will determine whether landowners will in fact be better off financially under a scheme that does not allow them to drain their peatlands. The variability of GAEC standards across Member States will also come into play when determining legal additionality as the requirements for peatland protection will already be in place. C**ompliance with GAEC** standards and other CAP eligibility rules will need to be factored in so that the activities of the project will be additional across all the criteria for additionality. Any payments under CAP would have to be deducted to avoid double-payment.

Various options exist for technical baseline setting of the resulting GHG emissions. Across different crediting schemes there are two ways to determine the baseline:

1. Project-level setting to estimate and monitor proxies for SOC stocks, e.g. using for example the GEST approach. This approach can be prohibitive in that it involves complex measurement, higher accuracy, lower uncertainty, but higher costs.

2. SOC levels determined through a model-based calculation can be used to automatically include projects that fit this default scenario. This is a simplified approach but must be able to properly account for context specific farm systems. MF uses a forward-looking baseline similar to a reference scenario, where current land use is a conservative estimate for the baseline.

Carbon leakage refers to the displacement of economic activities that directly or indirectly result in GHG emissions to be displaced from a jurisdiction with GHG constraints to another jurisdiction with no or lesser GHG constraints. The displacement is a result of the asymmetric environmental policies, costs and prices in different regulatory areas, such as national, regional and local, as well as the difference in carbon prices at a global scale (von Unger et al., 2019; Joosten et al., 2015). Leakage may occur through **activity shifting**. For example, if a farmer shifts pasturing activities to an undrained peat area which is then drained for agricultural purposes, the net gain may equal zero or may be negative. Leakage can also be a result of **changes in product supply**, which could occur if a peatland allotted and drained for peat extraction is rewetted, but the extraction of peat intensifies elsewhere outside the project boundary because the demand remains the same. The last type of leakage, specifically applied to wetlands, is ecological leakage which may lead to negative effects on hydrologically connected systems due to peatland rewetting (von Unger et al., 2019).

Different approaches exist on how to address leakage. The MF is based/built on the criteria of Verra (former VCS) and provides a set of guidelines on how to minimise leakage by site selection or the provision of alternative income sources for activity shifting leakage. Ecological leakage is minimised by site selection, as well as with the determination of hydrological buffers. Experiences from the MF highlight that due to the small geographical coverage of this scheme, market leakage is irrelevant (Joosten et al., 2015). In the PC, leakage must be included in GHG emissions estimates for the project and potential project changes, while the MM standard has concentrated their GHG accounting on degraded peatlands, which are no longer in agricultural usage. In general, there have been no identified patterns for projects with low or high leakage, so it is necessary to account for leakage on a project-specific basis. Unlike additionality where a common threshold can be used to set the baseline**, leakage cannot be standardised other than through a minimum percentage of leakage calculated as a deduction of the impact quantification as is used in some standards** (von Unger et al., 2019).

Double counting may undermine additionality and climate mitigation ambition. Double counting occurs when credit is accounted for or used twice or more times through doubling selling, double claiming or double monetizing, and it **can be mitigated through synchronisation between systems, jurisdictions and schemes by means of registry systems and specific ownership rules.** PC and MF account for this in such a way that there can only be one credit owner at a time, i.e. the landowner is the sole legal owner until the credit is sold to the new owner. MF credits can and must be reported/accounted in national inventories but cannot be traded (although in practice this happens via brokers of MF). The double-counting applies between end users of credits or offsets, and thereby also vis-a-vis governments that count on emission reductions from land management changes on peatlands in the cropland, grassland, wetland and forest categories. The PC and GDNL initiatives have coordination processes with GHGI compilers, but MF and MM is not linked to GHGIs. If projects do not use credits or offsets for compliance with legal GHG reduction targets, there is no legal double-counting issue but there is a challenge here for schemes and governments to resolve in the coming years when peatlands enter EU GHG accounting.

Permanence risk refers to the risk of reversal of credits generated by enhanced removals through sequestering carbon in forest or soil projects (Peskett, 2010) by re-emission of the same carbon due to a later event or action. In a peatland context the risk of permanence depends on the activities performed, e.g. whether peatland rewetting creates carbon sinks or avoided emissions. Several approaches exist on how to reduce risks of non-permanence, including establishing long-term land contracts, use land deeds actively and other legal measures or guaranteeing credits by a credit reserve – a **buffer account**. Buffer accounts work by only rewarding farmers for a proportion of their estimated results, holding the remainder back as a "buffer", to ensure that the rewards paid are not in excess of the actual reductions even with uncertainty, or in the case of non-permanence, or as scheme-wide insurance against ex-ante payments. In this case**, project proponents bear the risks by foregone credits** throughout and beyond the project duration (Joosten et al., 2015). By reducing the payment that farmers receive, buffers have the downside of reducing farmer incentives and therefore uptake. Existing peatland schemes set a low (10-30%) buffer account. This has proven overall satisfactory to cover potential events of stock loss and reversal in peatlands (von Unger et al., 2019). In addition to the assessment of the risk factor and buffer account, the MF and PC **further ensure permanence through requirements for project design, and contractual arrangements**, which in the UK can include the inclusion of Conservation Covenants to provide further protection to buyers. In MF, permanence is guaranteed through prescribed water levels under the Water Law, land registry and purchase of land for restoration (Bonn et al., 2014; von Unger et al., 2019).

c. Eligibility

Eligibility criteria are used to determine which actors, land, or project types can be accepted under the rules of the scheme. For peatland rewetting and restoration projects the presence of peat within the proposed project area is a first order eligibility criterion. As reported by MF, a lot of agricultural land with peat but eligible for direct payments under the CAP does not offer a business case for rewetting and restoration. This exclusion of the majority of peatlands under agricultural use is not an eligibility-criteria decided by the scheme, but it does reduce the area of available land. For MF, all project land so far rewetted and restored are exceptional marginal lands owned by farmers supporting the objective of the scheme. In a situation of shortage of land, most of the schemes have not developed detailed or demanding eligibility criteria (see overview below in Table 3). **In a situation where eligibility for CAP direct payments, or the nature of the payment changes, eligibility criteria may be needed to prioritise which peatlands are restored**.

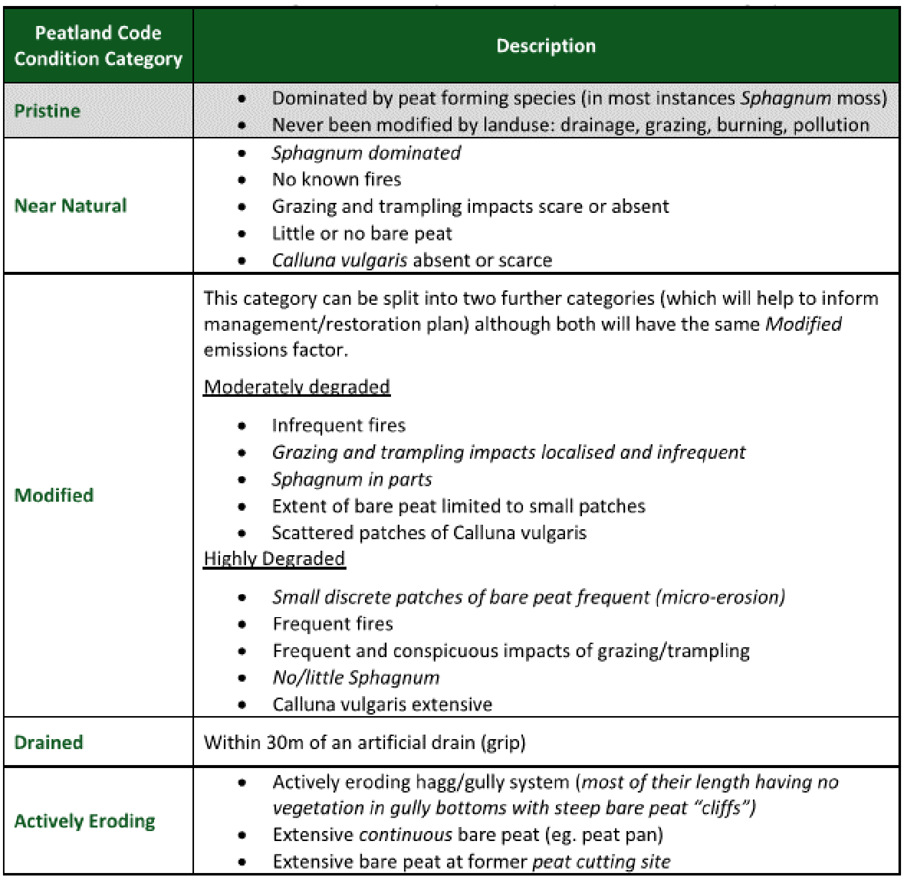
Table 3. Eligibility criteria for each initiative.

Peatland initiative	**Eligibility criteria**
MoorFutures	▪ Projects that rewet drained peatlands in temperate climate zone. ▪ Crediting period is 20-100 years with a minimum of 30 years cover transient dynamics. ▪ If project includes afforestation or improved forest management, the length of the project period must be at least the time period of one harvest cycle.
Peatland Code	▪ Blanket bog or raised bog with baseline condition of 'Actively Eroding' or 'Drained' with minimum depth of peat of 50 cm. ▪ Minimum project duration shall be 30 years. As peatland conditions are decreasing by approx. 1 cm per year projects longer than 55 years must prove that there will not be complete loss of peatland. ▪ No activity to drain or remove vegetation has occurred since November 2015 in the given project site.
Max.moor	▪ Project activities are on raised bogs not currently under agricultural use. ▪ Project term is 50 years.
Green Deal Netherlands	▪ Projects are mainly focused on agricultural land with the potential for full rewetting. ▪ At least 10 years if peatland has agricultural purpose and at least 50 years if peatland has environmental purpose.

A crucial part of the design of a carbon farming scheme for peatland restoration is the **definition of eligible condition categories and condition change scenarios.** A condition change scenario is to be understood as an allowed change from one drainage and management state to another drainage and management state, e.g. intensive arable production on a deeply drained peat soil changed to paludiculture on rewetted soil. The condition categories as defined for e.g. PC are a combination of vegetation, landscape features and hydrologic regime. Land that cannot qualify for these condition categories cannot enter the Code and is therefore not eligible. The definitions of applied condition categories are given in Table 4.

Inclusion of paludiculture in peatland standards and projects could increase access to land and most likely increase the peatland potential in a climate mitigation context. However, such a change would require a paradigm shift compared to the historical drainage-based peatland utilisation. Whereas technical barriers are being addressed and pilot studies tested in cooperation with farmers, implementation of paludiculture requires removal of legal, regulatory and financial barriers and further research.

Table 4. Peatland Code criteria for condition categories, serving as eligibility criteria for land to enter one of these categories



Peatland Code Condition Category	Description
Pristine	• Dominated by peat forming species (in most instances *Sphagnum* moss) • Never been modified by landuse: drainage, grazing, burning, pollution
Near Natural	• *Sphagnum dominated* • No known fires • Grazing and trampling impacts scare or absent • Little or no bare peat • *Calluna vulgaris* absent or scarce
Modified	This category can be split into two further categories (which will help to inform management/restoration plan) although both will have the same *Modified* emissions factor. Moderately degraded • Infrequent fires • *Grazing and trampling impacts localised and infrequent* • *Sphagnum in parts* • Extent of bare peat limited to small patches • Scattered patches of Calluna vulgaris Highly Degraded • *Small discrete patches of bare peat frequent (micro-erosion)* • Frequent fires • Frequent and conspicuous impacts of grazing/trampling • *No/little Sphagnum* • Calluna vulgaris extensive
Drained	Within 30m of an artificial drain (grip)
Actively Eroding	• Actively eroding hagg/gully system (*most of their length having no vegetation in gully bottoms with steep bare peat "cliffs"*) • Extensive *continuous* bare peat (eg. peat pan) • Extensive bare peat at former *peat cutting site*

Source: Peatland Code Metrics Report (2015).

3. Choosing results indicators and MRV

There are both project level and initiative level result indicators. **Initiative level result indicators** are indicators used to quantify delivery of the scheme itself towards a pre-set objective. None of the schemes were found to have initiative level indicators that were different from project level result indicators. Furthermore, as none of the initiatives defined quantitative targets, such as e.g. area rewetted or avoided emissions achieved, it is not possible to compare and evaluate initiative-level result indicators, targets or systems.

A **project level result indicator** is a quantitative variable that provide a simple measure of changes in a project's objective. As this case study concerns practices and experiences from setting up result-based schemes for carbon farming on peatlands, one common feature of all schemes is a project level result indicator for GHG emissions. Although the purpose and objective of all schemes is not only GHG mitigation, all schemes have mitigation of GHG emissions as a core objective. Many of the schemes have developed or are in the process of developing result indicators for co-benefits, mostly biodiversity and water protection and flood management. The following chapters offers observations and hypotheses for best practices for result indicators for both GHG and non-carbon benefits. Box 3 provides an overview of examples of result indicators used or considered.

Box 3. Overview of results indicators used and considered

Examples of types of specific result indicators possible for this case study

The GHG mitigation result metric is CO_2eq/ha/yr for avoided emissions for all initiatives except MM, where the result metric is avoided peat depletion (cm over predefined time period, e.g. 50 years). The commonly accepted indicators used for classification and monitoring are:

- Water table height, e.g. centimetres below surface
- Vegetation, i.e. abundance and status of certain peatland-specific species
- Land use, e.g. grazing, arable, fallow, paludiculture, forest
- Subsidence (mainly used in tropical settings)

Co-benefit result indicators, e.g.:

- Nitrogen release, e.g. using default values related to vegetation type.
- Modelling of the retention volume (m^3) or flood peak reduction, to measure and quantify changes following rewetting related to flood mitigation.
- Species, species groups, or communities, such as the abundance of amphibians, expected to react to peatland rewetting could be used to measure a potential change in mire-typical biodiversity.

As will be covered in more detail in later parts of this chapter, there is no way around measurements when estimating GHG emissions and thus quantifying the result indicator. It is merely a question of who provides the data, based on what sample and site, and how are these data are applied to estimate project emission reductions. For the other result indicators similar logic applies. In this way there is an intrinsic link between setting result indicators and developing MRV systems. As results should be monitorable, a key consideration before selecting and designing indicators, is what can be monitored at an acceptable cost. Feedback from initiatives confirm that this consideration has been key and, in some cases, defined the result indicator. No initiative covered herein or any projects under VCS or other schemes rely on on-site, real-time measurements of emissions at project level.

Box 4. Linking scheme objectives, goals and result indicators.

Linking scheme objectives, goals and result indicators

All of the peatland rewetting initiatives covered in this case study have applied very simple governance systems and have not defined scheme level goals or targets beyond a stated ambition of making it possible for rewetting or restoration projects to access result-based payments as part of the project financing. There is therefore no evidence for how links between objectives, goals and result indicators have been established.

Most of the land so far designated for a peatland rewetting or restoration project under one of the EU based schemes (not MM) have been eligible for direct payments under the CAP before the rewetting, and most likely also eligible for an area-based RDP measure at some time in the past. However, none of the mandatory result or impact indicators of CAP implementation has been referred to or used in objective, result or indicator systems of MF, PC or GDNL, while obviously the DKW as an RDP measure in Denmark has been developed in view of the DK RDP programme priorities and is monitored in accordance with the relevant DK RDP result indicators.

The lessons to be drawn from the four operational schemes is that result-based schemes are developed to gain access to an additional source of financing from buyers who demand quantified project level GHG results, and therefore only **need the minimum of result indicators necessary to ascertain the buyers**. Subnational/regional carbon farming peatland schemes serving voluntary private markets with offsets do not need elaborate goal, objective and result logics in order to operate, but this will most likely change if such schemes are linked to national level policies, contributing to compliance targets and issuing internationally recognized credits. In a situation (e.g. after 2025) where a scheme would become directly or indirectly subject to a GHG target, more elaborate objectives and quantitative, initiative level goals might be necessary.

It is also likely that, if rewetted and restored peatland becomes eligible for CAP direct payments after 2020, **schemes would have to align with or adopt indicators and MRV regimes of the Member State in order to function**, and to ensure allocation of results between offset buyers and national governments.

a. Result indicators for GHG mitigation

For the GHG objective of carbon farming initiatives on peatlands the result indicator translates into a means of reflecting change in GHG emissions from the project area. In general, an indicator in this context is a means of simplifying complex processes and measurements into a value (Brown, 2020), and this is reflected in all the indicators used by the schemes.

1) Selecting and designing GHG result indicators

A core design feature and decision of initiatives on peatland is the composition of the detailed result indicator for avoided emissions of GHG from the rewetting and/or restoration. **All initiatives define the GHG result to be achieved as avoided emissions resulting from the (full or partial) rewetting** of drained peatland, use CO_2eq/year as the metric for the GHG result (while including both CO_2 and CH_4).

The result in terms of avoided emissions is calculated by all initiatives as a change in emissions as expressed by an emission factor due to the rewetting multiplied by the area rewetted. The emission factors are developed using simple models that use simple input variables such as the applied land use, the height of the water table, subsidence due to degradation, and vegetation cover (see MF methodology, briefly explained in Joosten et. al, 2015). **In an EU climatic and phytogeographic setting, land use, water table and vegetation are the relevant indicators** which can be surveyed in the landscape or from maps/aerial photos and used to classify land and estimate emission factors. There is broad agreement, supported by science, that **it is not feasible to measure results for carbon sequestration over 5-10-year time-horizons and none of the covered initiatives includes this GHG flow at this stage.**

While there is almost full alignment on the choice of result indicator, initiatives have taken different approaches to quantification of results, both in terms of estimating the emissions factors and in how to assign these to the project peatland in the process of stratification.

2) Classification of land eligibility as precursor for emission factors

Natural state peatlands with a natural or near natural water regime and permanent vegetation cover will actively sequester carbon and at the same time emit a small amount of methane. At the other hand, intensive, tillage-based, monoculture crop production on a drained peat soil will have significant CO_2 emissions from active decomposition of the peat layer. In between exists a long list of possible peatland conditions, each with their own emission levels. The degree of peatland degradation is the basis for the categorisation used by the PC, and land with similar characteristics are labelled condition categories, a term used in this case study across initiatives. Deciding which condition categories to use and what characteristics to use to group land into condition categories is likewise called classification or stratification and is an important element in the EF determination process across initiatives. **There is consensus around the use of land classification of the project land and assigning GHG emission factors for each land category.**

The relationship between water table, vegetation, land use and emissions implies that surface observations of land features, vegetation or visible water can serve as a starting point or even basis for classification. In the PC, a field protocol was developed early on to allow for systemic coupling of condition categories to emission measurements in the field, which is a part of the stratification process. In practice, **classification of peatland condition categories and development of emission factors goes hand in hand and should be undertaken as an integrated process**, as was done for both MF, GDNL and PC. In many Member States, data availability and existing land use or vegetation classification systems will determine what classes can be used and therefore which condition category changes emission factors can be determined for, if no new measurement data are to be produced in the project pilot phase. On top of this, as is observed in the GDNL process, **political or economic rationales will prioritise certain condition changes**, and hence which EFs are needed.

As there is a proven functional relationship between water table depth, vegetation species composition and GHG emissions (Tiemeyer et al., 2020), vegetation has been used as basis for classification at the project level. The GEST approach applied for MF relies on this to apply implied emission factors to restored peatlands based on condition categories tied to vegetation cover and species composition. The approach developed for PC applies the same logic and defines five condition categories based on land degradation and vegetation characteristics. Experienced surveyors can identify degraded and drained peatlands (for PC, only bog mires) during field visits, whereafter look-up tables developed by scientists during the preparation of the PC offer emission factors (EF).

3) Estimating emission factors

For most initiatives, the difference between GHG emission factors assigned to two conditions categories is used to determine the estimated avoided emissions resulting from the restoration activity. None of the initiatives provide EFs for carbon sequestration, which is found by supporting literature to be too slow and uncertain to be considered as a result in a 5-10-year timeframe.

There are two principal ways to determine applicable emission factors within the project area. Either **EFs are quantified based on direct measurement of fluxes at site and over time** (using chambers, eddy covariance or other available scientific methods) or using **proxies that allow linking trial or reference data from other locations to the project site using pre-defined characteristics** that are common to both reference and project area. For the latter approach, project external data can be used, and costs reduced, (direct measurement of fluxes can cost 10,000 €/ha/yr and is not applied by any of the initiatives).

The changes in the estimated EF from before rewetting to after rewetting multiplied with the area rewetted is then the result achieved over a year. This requires that emission factors are available for both the land use and drainage level categories before the rewetting activity and after, and hence that **at least two EFs are necessary** but, in reality, many more are needed as project areas are always heterogenous. In practice, MF, PD, and GDNL all defined several sets of 'before and after' EFs to be able to consider different restoration activities. GDNL and PD are the only schemes to report an EF for partial rewetting where the land use is not changed, while the GEST model developed for MF can be used to provide EFs for this situation. MF offers also EFs for rewetting and establishment of paludiculture on the land.

All initiatives except one applies emission factors estimated from reference data. MM found insufficient national or subnational data applicable to small peatlands and found default factors were not applicable. The customized approach used by MM relies on the assumption that peat degradation when exposed to air releases a CO_2 volume equivalent to the loss of the carbon in the top 50 cm of peat within a timeframe of 50 years, and that degradation and emissions stop when the land is rewetted. The result indicator is therefore not based on reference data for emissions but for C-stock in peat of certain raised bogs in central Europe. **The annual peat decomposition rate of 1 cm per year is widely mentioned as a rule of thumb.**

The value of the EF can be determined in different ways which will impact on applicability (Table 5)

Table 5. Determining EF values.

Factor:	**Project EF**	**Local EF**	**Country specific EF**	**Default EF**
Data from:	Reference measurement on site	Local or regional reference data from another project	Implied emission factor reported for all peatlands (or organic soils) in national GHGI.	Global aggregation and averaging of data for broad land and climate categories
Applicability and reliability	Best possible	Satisfactory	In some cases, but caution needed considering various peatland types	Some project owners state that DEFs are not satisfactory for carbon farming, as they will not be representative of the land they are applied on. If the factor is sufficiently conservative, there is however only an economic loss and no integrity issue.
Initiatives	MF	PC, GDNL	DKW	*None*

The use of emission factors as one of two factors alongside area rewetted to calculate results is well-supported, but several approaches were identified for determining the value of the EF and, not least, the number of different EFs necessary to cover a rewetted area. Overall, land use and climate in combination with water table and nutrient status will determine emissions. Therefore, emission factors for drained organic soils can be estimated using **combinations of land use, water table, soil type and climate using e.g. by regression analysis of field measurements**. Thus, across the initiatives relying on EFs to calculate results, the data used are not only emission data, but also data for land use, land cover, vegetation, drainage history and type (open or pipes), current and past water table, soil type and peat layer depth, nutrient level, and climate/weather data on e.g. rainfall. FAO (2020) provides an excellent overview of the principal linkages between emissions and land use in a peatland context.

For all initiatives there was early on a recognition that **technical expertise** was needed due to the complexity of the topic. Universities, researchers or expert advisors have been consulted (MM, DKW), organised in a formal technical advisory group (PC, GDNL) or were already integral part the project owners and developers (MF). For MF, substantial data from earlier peatland restoration projects in Belarus and data from long term research by the University of Greifswald and other partners, allowed the **scheme to estimate and revise EFs early on**, before other parts of the scheme design were elaborated. The MF team has several members involved with methodology development under the VCS as well as IPCC authors and UNFCC COP negotiators and had significant expertise on emissions and removals from peatlands already, before the onset of the scheme. This level of in-house expertise is not found in any of the other schemes, which had to rely on external experts to determine emission factors. MM is perhaps a small exception, as one of the founding experts had a relevant scientific background, but not the funding or organisation to set up trials and data gathering or management systems. For GDNL, a technical committee with experts from Wageningen University and Ministries was established early on, through a top-down open process governed by the national cross-sector offsetting initiative for all non-ETS sectors. For various reasons it ended up with a focus on research and conditions in a particular Dutch region (Friesland) and researchers of the Radboud University of Nijmegen took the lead in defining EFs. The process included signing public-private partnerships between market partners and government, and in the context of one of these the dairy giant Friesland Campina led similar work to establish regionally specific EFs. However, under the GDNL, it is permitted to use IPCC NL EFs as reported in the Dutch GHGI, but project or area specific EFs are can be used. An important specific feature of the Dutch process and the EFs is that for historical reasons water tables in most regions are decided by Water Boards, which are populated by public authorities, farmers and NGOs. These boards were consulted in the process, as their decisions on water tables would also govern where and to what extend peatlands could be rewetted and therefore for what specific type of restoration EFs would be needed. This example highlights **the need to involve entities and authorities outside the climate and research domains when determining EFs**.

PC set up a technical advisory committee early on, inspired by and working with the similar committee set up for the Woodland Carbon Code. Funded by grants from DEFRA, the committee could gather experts and conduct a comprehensive study on potential metrics. The process and its outcome (Smyth et al., 2015) are among the most well-structured and transparent examples of how to deal with the challenge of setting up EFs. The EF process was a core component of the pilot phase of the study (WP1 out of four work packages) and brought together eight different institutions. The WP delivered a field protocol for assessing peatland conditions, developed a classification system for peatland conditions with inspiration from GEST, and undertook a literature review to establish potential Emission Factors for each condition category. Measurements to further refine EFs were not foreseen as part of the PC development process itself, but the report offers statistical analysis of data used and an overview of data points, sites and time series for these. Instead of own measurements, it was expected that planned work by DEFRA in preparation of the UK reporting of wetlands in its GHGI would provider better data and estimates and allow for improvement of EFs. At the time of the pilot phase there was a widespread expectation that the PC would be owned and operated by the UK government, as was the case for the already established Woodland Carbon Code. However, because environmental policy was by this time devolved to each UK country administration, there was no legitimate UK Government body that could perform this function and the IUCN UK Peatland Programme was chosen to operate the PC, with funding for its operation from each of the devolved administrations. At the time of writing no dedicated reference data set for refined EFs had been established, and **external data** was still used as the basis for EFs.

Determining EFs can be complicated, but equally demanding is the process of classifying the different parts of peatlands to be rewetted. The process of identifying and classifying condition change scenarios is covered in more detail in the previous chapter. Once classified, for each condition category an EF must be defined, and thus for a scheme allowing restoration of both grasslands and croplands into either paludiculture or near natural state at least 4 EFs would be needed, but in practice it would need many more. As mentioned, the PC identified **five condition categories,** each representing a step on a scale of degradation, and in principle this allows for any restoration activity that reduces the level of degradation. This sums up to five realistic condition change scenarios (several combinations were found to yield too small GHG results) and therefore requires up to ten EFs. GDNL allows for three condition change scenarios, all starting from intensive agricultural use on drained peatland. This requires four emission factors.

The EFs applied by the initiatives are not directly comparable, as all schemes have classified eligible peatlands into different (and not comparable) condition categories, then estimated EFs for each of these categories. The EFs below (Table 6) show the variation and spread of EFs used across projects. For comparison, the table includes default EFs as reported by the IPCC in most recent GPGs.

Table 6 Emission factors for peatlands based on IPCC Tier 1, The Peatland Code (Tier 2) and Moor Futures GEST approach.

Scheme	**Condition Category**[24]	**EFs (CO_2eq/ha/yr)**
MF GEST	High intensity grassland on peat	7.5 (very moist) – 24 (moderately moist
	Forb meadows	7.5 (very moist) – 20 (moderately moist)
	Reeds	3.5 (very moist) - 8.5 (lower eulitoral)
	Rewetted (short) grassland)	5.5 (wet)
PC (all grassland based)	Near natural	1.08
	Modified	2.54
	Drained	4.54
	Actively eroding	23.84
IPCC Tier 1	Cropland (drained and ploughed)	34.02
	Grassland on fen (deep-drained)	26.89
	Grassland on fen (shallow drained)	16.23
	Grassland on bog	22.09
	Re-wetted bog	1.76
	Re-wetted fen	6.76

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[24] The Condition Category is determined by the mechanism itself. The MF uses the GEST approach to determine EFs by site conditions (moderately moist to lower eulittoral) and by vegetation type. The PC relies on four categories for peatlands.

The EFs in the table clearly illustrates the order of magnitude of possible avoided emissions when shifting from one condition category to another, and shows that even with localised and specific EFs, values do not change much. Shifting from intensive land use on degraded peatland to rewetted and restored peatland will typically yield 15-25 CO_2eq/ha/year, depending on the type of peatland. Such approximate general EFs can be used to provide early estimates of GHG effects of rewetting and restoration in boreal and temperate zones of Europe**.**

b. Co-benefit indicators, quantification and payments

Peatlands schemes **can apply multiple sustainable indicators in order to cover the many and varied environmental and social benefits of rewetting and restoration**. This can be done explicitly, i.e. the scheme designer could separately reward participants for avoided emissions and for a change in another valued indicator, or indirectly in offset credit or emissions reduction certificate schemes, as is the case in existing examples of these. The schemes can charge a price premium for offsets compared to allowance prices because buyers recognise the multiple benefits even without monitoring, and in some cases without quantification of these co-benefits. The MF scheme, for example, has developed methodologies both for quantifying GHG emissions and for quantifying co-benefits and peatland-tailored services, covering improved water quality, flood mitigation, increased groundwater stores, evaporative cooling, and increased mire-typical biodiversity (Joosten et al. 2015). The PC does not formally monitor non-GHG benefits of peatland restoration and is limited to the sale of carbon units.

The MF methodologies for additional ecosystem services can be quantified using a **standard and a premium approach**. The premium approach is suitable for more complex, time-consuming and more accurate quantification of ecosystem services. For example, the role of peatlands in the landscape of nutrient balance for improved water quality can be measured and monitored using an N-Emission-Site-Type (NEST) approach which conservatively estimates nitrogen-release (in kg N leaching ha/year) using default values associated with vegetation type. Another approach in measuring nutrient retention is the WETTRANS/PRisiko modelling which uses soil mapping, vegetation and water course mapping among others. Another example of a co-benefit included in the MF is the aim to increase mire-typical biodiversity using the BEST approach. **Indicators** such as species, species groups, or communities are included in the approach and are expected to react to peatland rewetting, making it possible to assess the change in mire-typical biodiversity between the baseline and the project scenario (Joosten et al. 2015).

The selection of the most appropriate sustainability indicators depends upon the primary motivation for peatland rewetting and restoration and will differ with the type of ecosystem services, local priorities and needs and policies. Co-benefits and sustainability indicators should be emphasised clearly by consultants in communications with farmers, and reported to scheme operators, who should monitor these for trends. Therefore, **indicators should be specific, measurable, available/achievable in a cost-effective way, relevant for the scheme and available in a timely manner to monitor trends**.

Despite consideration and inclusion of multiple sustainability indicators, none of the schemes incorporate indicators of or quantification of non-carbon benefits into their pricing, and **the peatland carbon markets are currently one-dimensional, and only the climate regulation function has been on the market**. Including **price premiums** for co-benefits beyond climate change mitigation provides the opportunity for project proponents to achieve a higher reward depending on the co-benefits they achieve (von Unger at al., 2019; Cevallos et al., 2019). Overall, participants in the peatland schemes would pay a premium for projects (regional or national) that could provide multiple co-benefits in addition to the climate change mitigation impacts. The premium prices should not be fixed, but instead reflect the range of co-benefits and location. This will reflect greater environmental integrity and can potentially generate greater demand and/or higher prices for the peatland offset credits. Experience from existing peatland schemes shows that buyers are willing to pay a higher price for secure co-benefits, as well as ensuring that potential **negative externalities** are minimised.

Impact investors will continue using carbon crediting as a key metric for measuring and verifying the results of their investments and are more likely to see their corporate social responsibility in the light of sustainable development goals, thus including wider environmental and social benefits. These carbon units are defined by science and regulation, and the price defined by the market. It is up to the project developer to propose this on a case-by-case basis if they want to bundle and monitor these co-benefits for their project. Two options exist for how co-benefits, including ecosystems and ecosystem services, can be presented and monetised for further development of carbon credits: **Bundling and layering**: Bundling is grouping multiple ecosystems and ecosystem services (EES) together in one complete package to be sold as a single credit. This option might be useful if only one EES can be commodified. However, additional EES should be seen as additional and allow for charging higher premium prices. Layering refers to mechanisms where payments are made for several EES, which are then sold separately. Layering in only possible where EES can be commodified individually and where a market demand exists. Layering should however be carefully quantified to avoid potential double-counting (Joosten et al., 2015; Bonn et al., 2014; von Unger et al., 2019).

Quantification and economic evaluation of EES by bundling or layering payment is the next step in the further development of carbon credits, which can facilitate transparency of peatland benefits and costs, provide additional funds for peatland restoration and rewetting, as well as additional incentives for farmers and landowner to take-up the mechanism (Joosten et al., 2015).

c. Monitoring successes: The M in MRV

Monitoring the core result indicator for GHG emissions entails repeating the direct measurement of GHG fluxes or the proxies used to link emission factors to peatland characteristics continuously or at an agreed frequency, often annually. As none of the initiatives covered apply direct measurement of emissions (due to costs and complexity), the monitoring systems developed all map or measure the selected indicators.

The monitoring refers to the continuous logging, gathering, measurement or mapping of land use, soil, water level and vegetation data that allow for quantification of the result of the project activity. Schemes do not need to measure at every site or peatland, if credible peatland and condition classes are developed and for each of these local EFs are developed. The calibration of country or regional emission factors requires measurement and research into specific conditions at reference sites and is usually conducted by researchers or the scheme centrally for all projects (GDNL) and is therefore not a necessary part of the monitoring plan or system for each project. Monitoring systems relying on ongoing direct measurement of GHG fluxes for small scale (1-5 hectare) restoration site have been reported to cost as much as €55,000 a year in the early years (MM) and are therefore not feasible for any peatland restoration project. This realization has led the technical advisory committees (GDNL) and scientific members of the initiatives' steering groups (PC), to recommend **monitoring indicators**.

In order to quantify results, the monitoring system will be constructed to match the selection of result indicators, and the metric for estimating and reporting results. **Matching monitoring systems and result indicators is an exercise that requires technical expertise but is key to a functioning scheme**. The PC provides a simple explanation of its mandatory monitoring (and verification) practices in the 2017 Peatland Code 1.1 document. Here, monitoring is the repeated logging of indicators selected in a project plan, in order to verify (or adjust) the expected levels of avoided emissions (a 'baseline') also set out in the project plan. The project plan and, as part of this, the monitoring plan both have to be forwarded for approval by the PC registry as part of project registration.

Two main approaches stand out for the selection or combination of indicators to be used for monitoring peatland rewetting and restoration projects, with other approaches also having been considered and potentially being available for future projects. The first approach is based on the GEST method and is developed by the researchers behind MF but applied with modifications by PC as well. The GEST method relies on **vegetation mapping** and **classification of peatlands** into condition categories. The basic assumption, as explained in more detail elsewhere, is that vegetation is an indicator of water table height and other plant and site-specific properties which again is one of the key parameters impacting peat decomposition and thus emission levels. This overall approach is championed by MF. A second approach focuses on water table and peat depletion depth, using remaining C-stock in the exposed peat-layer as the metric. This approach is applied by MM.

d. Reporting, verification and auditing: RV

Verification and auditing are key processes for ensuring reliability and accuracy, checking action against targets in compliance markets or for issuing credits according to the rules by the Voluntary Standards (e.g. VCS). However, validation and auditing seem to be an area where cost cuts for farmers and products have been made possible through simplified or minimum validation. **It has been observed that implied or internal validation and verification processes have been implemented by several standards to reduce MRV costs**. For example, both the MF and the PC Code allow the same few third-party organisations to carry out both validation and verification. The GDNL is installing a committee of experts to undertake the project validation to reduce costs of validation.

All schemes covered, including CDM, JI, Gold Standard and VCS require approved projects to monitor progress against a pre-set baseline using a monitoring protocol, and to log and report findings in a report (von Unger et al., 2019). The PC v1.1 from 1.1 explains the verification setup which is similar to the MF setup: for year one, year five and every ten years thereafter, the monitoring results as reported in a monitoring report shall be verified by a third-party independent body, who will issue a 'verification statement' which will remain valid until the next verification. The verifier will assess and attest the condition categories on site to determine if they remain within the requirements. The verification bodies are to be appointed by the PC Executive Board and must hold at least an ISO 14065 accreditation. For some time, no verification bodies were approved, and the IUCN peatland programme could undertake verification of projects.

It differs between schemes whether verification is against an external standard or against a baseline and project plan approved at the time of acceptance of the project into the scheme. The first large MF projects were verified against the VCS tool for AFOLU project activities (versions up to v3.0) and a dedicated methodology based on the GEST model also used under VCS. PC projects are approved against their own plan as mentioned. No GDNL project have been subject to verification yet, and for MM there is no verification protocol, so the project developer who is also the issuer is responsible to buyers as far as verification is concerned.

Over the lifetime of a peatland rewetting and restoration project, conditions and context may change, which could lead to external changes in indicators. In such cases, the baseline, monitoring plan and/or verification criteria should be adapted.

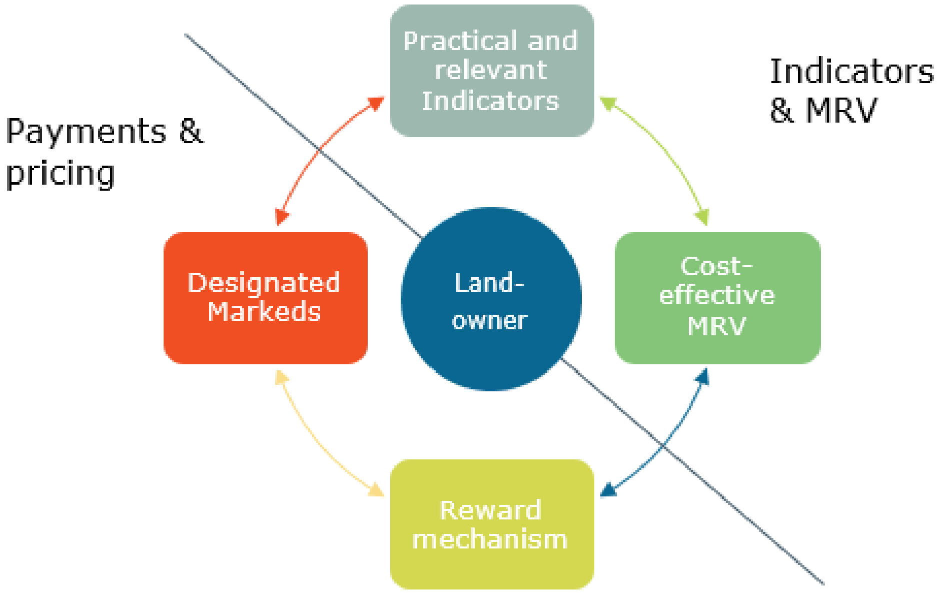
4. Paying for results

Setting result indicators and defining MRV systems to monitor them is often the art of the possible. Arranging the system for payments and price setting based on MRV'ed results is another challenge. Though closely linked, it is two different processes, and the latter is covered in this chapter.

a. Developing process for reward mechanism

A first observation is that the order of the two processes is not as clear as indicated with the structure of this case study. Initiatives have started at any of the four points of the cycle shown below.

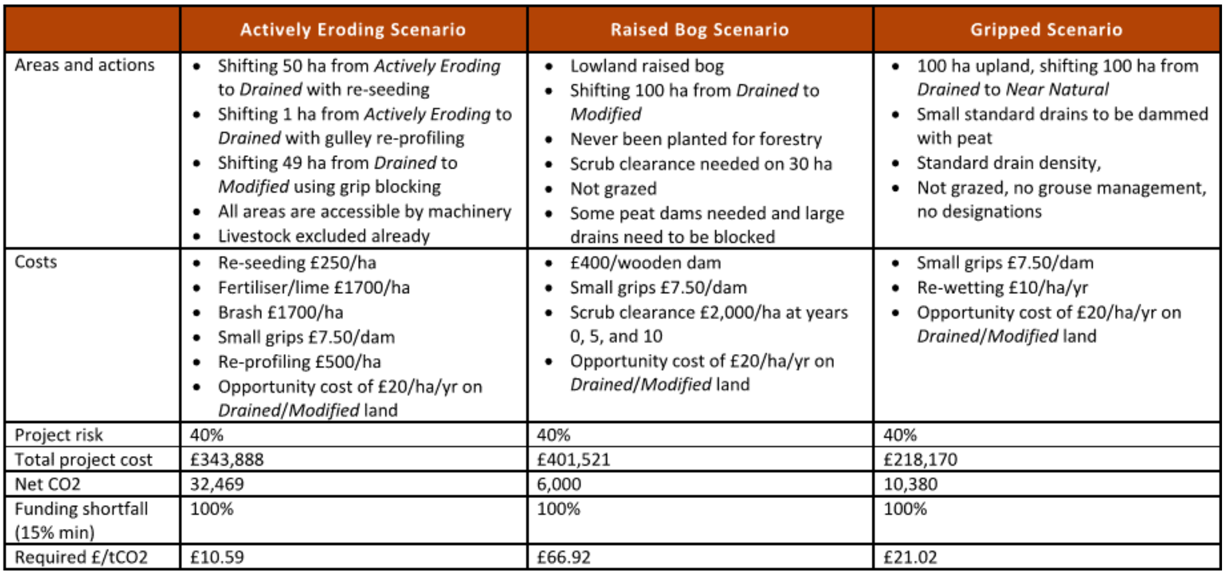
Figure 5. Reward mechanism cycle



Source: own elaboration 2020.

The farmer or landowner is at the centre of this process, but rarely has the capacity or background to own any of the four processes. It is the project or participant level business case that needs to make sense, for any peatland restoration project to get implemented, although a regulatory requirement to restore may change the economic rationale. For the PC, an **extensive financial modelling of pricing scenarios, buffers, condition change scenarios and MRV and code administration costs was conducted as part of the preparatory study** during the pilot phase. Relying on the capacity of university staff and carbon market off-takers, this study also explored capital requirements, buyer preferences, compared offsetting markets, liquidity and supply in designated markets and tested financial additionality. Finally, the study presented and analysed three project examples by constructing theoretical investment cases (see Table 7). The financial modelling was conducted in late 2014 under political circumstances and an offsetting market both very different from those for which projects are now being prepared, but has recently been extended and refined significantly[25],in view of an improved business case prepared at project level. The validity and the detail of the exercise is an example of an academic and solid landowner-centric process for setting up the reward mechanism.

Table 7. Overview of project implementation scenarios tested in the financial model for the Peatland Code during the pilot phase



	Actively Eroding Scenario	Raised Bog Scenario	Gripped Scenario
Areas and actions	• Shifting 50 ha from *Actively Eroding* to *Drained* with re-seeding • Shifting 1 ha from *Actively Eroding* to *Drained* with gulley re-profiling • Shifting 49 ha from *Drained* to *Modified* using grip blocking • All areas are accessible by machinery • Livestock excluded already	• Lowland raised bog • Shifting 100 ha from *Drained* to *Modified* • Never been planted for forestry • Scrub clearance needed on 30 ha • Not grazed • Some peat dams needed and large drains need to be blocked	• 100 ha upland, shifting 100 ha from *Drained* to *Near Natural* • Small standard drains to be dammed with peat • Standard drain density, • Not grazed, no grouse management, no designations
Costs	• Re-seeding £250/ha • Fertiliser/lime £1700/ha • Brash £1700/ha • Small grips £7.50/dam • Re-profiling £500/ha • Opportunity cost of £20/ha/yr on *Drained/Modified* land	• £400/wooden dam • Small grips £7.50/dam • Scrub clearance £2,000/ha at years 0, 5, and 10 • Opportunity cost of £20/ha/yr on *Drained/Modified* land	• Small grips £7.50/dam • Re-wetting £10/ha/yr • Opportunity cost of £20/ha/yr on *Drained/Modified* land
Project risk	40%	40%	40%
Total project cost	£343,888	£401,521	£218,170
Net CO2	32,469	6,000	10,380
Funding shortfall (15% min)	100%	100%	100%
Required £/tCO2	£10.59	£66.92	£21.02

Note: Net CO_2 in t CO_{2eq}/yr given for project examples.

Source: Peatland Code Metrics Report (2015).

The PC scenarios illustrates (bottom row) how at the time, the carbon market prices were very far from the price necessary to cover all costs of the project. It is also seen that the ‘actively eroding scenario’, which is the condition change leading to highest number of avoided emissions, is the most promising and requires the lowest carbon price. A cross-cutting observation is that **most initiatives seem to have considered both scheme and project level costs and funding, and pricing scenarios and buyer feedback** before designing the scheme specific reward systems.

1) Funding peatland restoration: Who pays for what?

The business case for each individual restoration project implemented or in preparation under each of the initiatives is the key to **mobilising projects and to build scale**, and this has been centre stage for most initiatives. Very few of the projects implemented or under preparation by any of the initiatives have been able to build a business case on the income from sale of credits, except for individual MF projects. Projects have combined and often blended private and project finance and relied on grants and in-kind support by the proponents of the initiatives in the preparation phase, as do farmers and foresters everywhere when seeking new funding for a project. Many interviewees explained that it was recognized widely that carbon markets (and price forecasts) in the period 2010-2017 when most of the covered initiatives was prepared and first projects launched, would not be able to fund all scheme level or project level costs. Thus, most initiatives and most projects have combined carbon market and other sources of funding. This leads to the question of

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[25] Unpublished cost modelling shared with the authors, ed

allocating risks and differentiating who pays for what. As a common approach, project level financial structures encompass four elements (Figure 6):

Figure 6. Principal sources of peatland restoration project funding.

Source: own elaboration 2020.

Then grants are often used to pay for reports, studies and consultations in the early phase, but also to cover site preparation and equipment purchase. For this, overall project objectives and assumed non-carbon benefits are sufficient to secure relevant funding, and no payment for results element is recognized in grant agreements. For MF and MM in particular, but also for other initiatives, a significant number of hours have been invested by project proponents to drive first projects and support early phase project development, as entrepreneurs and start-ups always do. MRV and the EF development for MF was largely done as part of work funded by budget lines and a research programme not linked directly to the MF, and in several cases in the decade before the scheme was even launched. This in-kind contribution to scheme and project development is also seen for PC, where volunteers and students linked to the project partners (Universities and IUCN among others) have done unpaid work. Linked to this are dedicated research programmes which, through public funding targeted at peatland restoration, have supported project development activities. For instance, the Life+ funded Polish RePeat project (PRP) was tasked with defining and explaining options for result-based for peatland restoration. **Carbon markets is often found to be the only source of funding to be tied to measurement and monitoring of results**, and as explained later so far only for GHG mitigation outcomes. Both for MF and PC it has been confirmed that all the avoided emissions at project level (with any buffer subtracted) have been sold, meaning that none of the other funding sources (such as local governments, NGOs or charities) have claimed these climate mitigation benefits for their own Corporate Social Responsibility (CSR) purposes.

Across the two main types of funding, carbon market and grants, a main barrier as reported by project developers is **market uncertainty**. For grants, changing priorities and lack of public funding in the aftermath of the financial crisis have meant that several of the projects ran out of or could not get funding for activities that were already planned. Initially it was foreseen the PC should be a government enterprise, but it was decided to nest the scheme with local stakeholders in Wales, Scotland, Northern Ireland and England, and shortage of funding for hosting preparatory work, meant that the NGO IUCN took over the scheme half-way through the pilot. A source of funding that has proven more reliable but limited in size of flow is local or regional private charities in the UK, which have funded preparatory work. Interestingly, the predominance of grants in the UK has been found to result in mostly NGO-led restoration projects, as these organisations are much better adapted to the grant application process, which is not suited to farmers (Brown, 2020). **For carbon markets, the low price of credits and the weak demand remains a barrier.** For both MF, PC and MM there has been a distinct market approach to label and explain on-carbon benefits (and in particular local relevance to some buyers) in order to secure credit prices with a price premium well above voluntary market prices. In fact, the MM allows for co-financing but is designed in such a way that at least 20% of investment needs to stem from carbon finance. In other words, up to 80% of the project costs can be covered by federal and cantonal governments (Cevallos et al., 2019; von Unger et al., 2019; MM developer, 2020).

With these **multi-source blended funding structures**, initiatives have been able to reduce the capacity costs to be covered by the credit price. It should also be noted that none of the initiatives has restrictions on how projects can be co-financed and financially structured, while payment arrangements may allocate certain costs to certain actors. For example, under PC, advisors are necessary to help farmers structure the financing package and determine the role of different funding sources, as well as market the credit. These are often also the project developers but can be discrete advisors as well (MM). For MF, the structure is different (see chapter on market considerations later) and some of this work is not needed, while a large share is handled by the initiative team. A key element for PC is therefore who pays for the advisory services, and whether the advisory function is governed or guided by the scheme protocols. For PC there are no specific set of rules on this, and costs will be borne by different actors for each project. In the early days of PC, it was foreseen that a small deduction per credit, labelled a ‘code payment’, should cover some centralised advisory and administration costs. The dominant practice is that developers make their fees dependant on issuance and sale of credit, and that this only happens once credits are paid for.

Despite close link between peatlands, restoration and biodiversity in many Rural Development Programmes of the Member States and regions hosting the initiatives covered, only one example of using RDP finance as a funding source was identified. A Scottish PC project still in preparation phase has tapped into Scottish RDP funds. A similar observation is the existence of the Danish RDP measure on wetland restoration, which does not entail or allow for carbon market co-financing, and for which main objectives are water and flood protection alongside nitrogen management, but not climate change mitigation.

2) Cash flow issue

Peatland restoration projects are capital intensive in the implementation phase, leading to an unbalanced cash flow profile timewise. For preparatory activities and costs projects typically have relied on grants from charities, funds or government, and other entities seeking non-carbon benefits and objectives. Types of costs (from PC Metrics study) can include:

1. Machinery and measuring equipment;
2. Site preparation, including ditch and drain works;

3. Hours allocated for consultations and permissions;
4. Hours allocated for financial and project design, expert advice; and
5. Hours allocated for mapping/survey and baseline measurements.

Only later in the projects' lifetime does crediting and payment per sold unit start to generate income which resembles an annualised fixed income for the farmer but will hardly cover income foregone. Therefore, all initiatives have had to make a key decision concerning ex-ante or ex-post crediting, which is covered in the next chapter.

b. Reward mechanism and calculation

Reward mechanism refers to the scheme's structure for paying participants for results. For peatland restoration, the design elements and decisions for a reward mechanism are not significantly different from other types of carbon farming schemes and thus from the other case studies. In this chapter, inputs from initiatives, experts and literature directly linked to peatland restoration is presented, even if these are not specific to a peatland project.

In short, the assessed reward mechanisms have included the following elements:

- Pricing strategy: linked to voluntary markets, negotiated prices with price premium or fixed price floors/ceilings;
- Payment structure: is farmer, project or developer paid?
- Payment timing: ex-ante or ex-post issuance and payment?
- Market restrictions: are units temporary, non-tradable, international or otherwise restricted.

1) Pricing strategy

Until now, carbon farming result-based peatland schemes have not been able to develop projects at market prices. Given that prices are the key incentive for participants, project/scheme developers need to **select reward settings and foster credit demand that will promote higher prices, to incentivize uptake and overall** scheme **success**. One way of advocating for higher prices is better valuing of the co-benefits (Cevallos et al., 2019) or ensuring access to co-funding from public sources.

By offering local and/or non-carbon benefits on top of avoided emissions, higher prices can be justified and accepted by buyers. Overall, European peatland projects have demanded higher credit prices than those traded in the international voluntary markets. PC (and WCC) developed pricing scenarios per condition category changes and incorporated risk buffers and administrative fees, but actual prices vary from project to project, primarily based on the (highly variable) costs of restoration in different sites. Prices for the MF certificates are based on the costs of their production, i.e. calculated by dividing the costs of implementation by the total amount of emission reductions over the project crediting period. MM is a public-private partnership and bases project implementation on public co-funding with a share of up to 90%, while the remainder of the investment needed comes from carbon finance.

Table 8. Overview of price ranges for Peatland Code, MoorFutures and max.moor.

Name of initiative	**Price range**
MoorFutures	Around 36-73 €/tCO2eq[26] (taxes not included)
max.moor	Around 30-100 €/tCO2eq

Local benefits that can be communicated by customers or other stakeholders are often a decisive non-carbon benefit that is of high value to CSR-motivated buyers. For these, **carbon market price setting serves as a benchmark for price setting before price premiums,** and project specific prices can easily vary significantly. While municipality level impacts have been reported as important for some prospective PC buyers, both PC and MM found that national level is sufficient local connection for most CSR motivated buyers, which served as an input to the market strategy.

2) Payment structure

There are different possible setups for payment transfer and thereby pricing. A key design question is who manages the **sales interface** between the buyer and the project or landowner. Figure 7 shows three different payment and pricing models as devised from the schemes covered.

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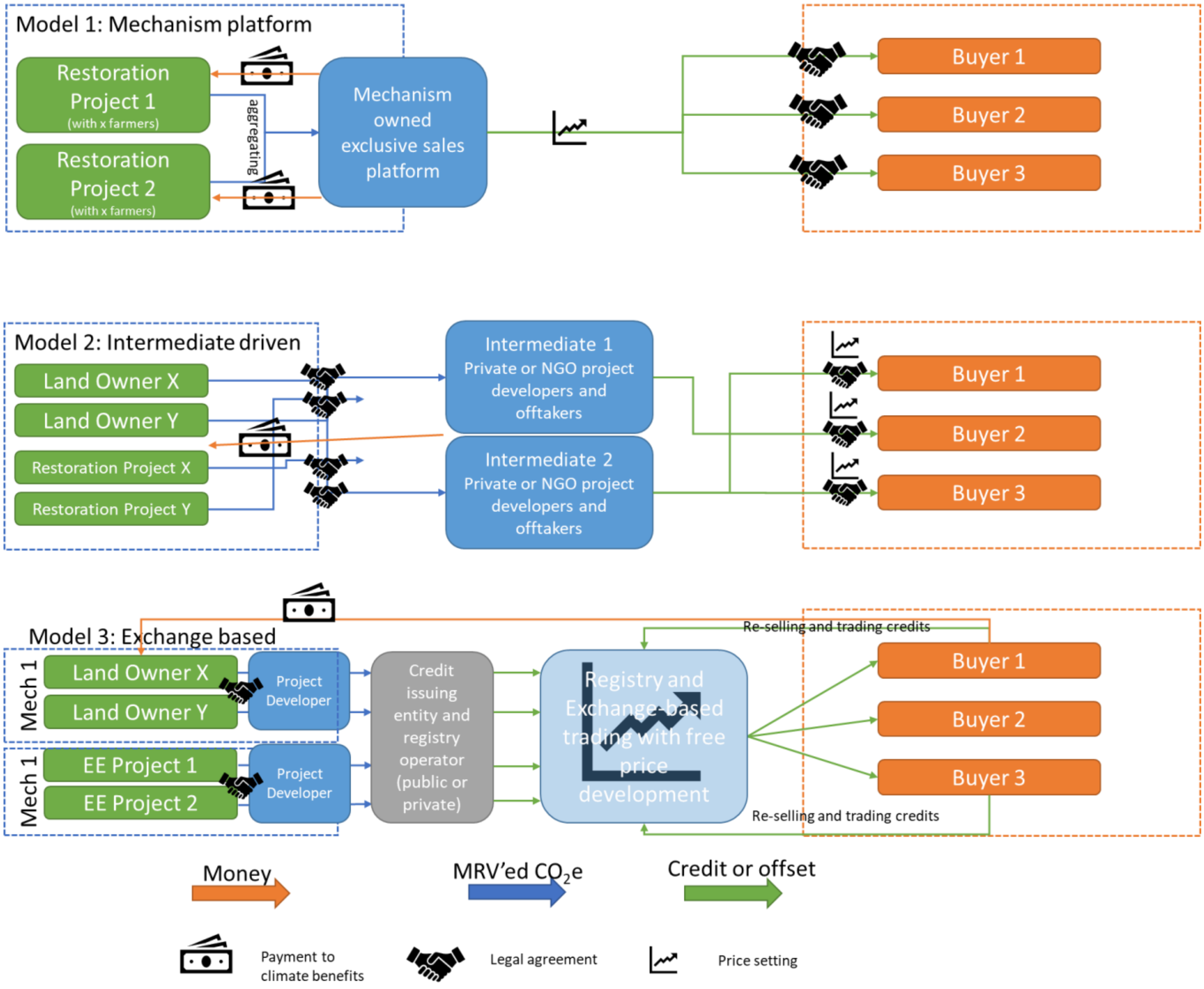
[26] Von Unger et al., 2019

Figure 7. Overview of three different models for payment and pricing as applied by peatland restoration schemes



Note: Green boxes are those entities owning the avoided emissions achieved. These can be both landowners such as farmers, and project entities. Blue boxes are market and trading entities and services. Orange boxes are buyers.

Source: own elaboration 2020.

The three key elements that differentiate the three models are the basis for and **time of pricing, use of legal agreements, and flow of payment**. This first model (Model 1: Scheme platform) is applied by MoorFutures and consists of projects that are developed within the frame of and with the explicit support of the scheme owners. A recognized project is usually a peatland, and the avoided emissions resulting from the restoration activity are offered at the MF homepage for sale at the cost of developing that specific peatland. Tranches of certificates are prepared and offered when new restoration projects have been implemented. Buyers are those seeking specific offsetting from MF, and they enter and place their orders on the MF homepage. There is no process for negotiating price, so the price setting is centralised. Also, there is no use of legal agreements in the pricing process, as any legal agreement governing split of income and costs is between the individual project and the landowners, for each peatland. When credits are sold, the MF operating entity transfers payments to projects with a deduction for administrative costs.

The second mode (Model 2: Intermediate driven) l is used by MM and PC and entails project developers or credit off-takers undertaking contractually governed obligations towards project owners (landowners, NGOs, trust funds or municipalities) to help develop the project and cover early phase costs, while securing the mandate and right to market and sell credits when these are issued. The scheme does not govern who can develop, market and own an issued credit, and relies on these entities to arrange for and provide advisory services on financial structuring, MRV and project design to farmers. It is not the scheme that issues credits, rather projects or project developers who can document that all elements are in line with the PC or MM regulations and principles. The decentralised issuance and marketing means the price is decided in the negotiation between the intermediary and the individual buyers that this intermediary can identify. And vice versa, the money from the buyer's payment is transferred to the project owner by the project developer without any role for the scheme. The scheme may organise a registry or rely on external registries as is being considered for PC (only one project has issued credits, so the setup has not been performing and may still be adapted). This model has also been used by the NZ-PFSI for afforestation projects in New Zealand since 2010 and is foreseen for the Australian Carbon Farming Initiative.

The third model (Model 3: Exchange based) is the model known from voluntary and Kyoto carbon markets (CDM/JI) and entails a central registry and issuer to keep track of uniquely identified credits which can be traded between buyers. Trading is not an option foreseen (but it is not legally restricted) for the two other models. This model is applied by the GDNL and allows for aggregation and selling of credits from many different sectors alongside peatland restoration (in Figure 7 illustrated by examples of Energy Efficiency projects). All credits are issued by a central body, the foundation in the case of GDNL. In this model there are no legal agreements, except for those necessary between the farmer and any project developer. Whoever is offering the credit to the market will find pricing guided by buyer preferences, and supply and demand in the market, and by selling and buying credits at the market accepts these terms without any contract between seller and buyer. That said, model 2 is often allowed to supply credits into a model 3 market.

Table 9 below compares some of the features of the three models, based on the experience of the European examples and global lessons learned reported in the Technical background report to the study.

Table 9. Strengths and weaknesses of the three models

Model	Examples	Strengths	Weaknesses
1.	MF	If demand is strong, this allows for better price premium. Also, for farmers an all-serving scheme organisation eases admin and reduce transaction costs.	Only one marketing channel and weak pricing influence. Would not meet VCS, CDM, JI or EU-ETS standards for independency. Difficult to grow scheme as it is entirely dependent on willing and able experts.
2.	PC, MM	Flexible setup, with reduced centralised costs of operating the scheme. Model creates opportunities for experts and businesses, thus easier to scale and grow.	Almost all landowners will have to contract advisors, developers and manage this work. More contracts and legal arrangements necessary.
3.	GDNL	Transparent price setting and national level cost effectiveness. Performs better with increasing scale and allows for transparent price setting.	Limited or no opportunity to ensure price premium for co-benefits. Typical peatland credit development cost levels cannot compete with Energy Efficiency or other industrial credits. Depending on scheme and exchange rules, project aggregation may be difficult and create costly project preparation incl. contracts and legal arrangements.

Source: Own elaboration, 2020.

3) Payment timing and credit issuance

An issue of relevance for peatland (and other CF LULUCF sector projects) is the issue of **payment timing**. GHG benefits from improved management of land and vegetation accrue over long time horizons, however costs of projects are dominated by upfront capital expenditure, and the time lag between cost and income have been difficult for scheme developers to bridge (Chenost et al., 2010).

In short, result-based payment can be offered in two basic ways: as **ex-ante in the expectation that results will come or as ex-post payment when the result has been verified**. Ex-ante allows upfront payment to cover restoration costs but comes with the risk of credits being issued and counted in by the buyer before the ER is achieved. Ex-post payments are less exposed to reversal risks, but the cash flow will not cover cost of restoration and necessitate lending or grants bridging cash flows (von Unger et al., 2019). Ex-ante payments are used by several schemes included in this case study, justified by the fact that **ex-ante credits allow to provide the needed funding to long-term projects, hence providing economic incentives to such projects.** These ex-ante credits for up-front payment do not fit into the classical ex-post and result-based crediting scheme and have been criticised regarding the environmental integrity of the avoided emissions, as well as their transparency. Therefore, in order to address such issues, several standards (such as the Peatland Code and the Green Deal) uses specific **discounts** when selling ex-ante credits, serving as an adjustment in case the effective amount of carbon avoided/sequestrated is lower than projected (this has the same function as a non-permanence buffer and they can be combined into one). The Peatland Code uses a discount of 10% of claimable units going to a precision buffer that can only be claimed when verification has been carried out, while the Green Deal uses a discount rate of 15%. The Woodland Carbon Code (WCC) transparently dealt with this issue by creating a Pending Issuance Unit (PIU), which is essentially a promise to issue a credit once the result has been verified. Although the MM does not issue credits as such, the commercial offset provider will issue credits according to MM standards and will sell all expected GHG benefits upfront, covering the avoided peat degradation for the entire project period (up to 50 years).

A specific issue related to **payment and issuance timing** is the link to **compliance schemes** and hence the use of credits for offsetting that are issued before the actual emissions have been avoided. As noted by some NGOs and researchers, company emission offsetting now based on ex-ante credits is problematic. Several of the schemes therefore have guidance on their homepage or in their technical guidance on what wording or claims buyers can make in any climate action report or voluntary GHG neutrality accounting. In compliance schemes with annual or short-term targets, issuance of credits for results achieved beyond the target date is not allowed and would confuse the pricing schemes. **Any peatland scheme that foresees entering or supplying a compliance market must therefore avoid issuance of ex-ante credits**. A similar observation holds for any linking to GHGI and thus national level GHG targets. GHGIs are annual accounts of changes in GHG emissions and can only recognize results that have been achieved. Restricted domestic schemes like the GDNL may find operational solutions to this issue in the future. The PC is considering an upfront payment structured as a loan which is repaid with credits serving as instalments as results are achieved and verified.

In deciding between the two principal options for result-based schemes for peatland restoration it is worthwhile considering **project scale and crediting lifetime**. For larger scale peatland projects and for projects with long implementation phases ex-ante credits may be risky due to uncertainties in expected deliveries. Therefore, options include **applying a stricter ex-post crediting rule, or developing instruments for advance payments**. The latter would require **a carbon fund** that could provide guarantees for projects that receive advance payments and provide inputs in setting up a market platform. For small and micro-sale projects such as the MF and MM standards, buffer accounts may have difficulties raising sufficient amounts to counter large disturbance events or measurement uncertainties with significant quantitative impacts.

4) Market considerations

Given the difficult demand situation for land use credits during the past 10 years several of the schemes faced **challenges estimating the size, reliability and preferences of demand for their credits.** Supply and demand remain low but niche market schemes like MF and MM continue to attract buyers and are running out of supply even with high credit prices. **The demand challenge may arise when the supply of credits from peatland projects increases and more EU-based land use projects compete for the same voluntary market buyers**.

Even if scheme developers would prefer to increase demand by increasing markets, both PC, GDNL, and MM have applied **market restrictions**. These schemes are national and only sell credits to domestic buyers. This is also preferable for the national authorities, as export of credits could become a double-counting issue between countries if the issued credit is not registered by the host country. MF has not restricted itself to certain markets but is considering **restricting sale** only to private citizens and companies who can prove that credits are not the only measure to achieve emission reductions or even GHG neutrality, but that enough in-house emission reduction is realised to stress the "unavoidable" character of emissions MF seeks to compensate. **All initiatives issue permanent credits with risk buffers (5-10%**) to compensate any invalidation of issued credits due to natural disturbances or similar events.

5. Delivery, scaling up adoption and evaluation

a. Resource needs

The development, implementation and operation of a peatland scheme is associated with complex procedures and requirements, training needs and stakeholder engagement, as well as high transaction costs. Resource needs and challenges, as well as solutions and key enabling conditions that developers need to consider in designing a competitive and attractive peatland scheme, are identified below.

Development and operation of a peatland scheme is associated with significant start-up costs and ongoing costs of operation. Such costs are context-specific and vary according to country-level costs, the design of the scheme and project, and to the characteristics of the sites, e.g. location, level of degradation and profitability of the land use. For example, in the PC, peatland restoration costs differ significantly between restoration of upland peatland (average around 4,900 €/ha) and lowland peatland (around 6,240 €/ha) (Committee on Climate Change, 2020). In general, peatland restoration schemes have high implementation costs which at the end are reflected in the carbon credit price, to the extent they cannot be covered by grants, subsidies, in-kind support or other supplementary project-level budget support (see Table 8) On the other hand, however, the negative externalities from current management practices are so large that from a macro-economic perspective peatland must be restored. Costs associated with peatland restoration and rewetting can be divided into:

- Development/setting-up costs: For example, peatland research on other approaches, peat damming and reprofiling, stakeholder consultations, defining and setting-up baselines, public relations and communication to media and stakeholders, guidance documents and counselling and contract points for offset intermediaries. Farmers' costs should be minimised in the development stages of the peatland scheme to encourage uptake.
- Recurring/on-going costs: Including MRV costs, reward payments to farmers, administrative costs, communication activities, accreditation fees and costs of oversight etc. For example, it is estimated that the annual costs of running the PC via IUCN UK Peatland Programme is approximately £30,000-50,000 (IUCN interview, 2020). Operational and ongoing costs could be covered through internal funding (i.e. public or internal company funding), or if the project is externally funded, by ensuring that income from offset credit/reduction certificate sales is higher than the amount paid to farmers. For some peatland schemes the costs of oversight are built into the payment regime. In the MF, costs of oversight are integrated in the scheme and the budget is made available to the post project manager to pay maintenance costs ad infinitum.

In order to address the financial barriers to implementation, several funding **opportunities** could be further explored and developed to ensure required peatland restoration funding needs, e.g. related to the up-front costs of pre-project implementation. One of the most pressing funding opportunities is to enhance and integrate co-financing including public-private partnerships. This could potentially increase the level of funding available as well as make more restoration projects economically viable. This further relates to the emerging markets of ecosystem services from peatland restoration and opportunities for co-investment into multifunctional marketplaces, such as LENs in the UK (Curtis et al., 2020a,b). To better manage the costs and resource needs, a number of different options and strategies are currently being explored in the UK that could enable effective integration between public and private funding for peatland restoration via the Peatland Code including the following options (detailed in Curtis et al., 2020a):

1. Funds delineation – using public investment to fund a discrete menu of 'value-added' components of a peatland scheme;

2. Carbon trigger funds – setting up government funding that only 'triggers' when a certain level of private sector carbon funding is achieved;

3. Establishing fund-matching / co-investment as a default principle; and

4. Using a transparent cost-benefit matrix to target public sector funds.

To make sure that project owners are not overburdened with oversight costs at the implementation stage as well as the during the life of the project, at least costs and fee levels must be predictive and fixed. In MM the ongoing costs of the offset providers are factored into the price of the certificate, but the planning and project management costs are not sufficiently covered by compensation funds. For PC, project developers internalise many of the operational costs into their fee, leaving the landowner with one fixed cost (low, frequent instalments) settled in a contract. Criteria for mixed financing still need to be developed for MF.

Another opportunity to facilitate funding is to provide peatland schemes with a **credit delivery guarantee** to increase funding from carbon buyers and in this way advance funding needs, especially related to the upfront investment needs. Furthermore, peatland schemes or governing institutions could **guarantee long-term fixed prices for peatland restorations,** similar to the German Renewable Energy Sources Act, which allows for investments. Lastly, governments could address the issues of high credit costs with the development of **dedicated funds to guarantee demand and provide market support** to projects. This could potentially advance funding from carbon buyers.

Furthermore, existing peatland schemes have not yet realised the **opportunity of paludiculture in combination with peatland restoration** - though the MF is currently discussing MF 3.0 and aiming to include paludiculture. Combing carbon offsetting with paludiculture can potentially lower costs per tonne of CO_2, bring down the price spread to create price compatibility with other sectors and make paludiculture practices more competitive and attractive (von Unger et al., 2019; Wichtmann et al., 2016). However, for paludiculture to be implemented and for it to provide cost-effective outputs and provide farmer incentives, there is a need for the current legal, regulatory and financial obstacles to be addressed.

Farmer engagement and recruiting could be challenging, and currently only limited information exists on farmer engagement in existing peatland schemes. Therefore, scheme designers should use **workshops and engage intermediaries, consultants and farmer networks** to facilitate farmer involvement while providing training and oversight needs. In addition, farmer support is determined by the availability of land resources for project implementation. Land availability represents a key factor in land use conversion and a **strict understanding of ownership rights in a local and regional context is necessary to protect land rights**. Collaboration between landowners through a communication platform could help to alleviate the issue of land scarcity.

Furthermore, **developing a peatland scheme is time-consuming.** For example, the PC included a two-year pilot phase to test the Code process in three pilot restoration projects in the UK, before being launched in 2015. **Peatland schemes can learn from and build on existing tools and schemes** in order to develop faster, as well as identify innovative opportunities and approaches. This knowledge transfer has already been seen in existing peatland scheme the PC and the Green Deal NL picked up part of the peatland methodological tools developed by MF. Existing and future peatland schemes should focus on enhancing cross-regions and boarder collaboration to mutualise knowledge and foster development of methodologies and cost-efficient approaches.

Ensuring demand for mitigation outcomes from peatland restoration and upscaling is further a key enabling condition. Currently the number of peatland schemes is small, and no compliance scheme accepts peatland carbon credits. Market conditions required for scaling up markets for peatland restoration includes for example and efficient and robust management systems, scale and timing of returns and long-term confidence and credibility of carbon credits for offset buyers (Curtis et al., 2020b; von Unger et al., 2019).

b. Transparency

Transparency facilitates reliable emission reductions and may be a substantial obstacle to evaluating the scheme's overall development. Transparency builds trust between stakeholders and potentially their willingness to engage. To support learning and promote transparency, a **peatland scheme should publish all methodologies, best practices and cooperate** with external stakeholders, such as farmers, as has been done for MF and PC so far. **Public credits registries**, managed by peatland scheme operators, can be an effective way to ensure recording of verified credits and any trade, as is done by MF, underway for PC and planned for GDNL. Both the PC and MF use regional or national credit registries. For the latter, credit prices and volume are visible, which supports the transparency of the projects and market information. However, credit buyers might prefer some information not to be published. Such registries should include non-commercially sensitive documentation, clarification of property rights, certification and results of the scheme without disclosure of private information, to avoid double counting and selling, as well as to generate trust and confidence in the market.

Generating demand for credits also comes directly from making the scheme known to local project developers. In MF and MM, there are specific strategies in place to make sure that landowners and farmers are aware of the initiative and the benefits that arise from it. MF has an undersupply of credits due to high demand, while there is evidence that promotion of the PC is not sufficient to make it profitable. It is vital to properly publicise the opportunities that come from such an initiative, which has been recorded as a barrier for upscaling by the PC team. It is therefore up to scheme and project developers to examine and decide on the most appropriate approach to ensure transparency in setting up their scheme and sharing information in a clear manner.

Conducting stakeholder consultation in the project development further enhances stakeholder and farmer acceptance and identifies potential socio-economic and environmental impacts early in the project process but can also add political complexity to otherwise scientific decisions (Rametsteiner et al., 2011). The degree to which peatland initiatives include stakeholder consultations in the project registration process varies. In the MF and PC, stakeholder consultation is required. For example, in PC, the specific project is required to identify and consult relevant stakeholders, or their representatives and project proposals are available to stakeholders for the consultations (IUCN, 2017). This **provides stakeholders and farmers with the opportunity to raise potential concerns, e.g. mistrust of**

regulators/administrators and lack of clarity on project outcomes. They also can propose alternative solutions. Therefore, communicating on co-benefits, expected costs and potential barriers could potentially enhance trust, participation and uptake of peatland restoration practices. This will further provide input for continuous development and improvement of peatland schemes.

c. Upscaling adoption

Upscaling refers to the opportunity to increase landowner uptake, the quality of and the opportunities for replicating the scheme. Policies and scheme developers have moved from thinking in terms of action with and for national authorities and national targets, and into how they can develop and build up actions with landowners, stakeholders and businesses. Upscaling of a peatland scheme is primarily related to investment needs and credit costs, validation and auditing and stakeholder engagements. Impediments should be considered and addressed to ensure opportunities to scale up peatland restoration and rewetting practices can be seized. Upscaling should be targeted to areas where it can deliver the highest impacts in the most efficient way – considering the impacts on the carbon cycle, climate and wider ecosystem benefits and the transactions costs. Existing peatland schemes demonstrate that diverse methods of upscaling are possible. Identified **upscaling success factors and strategies** being employed by the peatland initiatives and schemes include:

- **Economic incentives to ensure farmer interest and uptake**. Incentives should be upfront and further promoted as they are the first key for farmer engagement and management change. Ensure broader outreach and publicity of the peatland scheme, promoting successes stories and lessons learned in a clear and transparent manner.
- **Farmer involvement and interest**. Currently, there is limited information on the involvement of farmers in the existing peatland initiatives and schemes. A key element for peatland project success is collaboration with farmers to ensure their ability to increase water table height and alternative management options such as paludiculture. Therefore, there is a need to provide training and farmer consultations to ensure salience and practicality for farmers in order to build up interest, uptake and wider adoption.
- **Broader implementation of non-carbon co-benefits related to peatland restoration and rewetting**. Stakeholders care about the non-carbon benefits of peatland restoration and rewetting, broader impacts should be identified and highlighted using indicators to quantify different ecosystem services tailored to peatland restoration and rewetting. Learning and building on the co-benefit indicators identified and included in MF (improved water quality, flood prevention, groundwater enrichment, evaporative cooling and increased mire typical biodiversity) could increase the interest and scale-up the adoption of broader peatland schemes. Such indicators further provide options for replication by adjusting and tailoring them to specific contexts, sites and landscapes.
- **Scientific research and data collection**. MRV and peatland auditing remain one of the largest obstacles to uptake. Existing schemes have built on prevailing tools or research projects and involved scientists in development, governance and design, to ensure data robustness and credibility. Some developers requested the development of a method to apply on agricultural organic soils, which would require a transformative shift in management practices.
- **Interaction and integration of peatland schemes and projects with other initiatives and funding activities.** For example, the PC is currently promoting

opportunities for integrating carbon markets (PC and the Woodland Carbon Code) into multifunctional landscape marketplaces and public funding via landscape scale initiatives such as the LENs projects. Such integration is expected to deliver increasing investment into sustainable landscape management, co-investment opportunities from other demand sources and provide credit buyers for the PC. This could drive multifunctionality by promoting co-benefits and potentially increase the scale of investment and financial viability. However, integrating different schemes involves both technical, primarily related to additionality, and organisational challenges revolved around aligning stakeholders' interests and managing complexity (Curtis et al., 2020a).

- **Learning-by-doing through flexible and dynamic peatland schemes**. Existing peatland initiatives and schemes are dynamic and flexible, and develop over time, responding to opportunities and challenges as they arise. For example, MF developers are currently exploring options for the productive use of wet peatlands, and the PC in optimising public-private funding of peatland restoration and other ecosystem functions to ensure an effective and increased uptake.
- **Knowledge exchange on experiences and lessons learned on uptake, upscaling and replication**. Opportunities to exchange knowledge between peatland-rich regions in Europe (and globally) will develop tailored solutions and stakeholder acceptance.

Box 5: Role of the (future) CAP and connectivity to the delivery of peatland carbon farming

In order to ensure coherence between the CAP, climate policies and a peatland scheme, the CAP should safeguard and stimulate the preservation, protection and restoration of carbon-rich soils and peatlands. Overall, a **peatland scheme must be designed in alignment with CAP to ensure environmental integrity and lower costs** for development, participation and implementation. More specifically, the following actions and opportunities have been identified with the aim to ensure CAP and peatland complementarity, support and upscaling adoption:

- **Phasing out CAP payments** (e.g. direct payments, voluntary coupled support for arable and livestock systems) **for drained peatland to ensure coherence between agriculture, peatland and climate policies.** Several drainage-based agricultural practices and systems, such as dairy farming on peatlands, which result in CO_2 and N_2O emissions and other environmental losses, are eligible for CAP direct payments. A paradigm shift is needed to adjust conventional agricultural land use and policies towards adjusted practices and peatland management.

- **Guarantee eligibility of farming systems and practices on wet peatland, e.g. paludiculture, for CAP Pillar I direct payments and Pillar II payments.** This could be the basis for further support, for example through the proposed CAP eco-schemes, clearly defined minimum GAEC standards for wetland and peatland soils and though the AECMs and other Pillar 2 instruments, which are designed to create incentive-based voluntary schemes for farmers and/or other land managers. However, implementation of paludiculture requires policies and financial incentives that ensure it is competitive and advantageous for farmers and landowners. Paludiculture is not yet cost-effective and viable on its own.

- **Establishment of result-based agricultural payment schemes promoting climate mitigation benefits and provision of ecosystem service, as well as socio-economic benefits** by setting attractive incentives for carbon, as well as non-carbon benefits, such as those identified in the MF. The current CAP provides limited incentives for adaptation by landowners and farmers as peatland schemes can only pay for capital costs and income forgone.

- **MRV requirements could be linked with CAP** and criteria for additionality and avoidance of double counting and funding.

Sources: own compilation based on Greifswald Mire Centre et al. (2019); Peters & von Unger (2017); Wichtmann et al. (2016); von Unger et al. (2019).

d. Scheme evaluation

Regular evaluation, monitoring, reviewing and adaptation of the scheme to assess progress towards objectives and improvement of the peatland scheme. The existing peatland schemes included in this case study are periodically updated, based on evaluations and reviews. However, evaluation approaches differ between the schemes regarding evaluation structure, regularity and transparency. For example, the PC pilot phase final report (2015)27 provides a detailed description of the pilot phase evaluation outcomes which were considered in the first Peatland Code (version 1.0). Further, an updated version of the PC (version 2.0) is currently being developed which responds to several issues raised in recent years and feedback from accrediting entities. Furthermore, IUCN is in a longer-term planning process of framing PC as a gold standard, as well as developing a more flexible silver standard that integrates peatland restoration into the LENs approach which could provide synergistic benefits including financial and stakeholder opportunities28. No formal evaluation procedure is in place for the MF, but informally w the outcomes of the monitoring feed back into the MF scheme. For example, the third MF site, Königsmoor, is to be monitored this year and relevant insights from this monitoring process will be discussed and evaluated in the project steering group and scientific advisory board to help improving the MF scheme.

Evaluation of a peatland scheme could focus on the **impacts, effectiveness, practical feasibility, efficiency, equity and sustainability** of the scheme, or be adapted to other carbon farming schemes (see Figure 8). The criteria are identified based on the experiences with the existing peatland schemes included in this case study (as well as broad-term carbon farming evaluation), combined with the DAC evaluation criteria. The identified evaluation criteria and associated evaluation activities could be used on the overall peatland scheme and more specifically on the relevant design elements. This could include the evaluation of the effectiveness and practical feasibility of the MRV and additionality approaches for different peatland schemes, or the specific impacts, sustainability and equity of a shift to paludiculture management.

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[27] http://www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/Peatland%20Code%20Pilot%20Phase%20Evaluation%20Report%20%28final%29.pdf

[28]

Figure 8. Illustration of identified evaluation criteria and examples of associated evaluation activities for a peatland scheme.

Source: own elaboration.

The evaluation could draw on aggregated scheme data as well as interviews with stakeholders, and potentially with a European peatland experts' panel. A panel could consist of peatland experts, landowners and stakeholders, as well as peatland scheme owners that could exchange their experiences and reflect on local and wider-scale implementation. The evaluation could be completed annually to ensure up-to-date and new data, lessons learned and best practices from research and practical applications elsewhere. The feedback and evaluation outcomes should be used to **review and update** the peatland scheme to develop and improve the overall scheme and the specific design components.

6. References

Barthelmes, A. (ed.) (2018) Reporting greenhouse gas emissions from organic soils in the European Union: challenges and opportunities. Policy brief. Proceedings of the Greifswald Mire Centre 02/2018 (self-published, ISSN xy), 16 p. Available at: https://www.greifswaldmoor.de/files/dokumente/GMC%20Schriften/18-02_Barthelmes_GMC.pdf

BfN (2020). Policy Breif: Peatland Strategies in Europe. Why and how to develop national strategies for peatland. Available at: https://www.bfn.de/fileadmin/BfN/internationalernaturschutz/Dokumente/Peatland_Workshop_2019/Policy_brief_peatland_strategies_bf.pdf

Bielak, A., Cambell, A., Pope, S. and Schaefer, K. (200(). From Science Communication to Knowledge Brokering: the Shift from "Science Push" to "Policy Pull". Research gate. January 2008. DPO: 10.1007/978-1-4020-8598-7_12.

Bodin, Ö. & Crona, B. (2009). The role of social networks in natural resource governance: What relational patterns make a difference? Available: https://www.stockholmresilience.org/download/18.5ce3bd8012d79a5929580003005/Bodin+and+Crona+2009_Social+networks+in+NRM+review.pdf

Bonn, A., Reed, M., Evans, C.D., Joosten, H., Bain, C., Farmer, J., Emmer, I., Couwenberg, J., Moxey, A., Artz, R., Tanneberger, F., von Unger, M., Smyth, M. and Birnie, D. (2014). Investing in nature: Developing ecosystems service markets for peatland restoration. Ecosteym Services 9 (2014) 54-65. ScieneDirect. http://dx.doi.org/10.1016/j.ecoser.2014.06.11 2212-0416/ 2014 Published by Elservier Ldt.

Cevallos, G., Grimault, J. & Bellassen, V. (2019). Domestic carbon standards in Europe: Overview and perspectives. Institute for Climate Economics.

Chenost, C., Gardette, Y. M., Demenois, J., Grondard, N., Perrier, M., & Wemaëre, M. (2010). Bringing forest carbon projects to the market.

Committee on Climate Change (2020). Land use: Policies for a New Zero UK.

Couwenberg J, Thiele A, Tanneberger F, Augustin J, Bärisch S, Dubovik D, Liashchynskaya N, Michaelis D, Minke M, Skuratovich A, Joosten H (2011): Assessing greenhouse gas emissions from peatlands using vegetation as a proxy. Hydrobiologia 674: 67-89.

Curtis et al., (2020a). Integrating Natural Capital Schemes: Opportunity analysis for integrating carbon markets into multifunctional landscape marketplaces, such as those developed by the Landscape Enterprise Networks (LENs) approach.

Curtis et al., (2020b). Funding Peatland Restoration: Options analysis for optimising public-private funding of peatland restoration, for carbon and other ecosystem functions.

DEHSt (2018). Peatland climate protection: Umwelt Bundesamt, German Environment Agency. Available at: https://www.dehst.de/EN/carrying-out-climate-projects/peatlands/peatlands-node.html (accessed April 2020).

DEHst (2018b). Future of the Voluntary Carbon Markets in the Light of the Paris Agreement. Perspectives for Soil Carbon Projects. Available at: https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/moorstandards_studie.pdf?__blob=publicationFile&v=2

FAO (2020). Peatlands mapping and monitoring – Recommendations and technical overview. Rome. http://doi.org/10.4060/ca8200en

FAO (2017). Unlocking the potential of soil organic carbon: Outcome document. Available at: http://www.fao.org/3/b-i7268e.pdf

FAO and Wetlands International (2012). *Peatlands – guidance for climate change mitigation through conservation, rehabilitation and sustainable use.* Second edition. Joosten, H., Tapio-Biström, M., and Tol, S. (eds.). Available at: http://www.fao.org/3/a-an762e.pdf

Greifswald Mire Centre et al., (2019). Peatlands in the EU – Common Agriculture Policy (CAP) after 2020. Position Paper – (Version 4.8). National University of Ireland, Galway, and Wetlands International European Association. Available at: https://www.greifswaldmoor.de/files/dokumente/Infopapiere_Briefings/202003_CAP%20Policy%20Brief%20Peatlands%20in%20the%20new%20EU%20Version%204.8.pdf

[IPCC] Intergovernmental Panel on Climate Change (2014). *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands.* https://www.ipcc-nggip.iges.or.jp/public/wetlands/

IPCC. (2019). *The Special Report on Climate Change and Land.* Available at: https://www.ipcc.ch/srccl/

IUCN. (2015) Annual Report. Available at: https://portals.iucn.org/library/sites/library/files/documents/2016-020.pdf

IUCN (2017): Peatland Code. Available at: https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2019-07/PeatlandCode_v1.1_FINAL.pdf

Joosten H, Sirin A, Couwenberg J, Laine J, Smith P (2016) The role of peatlands in climate regulation. In: Bonn A, Allott T, Evans M, Joosten H, Stoneman R (eds) Peatland restoration and ecosystem services - science, policy and practice. Cambridge University Press, Cambridge, pp 63–76

Joosten, H., Brust, K., Couwenberg, J., Gerner, A., Holsten, B., Permien, T., Schäfer, A., Tanneberger, F., Trepel, M., and Wahren, A. (2015). MoorFutures: Integration of additional ecosystem services (including biodiversity) into carbon credits – standard, methodology and transferability to other regions. BfN-Skripten 207. Federal Agency for Nature Conservation: Available as: https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript407.pdf

Joosten H, Tanneberger F & Moen A (eds) (2017) Mires and peatlands of Europe: Status, distribution and conservation. Schweizerbart Science Publishers, Stuttgart, 730 p. "A Europe-wide overview on peatland terminologies". https://www.schweizerbart.de/publications/detail/isbn/9783510653836/Joosten_Tanneberger_Moen_Mires_and_peat

Joosten, H., Tapio-Biström, M. L., & Tol, S. (2012). *Peatlands: guidance for climate change mitigation through conservation, rehabilitation and sustainable use*. Food and Agriculture Organization of the United Nations.

Joosten, H. (n.d). Presentation. Greifswald Mire Centre. Available at: https://www.dehst.de/SharedDocs/downloads/EN/events/Peatlands_Joosten.pdf?__blob=publicationFile&v=1

Kløve, B., Berglund, K., Berglund, O.m Weldon, S., and Maljanen, M. (2017). Future options for cultivated Nordic peat soils: Can land management and rewetting control greenhouse gas emissions? Environmental Science and Policy 69 (2017) 85-93. http://dx.doi.org/10.1016/j.envsci..2016.12.07 1462-9011/ 2016 Published by Elservier Ldt.

Nordic Council of Ministries (2015). Peatlands and Climate in a Ramsar context. A Nordic-Baltic Perspective. Barthelmes, A., Couwenberg, J., Risager, M., Tegetmeyer, C., and Joosten, H., http://dx.doi.org/10.6026/ TeamNord 2015:544. ISSN 0908-6692. Available at: http://norden.diva-portal.org/smash/get/diva2:814147/FULLTEXT02.pdf

Peskett, L. (2010). *Benefit sharing in REDD+: exploring the implications for poor and vulnerable people* (No. 65843, pp. 1-48). The World Bank.

Peters, H., and von Unger, M. (2017). Peatlands in the EU Regulatory Environment. Survey with case studies on Poland and Estonia. Federal Agency for Nature Conservation. Available at: https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript454.pdf

Rametsteiner, E., Pülzl, H., Alkan-Olsson, J., & Frederiksen, P. (2011). Sustainability indicator development—Science or political negotiation?. *Ecological Indicators*, *11*(1), 61-70.

Reed, M. S., Allen, K., Attlee, A., Dougill, A. J., Evans, K. L., Kenter, J. O., ... & Scott, A. S. (2017). A place-based approach to payments for ecosystem services. *Global Environmental Change*, *43*, 92-106.

Tanneberger, F., Moen, A., Joosten, H., & Nilsen, N. (2017). The peatland map of Europe. Available at; https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2476533

Tanneberger, F., and Wichtmann, W., (eds.) (2011). Carbon credits from peatland rewetting: Climate – biodiversity – land use. Science, policy, implementation and recommendations of a pilot project in Belarus. Schweizerbart Science Publishers. https://www.schweizerbart.de/publications/detail/isbn/9783510652716/Carbon_credits_from_peatland_rewettingbrClimate_biodiversity_land_use

Tiemeyer, B., Freibauer, A., Borraz, E. A., Augustin, J., Bechtold, M., Beetz, S., ... & Förster, C. (2020). A new methodology for organic soils in national greenhouse gas inventories: Data synthesis, derivation and application. *Ecological Indicators*, *109*, 105838.

Umweltbundesamt and DEHSt (2017). Peatland Climate Protection. Available at: https://www.dehst.de/EN/carrying-out-climate-projects/peatlands/peatlands-node.html

Von Unger, M., Emmer, I., Joosten, H., and Couwenberg, J., (2019). Design an International Peatland Carbon Standard: Criteria, Best Practices and Opportunities (Final Report). On behalf of the German Environmental Agency. Climate Change 42/2019. Available at: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-11-28_cc-42-2019_sca_peatland_standards_0.pdf

[WSL] Swiss Federal Institute for Forest, Snow and Landscape research (2017). “Climate protection through raised-bog conservation now a reality with max.moor”. Available at: https://www.wsl.ch/en/news/2017/11/climate-protection-through-raised-bog-conservation-now-a-reality-with-maxmoor.html#tabelement1-tab1

Wichtmann, W., Schröder. C. and Joosten, H. (2016). Paludiculture – productive use of wet peatlands. Climate protection, biodiversity, regional economic benefits. Shcweizerbart Science Publishers.

7. Summary of peatland schemes/initiatives included in this case study

- **MoorFutures**

The MoorFutures (MF) is a science-based scheme and was founded in 2011 following the success of the Forest Shares project (https://waldaktie.innoforest.eu/) in the mecklenburg-vorpommern (Mecklenborg-Vorpommeren) region in Germany. After its start in 2007, the Forest Shares project sold 50,000 shares by 2013. The Ministry of Agriculture, Environment and Consumer Protection of Mecklenborg-Vorpommeren then adapted the standard into MoorFutures for medium-sized peatland rewetting projects. MF is a regional standard and has been adopted in Mecklenborg-VorpommerenP, Brandenburg (2012) as well as Schleswig-Holstein (2014) (Joosten, 2015). MF is a voluntary carbon crediting scheme and is not connected to the mandatory market, but offsets can be purchased by private companies seeking to improve their environmental standards. The quality of the credits is a central aspect of the scheme, e.g. the Mecklenborg-VorpommerenP credits are guaranteed by the land agency of Mecklenborg-VorpommerenP as well as the Ministry of Mecklenborg-VorpommerenP and the Ernst-Moritz-Arndt University of Greifswald. Similar guarantees are in place for the other two regions. The standard uses the Greenhouse Gas Emission Sites Types (GEST) approach to quantify GHG emissions in the regions, which uses ground vegetation and water table depth as proxies. In general, the principles of carbon crediting in MF have been adapted based on experiences under the Verified Carbon Standard (now Verra). The MF maintains its own registry and does not allow trade in credits. The scheme is the first of its kind and has been lauded by international actors for its emphasis on ecosystem services such as increasing biodiversity, flood protection, groundwater retention, nutrient retention, etc. See more: https://www.moorfutures.de/

- **Peatland Code**

The Peatland Code (PC) is a voluntary standard within the United Kingdom, which is established by the IUCN UK National Committee and managed by an Executive Board with support from a Technical Advisory Board. The programme began in 2009 as a partnership between scientists, public bodies, land managers and environmental NGOs with the aim to restore and sustainably manage two million hectares of UK peatlands by 2040. It follows the same criteria as the previously executed Woodland Carbon Code (https://www.forestcarbon.co.uk/certification/woodland-carbon-code). In 2018 the first project was validated and remains the only validated project of the programme thus far (Interview input, 2020). Validation and verification of projects is done through accredited independent entities that are appointed by the Executive Board. Eligible project areas must be classified under the condition of drained or actively eroding peatland with a minimum depth of 50 cm. The Peatland Code Field Protocol identifies baseline categories for eligibility and projects that do not fit these four criteria will not be able to claim emission reductions. The registry of projects is done through the Peatland Code Registry and requires a per unit administration fee that is paid during the first year of verification (IUCN, 2017). See more: https://www.iucn-uk-peatlandprogramme.org/funding-finance/peatland-code

- **Max.moor**

The Swiss standard max.moor is concentrated on degraded peatlands located on areas that are no longer under agricultural use. The standard has been active since 2017 and was established by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). The standard is an addition to the Rothenthurm Initiative (people's initiative of the protection of moors) from 1987, which established raised bog protection through regional protection measures. The raised bogs of Switzerland are estimated to emit 19,000 tCO_2 a year and are the focus of the standard as only 10% of these bogs have stayed in their natural condition over the past century (von Unger, 2019). Max.moor is a public-private partnership with public co-funding of up to 90% for project implementation. On average, the federal government finances 40-60% of the restoration projects, while the rest is the responsibility of the municipalities or cantons. Domestic compensation for bog restoration is conducted through two main providers, The South Pole Group and myclimate. The offsets are guaranteed to be permanent as well as promote biodiversity and flood protection and are sold through these two companies on behalf of max.moor (WSL, 2017). See more: https://www.wsl.ch/de/projekte/klimaschutz-durch-hochmoorschutz-1.html

- **The Dutch Green Deal**

The Dutch Green Deal (GDNL) has been in development since 2017 with a planned pilot period of 3 years under the Green Deal National Carbon Market (GD) for voluntary compensation. The scheme was initiated by the Dutch Government with input and involvement from 17 private stakeholders (Cevallos, 2019). The GDNL uses the *Euro's for peat* method after the Gold Standard methodology, but currently there are no carbon credits sold; the first credits will potentially be sold in the upcoming in summer 2020. Validation and verification are done with independent verifiers and the cost of verification is the responsibility of the project owner. There are three eligible activities for consideration in the programme including raising water level to 20 cm under extensive agricultural land, implementing paludicultures with cranberries or rewetting of nature to soil surface or above (Interview input, 2020). These activities consider the barriers to uptake by farmers by allowing them to continue to use their agricultural land. The future of the programme depends on acceptability within the Netherlands government and policy priorities. See more: https://www.greendeals.nl/english

- **Wetland restoration RDP measure in Denmark (DKW)**

The pilot project developed in Denmark, translates to *'multifunctional land distribution'* and is a method for the transitioning of agricultural land to wetland, forest etc., and can be applied in a peatland context. The Ministry of Food and Environment launched a drought package from which roughly €20 million (DKK 150 million) was allocated to multifunctional land distribution. The project includes the payment by the Danish Agricultural Agency to land distribution (or conversion) process. The Ministry estimates that 6-7,000 ha of land will be reconfigured under the scheme. The scheme works in such a way that local associations, landowners and municipalities will collaborate on land use in the region such that landowners will be rewarded if they convert agricultural land or leave natural areas untouched. Project proponents that fulfil environmental national interests (from directives that include clean drinking water, climate adaptation afforestation, etc.) will be rewarded with functioning agricultural land. The costs are entirely taken by the Danish Agricultural Agency and land distribution takes roughly 1-3 years. The pilot project can easily include rewetting of peatlands. See more: https://lbst.dk/landbrug/arealer-og-ejendomme/jordfordeling/pilotprojekt-multifunktionel-jordfordeling/

8. Interviews and reviews

Interviews with key actors involved in exiting peatland schemes were conducted to explore motivation, approaches, opportunities as well as how they overcome challenges in setting up and running a result-based peatland scheme. The list of interviewees is found in Table 10 * denotes interviewees as well as reviewers of the draft case study.

Table 10. Interviews and reviews carried out for this study

Name		**Organisation / position**	**Date Interview conducted**
Moritz von Unger		Silvestrum Climate Associates / Policy Director	31 March 2020
Thorsten Permien*		Ministry of Agriculture and the Environment, Mecklenburg-Vorpommer / head of unit ("Referatsleiter") for Ecosystem Services and Education for Sustainable Development	16 April 2020
Henrik Manthey		MoorFutures (Mecklenburg-Vorpommern)	16 April 2020
Mark Reed*		Newcastle University / professor and IUCN UK Peatland Programme / Steering Group	20 April 2020
Adam Lentz		LBST / Chief Advisor	23 April 2020
Jarosław Krogulec		The Polish Society for the Protection of Birds (OTOP)	27 April 2020
Lena Gubler*		Max.Moor (Switzerland) / Scientific collaboration and max.moor Project Leader	29 April 2020
Pawel Pawlaczyk		Klub Przyrodnikow (NGO) / project leader	6 May 2020
Jos Cozijnsen		Climate Neutral Group (Green Deal NL) / Carbon Specialist	7 May 2020
George Hepburne Scott		Forest Carbon Limited	11 May 2020
Stephen Prior*		Forest Carbon Limited (related to the Woodland Carbon Code) / Director	11 May 2020

Name		**Organisation / position**	**Date Interview conducted**
Arnoud de Vries*		Milieufederatie / Project leader	12 May 2020
Bärbel Tiemeyer		Thünen-Institute / Research-group leader	18 May 2020

9. Peatland workshop 23 March 2020 (via WebEx)

A three-hours workshop was arranged to clarify and discuss decisions, constraints, critical elements, options and enablers for setting up a carbon farming scheme on peatlands in the EU. The workshop centred around the MoorFutures and primarily include scientist involved in the peatland of the MoorFutures scheme. * denotes interviewees as well as reviewer of the draft case study.

Table 11 Participants in the workshop on peatlands

Name	Organisation
Simon Kay	European Commission, DG CLIMA
Franziska Tanneberger*	University of Greifswald
Hans Joosten*	University of Greifswald
Asger Strange Olesen	COWI
Sarah Pyndt Andersen	COWI
Hugh McDonald	Ecologic Institute
Anke Nordt	University of Greifswald
Felix Reichelt	University of Greifswald
John Couwenberg	University of Greifswald

Annex II

AGROFORESTRY

A CARBON FARMING CASE STUDY

Table of Contents

Lead Authors: Catherine Bowyer and Clunie Keenleyside, IEEP

Summary and recommendations

Context**:** Agroforestry is the practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or animal production systems on the same plot of land. Traditional agroforestry systems are highly variable and adapted to local soils, climate conditions and farming systems; examples include large areas of *dehesa* and *montado* on drylands Spain and Portugal, permanent crop and pastoral systems in south-eastern Europe and the wood pastures and *bocage* (hedgerow) landscapes of the northern Member States. More recently, new agroforestry systems have been established on both arable and grassland farms, but it is clear that the potential of agroforestry is not being exploited and existing long-established systems are under threat.

Compared to conventional production systems, agroforestry contributes significantly to carbon sequestration, increases a range of regulating ecosystem services, and enhances biodiversity. Recent research estimates that introducing agroforestry on arable and grassland where there are already multiple environmental pressures could lead to sequestration of 2.1 to 63.9 million t C per year (7.78 and 234.85 million t CO_{2eq} per year). The type of agroforestry adopted will affect both the sequestration potential and the contribution of agroforestry to mitigating other environmental pressures (Kay et al., 2019). Agroforestry can take more time to deliver GHG benefits than other interventions (IPCC, 2019), and the permanence of the carbon sequestered depends on the type of trees and their end use. Agroforestry systems are also at risk of re-emission associated with poor management and natural events.

Case study's aim and scope: Result-based payment schemes for maintaining existing agroforestry systems and for the establishment of new agroforestry are in their infancy. This case study focuses on the potential for the sequestration of carbon in biomass (above and below ground) and in soil associated with the adoption of agroforestry on agricultural land. In GHG sequestration terms, agroforestry represents a micro site, land conversion associated with the introduction additional biomass per unit of land.

Recommended agroforestry scheme - Summary

Objective: Incentivise management of existing agroforestry systems and creation of new agroforestry systems on agricultural land.

Scale/coverage: Existing long-established agroforestry systems under threat; locations within existing arable, grassland, horticultural and permanent crops systems across the EU, where soils and climatic conditions are appropriate for the introduction of new, locally adapted agroforestry systems.

Climate Actions: Any actions that maintain/enhance or introduce woody components integrated with agricultural production, for the long-term enhancement of C stocks and sequestration potential in biomass and soils, without increasing emissions in the short-term.

Monitoring, reporting and valuation (MRV): Only indirect methods are feasible for infield attribution of C savings linked to above ground biomass, and actual values will depend on the agroforestry system, the end of life use of the timber and local definitions of the baseline for assessment. SOC methodologies are not yet considered fully tested or validated for result-based schemes for agroforestry.

Typical project steps include:

- **Step 1a**: for existing agroforestry systems: using transect or field audit on-site by specialist advisers, establish baseline assessment of above ground biomass, health of the woody biomass component and its quality in terms of co-objectives (e.g. biodiversity, water). Identify management actions required to meet climate and other environmental objectives, whilst maintaining the associated agricultural production system

- **Step 1b**: for new agroforestry systems: using field audit on-site by specialist advisers, identify the most appropriate location and type of agroforestry system to meet climate (and other environmental) objectives and to fit with the existing agricultural production system. Identify establishment and management actions required to create an agroforestry system that meets long-term climate and other environmental objectives, and identify sources of funding. Adviser prepares an establishment and management plan for the woody component, and assists with funding applications.

- **Step 2**: Farmer implements the establishment and management plan, with advisory support, and keep records. Farmer commits to maintaining the system until trees reach maturity.

- **Step 3**: Advisors visit farms at selected intervals to assess establishment quality, health and retention of the woody species, compliance with rules on species choice and the added value in terms of other parameters being evaluated and discuss potential adjustments. Intermediate measurement can be taken.

- **Step 4**: All systems will require a long-term review cycle, commonly every 5 years, to assess ongoing health and compliance; this should also be linked to advice and knowledge transfer

Rewards: in the case study examples there were two approaches: supply chain reward where farmers are provided with advice and other resources to establish an agroforestry system for tree fruit, while the supermarket providing this support uses the credit to offset their emissions associated with the operation; and carbon credits available to the farmer, used by the purchaser to offset emissions (and retired), or for trading specifically in a local market. An experimental approach using result-indicators for other parameters (e.g. biodiversity) in a *montado* system is still at the development stage.

Design principles: 1) *reduce MRV costs* by focussing on monitoring the quality, robustness and longevity of the tree component (2) *provide financial support for initial establishment and maintenance costs* and make this *conditional upon the use of on-site specialist advice for the first 5 years*, to maximise farmer uptake of the most appropriate agroforestry systems for the locality; (3) *learning-by-doing* through peer-group support and refinement of MRV as improved or more cost efficient methods become available.

Recommendations related to scheme design

Overcoming farmer resistance adopting new agroforestry: with the exception of a few Member States (notably France), there has been very limited interest among farmers with little or no experience of agroforestry. Introducing a new component to their business, which requires significant up-front investment and unfamiliar specialist skills, plus adjusting to a tree crop with a rotation cycle so much longer than conventional arable or grassland systems, can be a daunting prospect. Uptake of CAP support for establishment and maintenance of agroforestry systems has been very low.

Improving policy awareness of the significance of existing, traditional agroforestry systems and the multiple environmental benefits these provide: these systems are often part of extensive, low input livestock systems on marginal land of inherently low productivity and they are not taken fully into account in many Member States' rural land use policies or definitions of land eligible for CAP direct payments.

Improving institutional co-operation on policy and capacity to support the development of agroforestry: agroforestry may be seen as the responsibility of a different institution than the one in charge of agricultural policy, especially when agriculture and forestry responsibilities are separated at government level.

Learning from existing projects: scheme designers should draw on experience from ongoing initiatives and projects, in particular the Woodland Carbon Code and recent projects testing the use of result-based payments for biodiversity.

Eligibility: all farming systems, other than those on peatland, have potential for the introduction of locally appropriate agroforestry systems. Member States should ensure that their definitions of CAP direct payment eligibility rules include land occupied by long-established pastoral agroforestry systems, new agroforestry systems and woody landscape features.

Farmer engagement and advisory support: key elements are actively engaging farmers in the scheme design process and providing authoritative advice from sources trusted by the farmer. It is important that this advice takes an integrated approach to the agronomic, economic and environmental objectives and actions. From outset, training and advisory opportunities should be provided that facilitate farmer learning and capacity building, including peer-to-peer learning.

Additionality: Schemes need to aim for environmental additionality (enhanced carbon sequestration over the long-term that would not have occurred in the absence of the scheme), regulatory additionality in that project activities go beyond the legal baseline (e.g. retention of existing trees and other woody features) and financial additionality (meaning that without the scheme rewards, including those for the provision of environmental public goods, the costs of the action would outweigh the benefits).

Result indicators: Currently, most projects focus on the changes in the quality and quantity of the woody element as indicators. Although SOC measurements in agroforestry systems are not suitable as monitoring tools or the basis for payment, opportunities should be taken for co-operation with researchers to evaluate such parameters over the long-term (typically 10-15 years, or until full establishment of the woody element). Monitoring additional benefits (e.g. climate adaptation benefits of shade and shelter for crops and livestock, diversification of income) can be used to facilitate farmer recruitment.

Reward: Depending on the robustness of MRV and the purpose for which the results are used, scheme designers should consider several options. These can also be seen as stepping-stones through which the scheme can move as additional result-based and MRV experience accrues: 1) Hybrid scheme: Farmers receive up-front investment support and a guaranteed activity-based payment, with a top-up based on monitoring results; 2) result-based schemes/certified credits: farmers are paid solely for the measured or modelled result in changes in woody biomass and/or indicators of other objectives such as biodiversity habitat quality.

Governance: to develop verified, fungible offset credits or verified emissions reduction certificates, a scheme based on adapting exiting verification standards might be developed e.g. by adapting the Woodland Carbon Code.

Overall Conclusion: existing extensively-managed agroforestry systems are under threat and their agricultural intensification risks increasing GHG emissions, therefore ongoing supportive management is a priority. Introducing new agroforestry within conventional farming systems offers potential for additional climate benefits (for both mitigation and adaptation) and also for a range of other ecosystem and biodiversity services. However, achieving these cost-effectively requires careful selection of locally appropriate systems, and rewarding provision of other environmental public goods, not just GHG emission reduction. Significant advisory, technical and upfront investment support will be required to overcome farmer resistance in many parts of the EU. Result-based schemes have yet to be developed and tested for agroforestry, and must take account of the timescale of the time taken to realise the full benefits of the woody element.

1. Introduction

Agroforestry is a land use choice that integrates trees and other woody plants with agricultural production on the same plot, and diversifies the range of products from the farm business. It can also contribute to delivering a number of environmental goals, if tailored to the farming system, soils and bioclimatic conditions in a way that addresses local priorities for ecosystem service provision and biodiversity needs.

This case study explores the factors to be taken into account in designing and implementing result-based carbon farming schemes focused on the creation, maintenance and enhancement of the above ground woody elements of agroforestry systems associated with arable land, pastoral systems, permanent crops and horticulture. It covers both long-established agroforestry systems as well as the introduction of new agroforestry, and also the climate benefits of woody landscape features on farms, such as hedgerows. The case study is focused on carbon sequestration potential of the above ground woody biomass elements of agroforestry systems; for the below ground component of these systems, see case studies Maintaining and Enhancing Soil Organic Carbon on Mineral Soils (Annex III), Livestock Farm Carbon Audit (Annex IV) and Managing Soil Organic Carbon on Grasslands (Annex V).

There are opportunities for climate mitigation and adaptation benefits from introducing agricultural land uses into existing forests (e.g. forest fire reduction linked to forest grazing) but these are not the focus of this case study.

There are few examples of result-based payment schemes for agroforestry and those examined for this case study are all at an early stage of development or piloting and designed for local or regional implementation. The most relevant examples are Montado in Portugal, being developed by the University of Evora in coordination with farmers in the region and building on an earlier H2020 project; the CarboCage 3-year pilot hedgerow scheme funded by the publicly-funded Ecological Transition Agency in the Pays de la Loire region of north-west France, which originates from an RDP initiative to valorise hedgerows; an initiative by the Coop retailer in Switzerland to support farmers within its supply chain to plant trees on their land to deliver GHG emission reductions. The case study also draws upon the work of AGFORWARD the EU FP7 study of agroforestry and rural development, and the Woodland Carbon Code, established in the UK since 2011. The case study was informed by interviews with other stakeholders, discussions at the two Carbon Farming Roundtables, and both grey and academic literature.

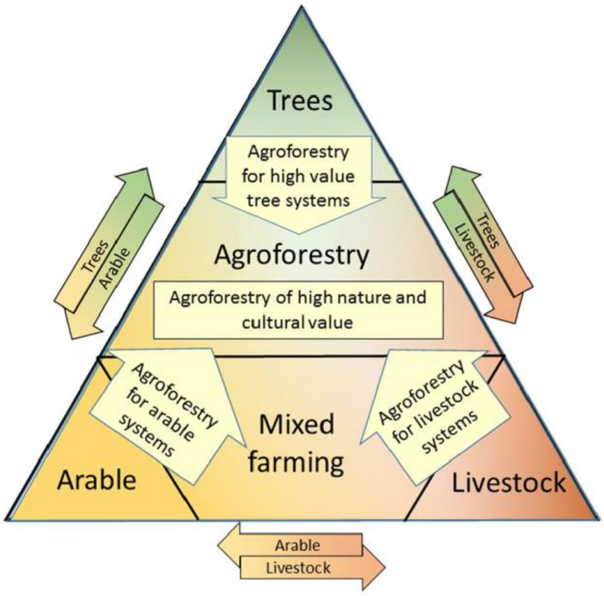
a. Defining agroforestry

Agroforestry systems in the EU fall into two broad groups:

- livestock agroforestry systems, integrating trees and the grazing of animals in a mutually beneficial way, where plant diversity is greater than conventional grassland.
- arable agroforestry systems, integrating the cultivation of woody perennials with arable or horticultural crops at field scale.

A third category of agroforestry with high value trees overlaps with both groups. Within each of these broad categorisations there are very many variants, with different proportions and types of agricultural land and woody elements (Figure 1).

Figure 1 Agroforestry systems



Source: Burgess et al. (2018))

2. Exploring options – choosing the approach

a. Putting the case study in context

Estimating the extent of European agroforestry is challenging but essential if governments are to identify priorities for policy and to evaluate the impact of interventions on the extent of agroforestry. Using the LUCAS database and tree cover density data, AGFORWARD estimated that EU-27[1] agroforestry covers about 15.4 million hectares in - equivalent to 8.8% of the Utilised Agricultural Area or 3.6% of the territorial area (Figures 2 and 3). Almost all of this is livestock agroforestry which extends to over 15.1 million hectares, mainly in the Mediterranean and south east Europe, but examples occur across the whole of Europe. In contrast, arable agroforestry is estimated to cover less than 0.36 million hectares, again with the largest areas found in the Mediterranean. Agroforestry with high value trees accounts for around 1.1 million hectares and is found in mainly in southern, eastern and central Europe (den Herder et al., 2017).

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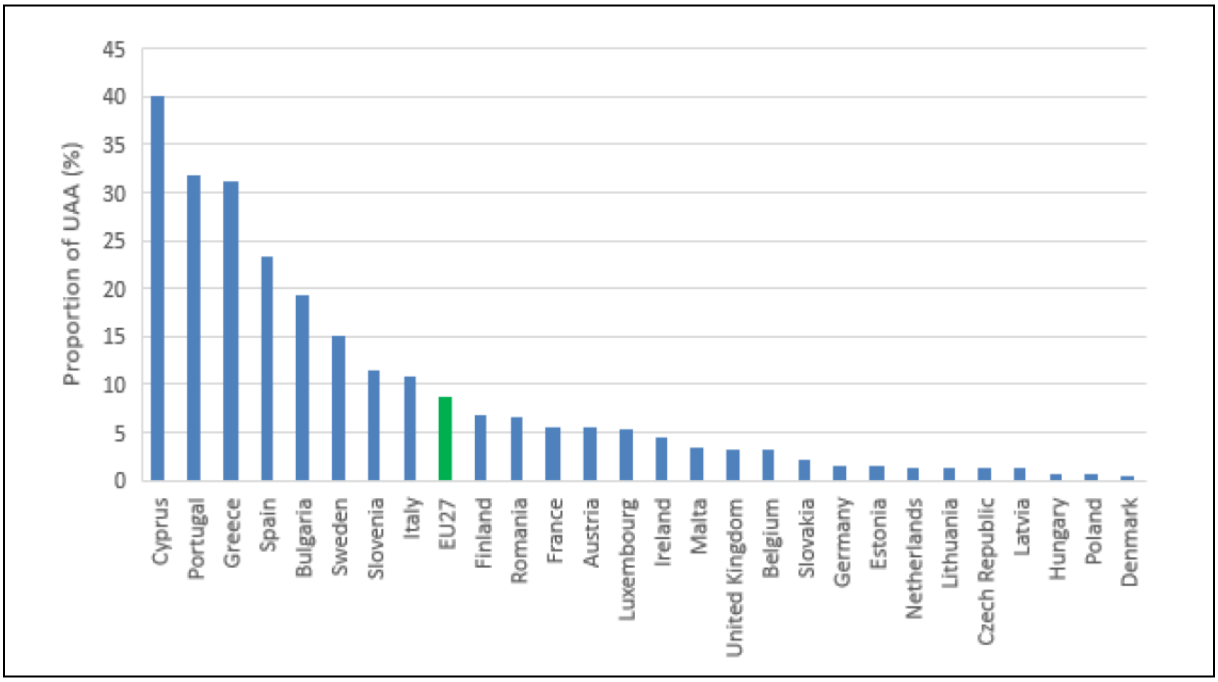
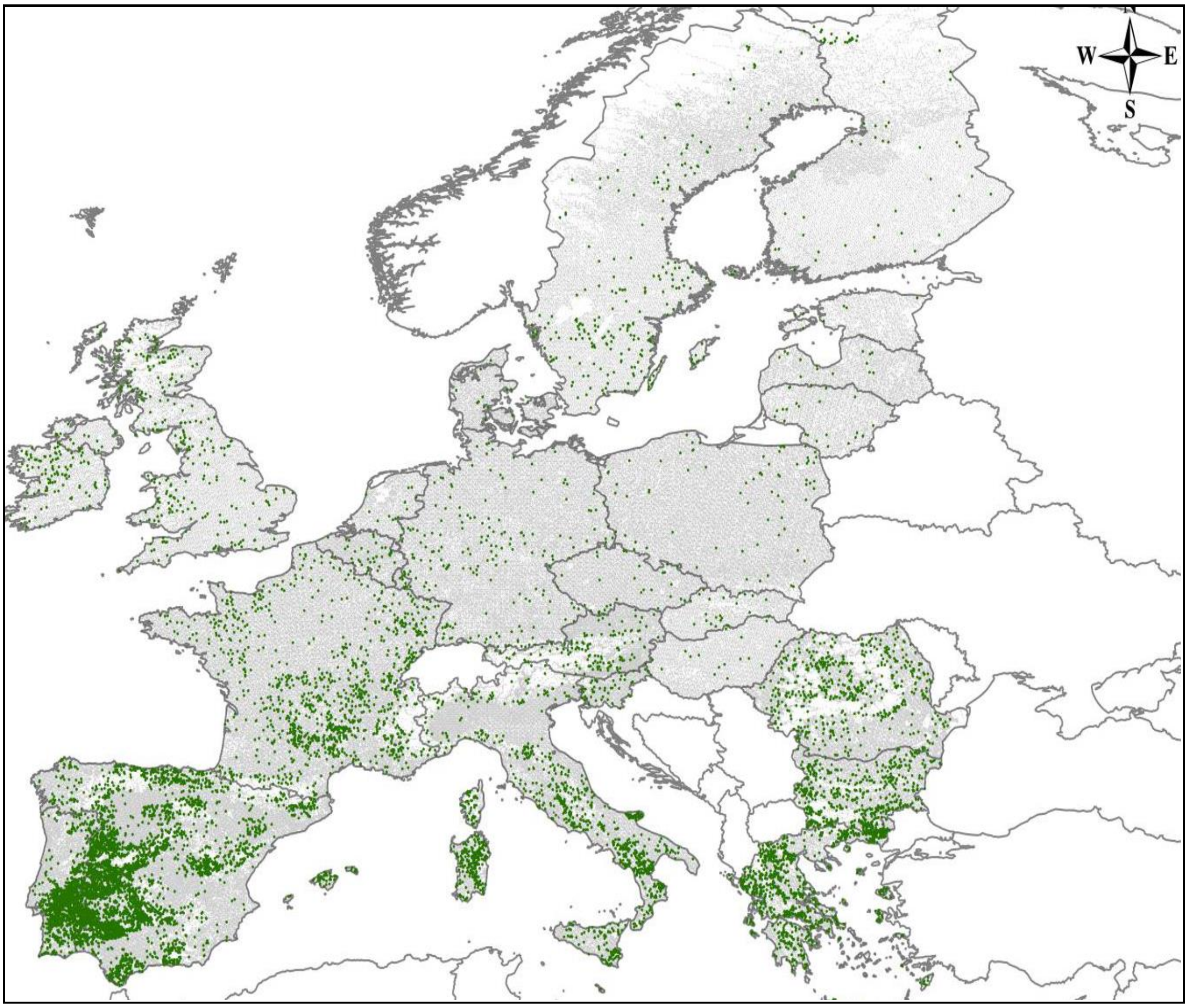
[1] Excluding Croatia but including the UK.

Figure 2 Estimated extent of agroforestry as a proportion of the Utilised Agricultural Area in the EU27 ()



Source: den Herder et al. (2017)

Figure 3 Agroforestry in EU-27[2] based on LUCAS data



Source: den Herder et al. (2017)

b. Technical potential for agroforestry

The IPCC rated agroforestry having moderate potential for both climate mitigation and adaptation, with no adverse impacts on the other challenges of desertification, land degradation, and food security (IPCC, 2019). Garcia et al. (2018a) found that environmental externalities from arable systems can be reduced by the appropriate integration of trees including the potential for mitigating climate change through carbon sequestration, reducing soil degradation, and reducing adverse impacts on water quality from agrochemical use. The IPCC has identified agroforestry as of potential use on 35% of global ice-free land including croplands, range lands and in village settings (IPCC, 2019). Agroforestry has been highlighted as an agricultural practice of high potential across the whole of the EU for GHG mitigation, focused on its ability to sequester carbon (Hart et al., 2017, Aertsens et al., 2013).

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[2] Excluding Croatia but including the UK.

In GHG sequestration terms, introducing agroforestry represents a micro-site land conversion associated with the introduction of additional biomass per unit of land. This addition of woody vegetation to existing herbaceous vegetation supports an increase in the amount photosynthetically active infrastructure per unit of land due to the vertical exploration of the system by leaves. The introduction of a tree or woody perennials with deeper roots than herbaceous plants increase the volume of soil explored by roots, and hence the potential to store carbon below ground (EIP Agri, (2017).

Introducing agroforestry implies production of additional woody biomass, but the carbon sequestered and used in harvested wood products is not accounted for within the agricultural sector and hence is not used formally in schemes for offsetting within the sector. However, when developing schemes to promote agroforestry the 'use' and retention of the sequestered carbon in harvested or end of life biomass is an important consideration. This is both important economically to success, but also in terms of maximising the GHG emission reduction potential.

Compared to conventional production systems, agroforestry contributes significantly to carbon sequestration, increases a range of regulating ecosystem services, and enhances biodiversity. Recent research by Kay et al. (2019) estimates that targeting the introduction of agroforestry on Priority Areas (arable and grassland where there are already multiple environmental pressures) that make up 8.9% of total European farmland could lead to sequestration of 2.1 to 63.9 million t C a^{-1} (7.78 and 234.85 million t CO_{2eq} per year), depending on the type of agroforestry[3]. This could offset between 1.4% and 43.4% of the European agricultural sector's current greenhouse-gas emissions (Kay et al., 2019).

EURAF looked in detail at the carbon-sequestration potential of agroforestry systems at farm level and found that the literature quoted figures ranging from 0.3 to 7 t C/ha/yr, (including examples with very low numbers of trees e.g. in hedges). A 30-year silvopastoral trial with ash (*Fraxinus excelsior*) in Northern Ireland demonstrated an average sequestration rate of 3.4 t C/ha/yr (EURAF, 2020). Table 1 summarises these findings.

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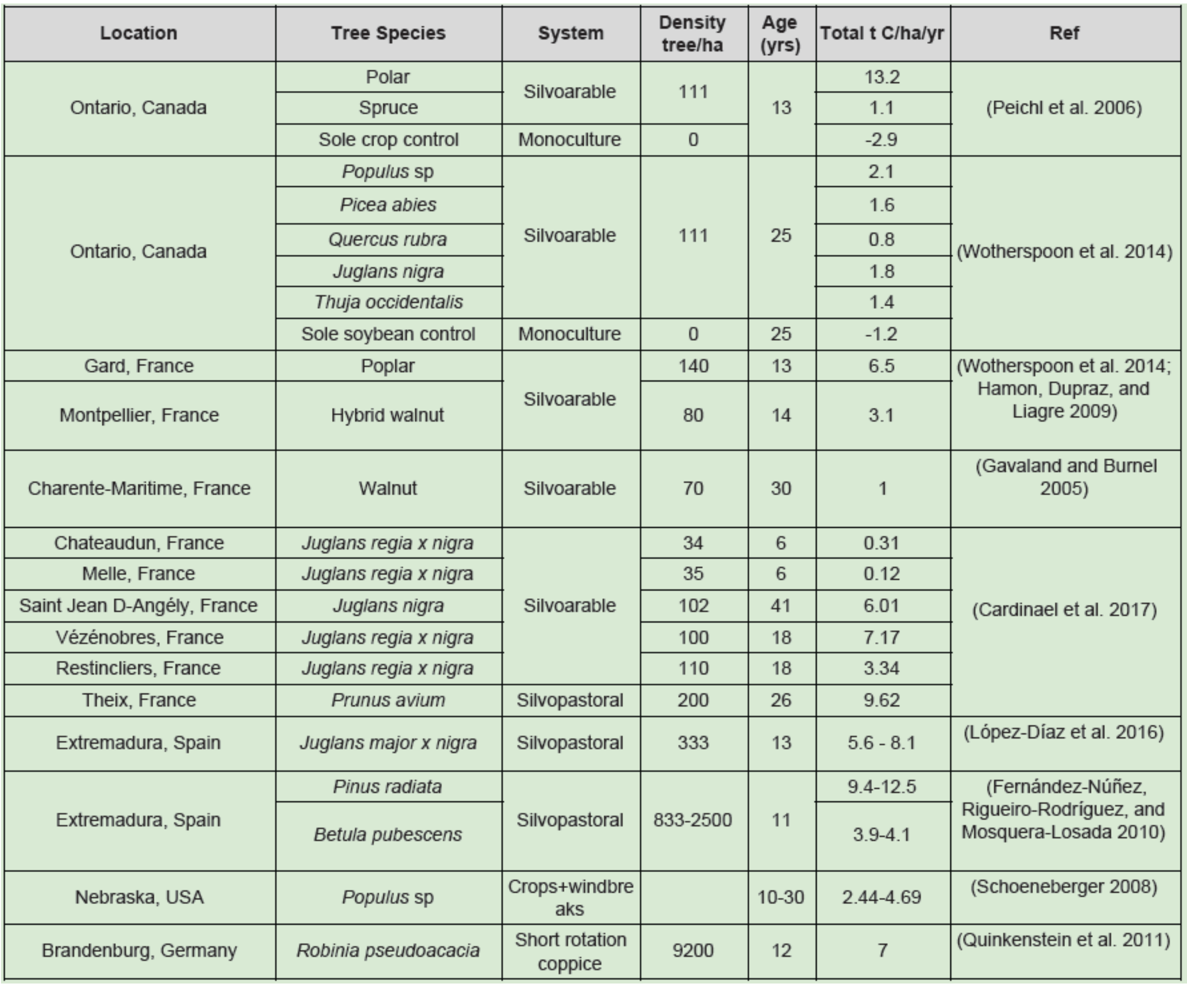
[3] For example, whether the focus is on increasing tree cover in hedgerows/field boundaries or supporting infield silvoarable and silvopastoral systems.

Table 1 Observed carbon sequestration rates in tree-based agricultural systems



Location	Tree Species	System	Density tree/ha	Age (yrs)	Total t C/ha/yr	Ref
Ontario, Canada	Polar	Silvoarable	111	13	13.2	(Peichl et al. 2006)
	Spruce				1.1	
	Sole crop control	Monoculture	0		-2.9	
Ontario, Canada	*Populus* sp	Silvoarable	111	25	2.1	(Wotherspoon et al. 2014)
	Picea abies				1.6	
	Quercus rubra				0.8	
	Juglans nigra				1.8	
	Thuja occidentalis				1.4	
	Sole soybean control	Monoculture	0	25	-1.2	
Gard, France	Poplar	Silvoarable	140	13	6.5	(Wotherspoon et al. 2014; Hamon, Dupraz, and Liagre 2009)
Montpellier, France	Hybrid walnut		80	14	3.1	
Charente-Maritime, France	Walnut	Silvoarable	70	30	1	(Gavaland and Burnel 2005)
Chateaudun, France	*Juglans regia x nigra*	Silvoarable	34	6	0.31	(Cardinael et al. 2017)
Melle, France	*Juglans regia x nigra*		35	6	0.12	
Saint Jean D-Angély, France	*Juglans nigra*		102	41	6.01	
Vézénobres, France	*Juglans regia x nigra*		100	18	7.17	
Restincliers, France	*Juglans regia x nigra*		110	18	3.34	
Theix, France	*Prunus avium*	Silvopastoral	200	26	9.62	
Extremadura, Spain	*Juglans major x nigra*	Silvopastoral	333	13	5.6 - 8.1	(López-Díaz et al. 2016)
Extremadura, Spain	*Pinus radiata*	Silvopastoral	833-2500	11	9.4-12.5	(Fernández-Núñez, Rigueiro-Rodríguez, and Mosquera-Losada 2010)
	Betula pubescens				3.9-4.1	
Nebraska, USA	*Populus* sp	Crops+windbreaks		10-30	2.44-4.69	(Schoeneberger 2008)
Brandenburg, Germany	*Robinia pseudoacacia*	Short rotation coppice	9200	12	7	(Quinkenstein et al. 2011)

Source: EURAF (2020)

Taking a different approach, Martineau et al. (2016) estimated the median mitigation potential of new agroforestry, expressed as a quantity of GHG emissions per ha of land[4], for NUTS 2 areas or Member States, as shown on the map in Figure 4.

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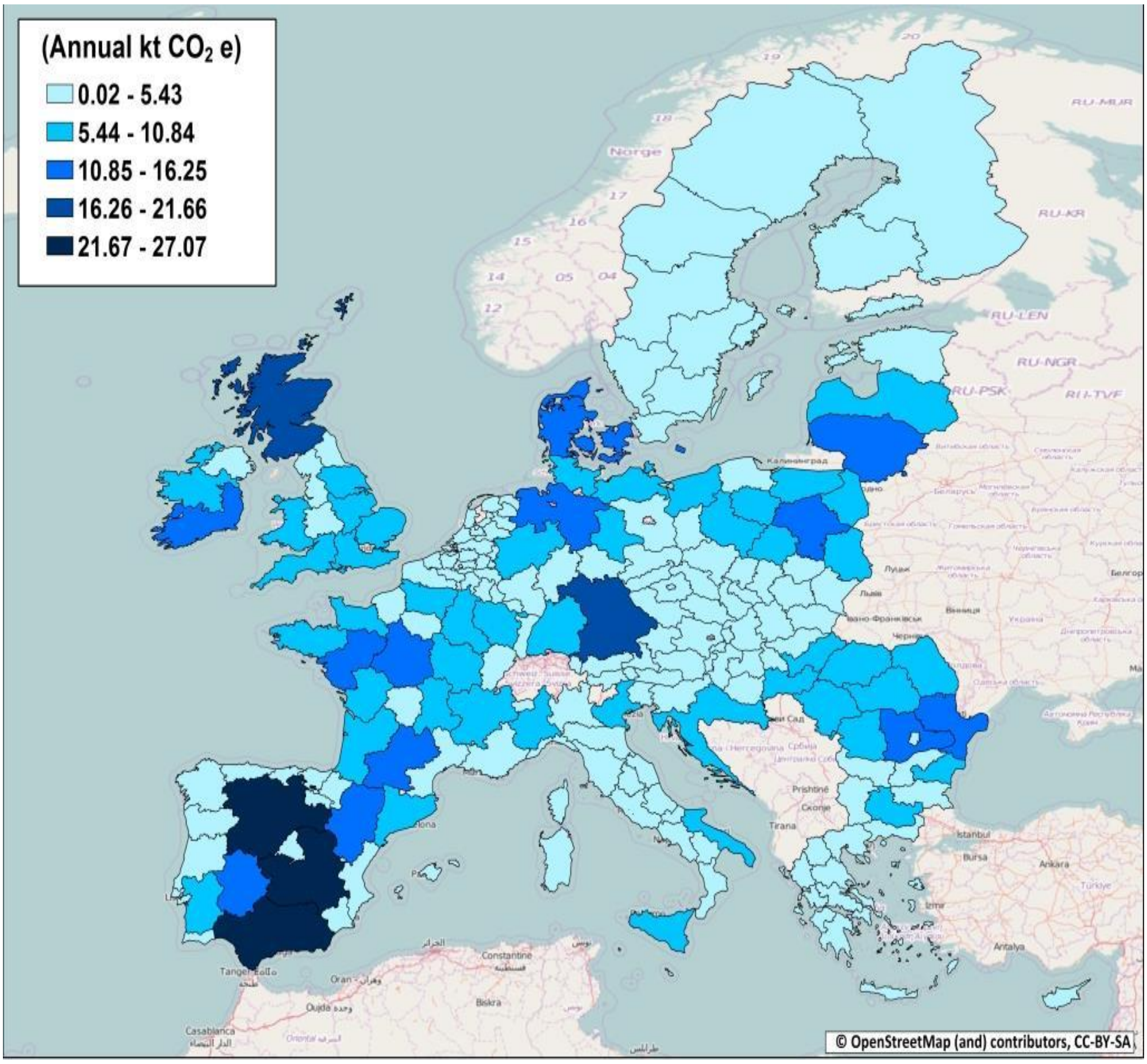
[4] To reflect the variability in agroforestry systems Martineau et al. (2016) estimated a range of values of C sequestration based on data reported by Frelih Larsen et al., (2014), and a range of 0.15 to 0.88 t CO2eq sequestered in soil per ha per year.

Figure 4 Mitigation potential at NUTS 2 level, kt CO2eq per year



Source: Martineau et al.(2016)

However, it is important to note that the type of agroforestry adopted will affect significantly both the sequestration potential and the contribution of agroforestry to mitigating other environmental pressures (Kay et al., 2019). Agroforestry systems can vary widely, for example in terms of crop types and tree species, duration of the rotation for both crop and trees, share of land given to each, and management practices used within both parts of the system; therefore the potential for C sequestration is very variable. Agroforestry can take more time to deliver GHG benefits than other interventions (IPCC, 2019), and the permanence of the carbon sequestered depends on the type of trees and their end use. Agroforestry systems are also at risk of re-emission associated with poor management and natural events.

In considering the potential for introducing or expanding agroforestry systems it is important not to lose sight of the importance of maintaining and enhancing the contribution of more than 15 million hectares of *existing* agroforestry in the EU to climate mitigation/adaptation, and to other ecosystem services and biodiversity. Many of these low-intensity pastoral systems are under threat of abandonment or intensification. Lack of maintenance of these systems, including loss of a viable age structure of the woody elements, and conversion to agricultural rather than agroforestry systems would lead to increased carbon emissions.

1) Other GHG impacts

Although this case study focuses on carbon sequestration associated with the above ground woody elements, there are other potential GHG savings associated with agroforestry establishment. The AGFORWARD project (Garcia et al., 2017b) noted that the introduction of agroforestry could reduce GHG emissions from the associated agricultural land use, including a decline in nitrogen-based emissions from the land on which the trees are planted. This is a component that could be considered in terms of the wider emissions associated with farm management, machinery use, consumption of fertiliser etc in combination with wider farm audit approaches (see Livestock Farm Carbon Audit – a carbon farming case study – Annex IV).

2) Leakage due to displacement of production

Introducing agroforestry to an arable system can lead to a decline in the production of the arable crop component, in parallel with an increase associated with the introduction of the wood component. For example, in the case of a poplar (*Populus* spp.) silvoarable system in the UK, García de Jalón et al., (2018) predicted that crop yields would be 42% of those in an arable system, but timber yields would be 85% of those in a widely-spaced forest system. Another comparative study of a poplar-based silvoarable system, this time in the Netherlands, found that in the agroforestry system emissions were reduced by 56% compared to the arable system, but CO_{2eq} emissions per tonne of crop yield (in this case wheat) increased by 4.4% (Garcia et al., 2017).

It is important to take account of these questions of production displacement under new agroforestry systems, and to ensure that there is a net GHG benefit from the whole agroforestry system, not just the woody part. Overall, introducing an agroforestry system provides for increased biomass production per unit of land, but there may be indirect land use impacts if crop or livestock production is intensified or displaced elsewhere. Not all systems will act in the same way. For example, studies show additional shade may benefit production intensity of some crop and grassland systems or can increase production of valuable products. The extent to which this represents a challenge will depend on the ability to utilise all products of the system, the design of the agroforestry system itself and the ability to integrate production of new products with the wider rural bioeconomy.

The question of soil disturbance and resulting GHG emissions associated with introducing agroforestry is highlighted in the literature. Only one of the projects examined (the Woodland Carbon Code) accounted for emissions from soils during the establishment phase of tree planting. This should help to ensure a positive balance of emissions over the lifetime of the trees, and to target establishment of agroforestry at soils of lower existing soil carbon. However, the current lack of reliable methods or examples of measuring changes in SOC under agroforestry systems as they mature means that it is not possible to take these GHG benefits into account in a result-based payment scheme.

c. EU policy and agroforestry

Climate policy: Although the EU LULUCF accounting rules5 include mandatory land accounting from 2021 of GHG fluxes from managed cropland and managed grassland, current capacities of Member States to report complete and accurate emissions and removals vary considerably (see Box 1).

Biodiversity policy: large areas of long-established agroforestry systems are of high natural and cultural value and identified as habitat types Community interest under Annex I of the Habitats Directive6, with an obligation for Member States to maintain these in favourable conservation status. The most extensive of these agroforestry systems are Mediterranean wood pastures known as *dehesa* in Spain and *montado* in Portugal where evergreen oaks such as cork oak (*Quercus suber*) are grown on land grazed extensively by pigs, cattle or sheep (historically these systems also produced cereals). Of the estimated 3.5 million hectares of this farming system in the south-western Iberian Peninsula (Moreno et al. 2017), more than 1.5 million ha are protected Annex 1 *dehesa* habitat (6310) but despite the legal obligations these are almost entirely of unknown conservation status (presumed unfavourable) and only 65% are within designated Natura 2000 areas. Other protected Annex 1 agroforestry habitats are Fennoscandian wooded meadows (6530) and wooded pastures (9070), which are known to be in unfavourable conservation status (Olmeda et al., 2014). The Biodiversity Strategy 20307 recommends that the uptake of agroforestry support measures should be increased.

CAP policy: specific support for the establishment of new agroforestry has been one of the optional EAFRD measures under Pillar 2 of the CAP since 2007. In the current period (2014-20) this measure was extended to include support for maintenance of both newly established and existing agroforestry, but levels of programming by Member States and uptake by farmers remain low, compared to the measure supporting afforestation. New agroforestry established with RDP support is one of the options for Ecological Focus Areas under the Pillar 1 greening requirements.

d. Agroforestry - economic and environmental co-benefits and risks

The IPCC (2019) report importantly identified payments for ecosystem services as the key policy response to support agroforestry. This study focuses the potential of agroforestry to provide climate benefits, but promotion of agroforestry must take into account the other economic and environmental co-benefits, both to the farm business and to achieving societal goals for ecosystem services and biodiversity. These include:

- at farm level: reduced soil erosion and nutrient leaching and improved soil functionality and water infiltration; diversified income stream for the farm business; microclimate benefits (shade and shelter); improved adaptation to climate change; pollination services;
- wider benefits: improved ecosystem services and biodiversity (depending on the tree species used and the intensity of management); greater structural diversity of landscapes and habitats connectivity; flood risk management.

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[5] https://op.europa.eu/en/publication-detail/-/publication/5327fa89-e78d-41bd-9465-2974d473a1a5/language-en

[6] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

[7] EU Biodiversity Strategy for 2030 Bringing nature back into our lives. COM(2020) 380 final

Evidence suggests limited potential negative impacts on the wider environment of introducing agroforestry but there are some potential risks:

- of negative effects on biodiversity if non-native tree species/genotypes are grown near existing semi-natural woodland habitats;
- to farm income and broader rural development needs if the opportunity costs, impacts on yield and supply/processing chains are not taken into account in tailoring and targeting agroforestry interventions.

The CarboCage project illustrated of the importance of recognising co-benefits to attract investors, and realising all economic opportunities from the agroforestry system. The question for carbon farming system is where to prioritise the use of agroforestry, what type of system will maximise the opportunity. However, MRV should take into account the wider ecosystem service benefits and payments also reflect that while for example C per unit area may be lower than full forest conversion other benefits persist.

e. Agroforestry and result-based schemes

Result-based scheme design associated with trees on farmland have not considered these wider co-benefits. However, some modelling of the opportunities associated has been completed using the Farm SAFE model to look at the economic and broader GHG benefits, as well as other externalities including soil erosion (Garcia et al., 2017). Arguably, with better assessment of agricultural life cycle emissions it might be possible to develop a more integrated approach to take into account the wider benefits of change in terms of emission reductions associated with the farming system and nutrient recovery. Providing a more holistic approach to GHG measurement and design might be a next step to integrate on-farm or whole-farm emissions with agroforestry approaches. However, this would require further development and monitoring of systems.

Using a result based, rather than a management based, payment to encourage more widespread use of agroforestry, provides an alternative basis for valorisation and reward through the different phases of establishment and maintenance of the agroforestry system. This can be linked to monitoring achievement against goals that reflect not just the carbon benefits but potentially those for biodiversity and other ecosystem services.

Although the potential for result-based agroforestry schemes exists, the ability to use these and the scale of achievable coverage depends on a number of variable factors including the availability of data to set system baselines, and of reliable monitoring and reward parameters. Table 2 summarises the advantages and challenges of using result-based schemes for agroforestry, compared to management-based approaches.

Table 2: Advantages/challenges of result-based schemes for agroforestry compared to management-based schemes

Advantages	**Challenges**
Farmer choice: Result-based payments gives land managers freedom to choose the most appropriate management for their location, with the measurable level of achievement of specific environmental indicators reflected in the payment structure. The monitoring can provide **useful feedback to land managers** to improve their ability to manage agroforestry systems for multiple impacts, including carbon sinks/ Payments are clearly **linked to measurable impacts**, which improves targeting and environmental effectiveness of public or private funds, whilst reducing deadweight. They provide a **means of channelling private funds into climate action**.	Quantification of carbon sequestration depends on modelling data which makes the **design of the mechanism is more difficult,** given the very wide range of agroforestry systems. To achieve GHG benefits it is necessary to take account of any changes in the net emissions of the 'agro-' component of the agroforestry system. There is a **risk that land managers may choose to intensify management of the agricultural part of the system** when establishing new agroforestry systems. To gather sufficient data and to enable monitoring and verification of results (MRV component) **increased administrative effort and skills** are required compared to action-based payments. Result-based schemes are **more knowledge-intensive** and in the case of new agroforestry there is also the **need to overcome unfamiliarity** with a different land management system. The **initial investment in establishing new agroforestry may not be recovered** within the timescale need to achieve measurable GHG benefits. Potential risks for farmers if the results are not achieved and lead to reduced or zero payments.

Box 1. Connecting agroforestry to national GHG inventories

For new agroforestry, there is a specific methodology in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories that shows the impact of the land use change in both arable and grassland systems. Under the category 'cropland remaining cropland' the methodology uses default values for the accumulation of carbon in the perennial woody crops (in Tier 1); default values taking climatic zones into account (in Tier 2); or using actual measurements (in Tier 3). For 'grassland remaining grassland' there is much less detail in the methodology - Tier 1 will not account for agroforestry, Tier 2 allows for estimated changes in biomass as a result of management, and Tier 3 permits country-specific methodologies, if there is sufficient evidence (Martineau et al., 2016). Interestingly, Romania has started to use data from their CAP Land Parcel Identification System (LPIS), for quality checks of their GHG inventory (Böttcher et al., 2019).

3. Feasibility, support and enabling scheme development

This chapter discusses the factors affecting the feasibility of development of result-based payment schemes for agroforestry, based on the experience of the projects reviewed for the case study and relevant literature on other result-based schemes, notably for biodiversity. Given the diversity of agroforestry systems and the potential for them to be used within a wide range of conditions across the EU, feasibility depends to a large extent on the socio-economic context into which agroforestry is being introduced (or already exists), and on tailoring the scheme to the local farming systems and pedo-climatic conditions.

The importance of stakeholder engagement in designing and rolling out agroforestry schemes cannot be over-emphasised. This requires bringing together different actors, skills, sources of data and expertise from the earliest stages of development – all elements of advice, cooperation and governance should reflect this.

a. Institutional capacity

The projects reviewed here have shown that delivering robust agroforestry schemes is much more dependent on institutional capacity than on a specific system of governance. Institutional capacity is needed for:

- identifying, gathering and analysing the data needed to develop a regional/local knowledge base, and to provide schemes which can feed this information into future scheme design;
- integrating stakeholders into the design process and using their knowledge to support scheme development;
- management and IT infrastructure for technical support throughout the scheme, structured to interact with key monitoring and advisory windows and other relevant data sets (e.g. LPIS);
- enhancing the role of advisers and upskilling them to cover technical and economic aspects of agroforestry at farm level;
- providing or overseeing traceability and links to trusted standards/organisations.

b. Advice and knowledge transfer

Agroforestry requires specialised technical advisory input that fully integrates silvicultural and agricultural advice with information on the implications of changing the farming system, making the transition and understanding the economic consequences/planning needs. Advisors must understand and be able to explain the details of costs, investments, changes in farming practices, timescales and production and marketing methods, particularly for delivering at the quality the market demands.

Advice must be tailored to the specific agroforestry system, delivered when needed and, most importantly, provided by a trusted source. The needs of a farmer seeking to restore an existing agroforestry system of high nature and cultural value are very different from those of an arable farmer seeking to introduce specialised timber crop in an alley-cropping system. Woody perennials have quite different practical management requirements from those of annual crops, and introducing trees into an established system can raise many issues.

Timing of advice should be linked to the specific objectives, result indicators and monitoring requirements of the scheme, and be structured to address the issues of life-cycle and permanence of new or restored woody features. This is likely to requires preparing at the outset (before the first tree is ordered) a detailed design and management plan for the lifetime of the scheme – a process more familiar to foresters than to many farmers.

c. Farmer engagement

Agroforestry is a significant change for many farmers, especially those with no previous experience of woodland management. Farmer engagement early in the process is essential to allay suspicion and address perceived barriers to uptake associated with knowledge gaps, the process of transition and particularly the change in economic profile of the farm business, payback times and transactional costs.

The projects studied reveal the value of collaborative approaches to designing schemes, and involving farmers in piloting and monitoring a new scheme before rolling it out. The Montado scheme placed emphasis on support, advice and onsite visits and tailoring to farm needs. Both this scheme and the Coop scheme worked with active farmer groups and interested farmers to develop and set up the scheme and roll it out. Montado developed an understanding of the target farmers' expertise and knowledge base, and studied their perceptions and reasons for uptake.

d. Cooperation and stakeholder engagement

Cooperation is key to the long-term success of agroforestry in bringing about transformational change of agricultural land management and production. This requires bringing different disciplines, interests and stakeholders together in scheme learning and setting baselines, choosing result indicators and evaluating and improving schemes. As the CarboCage scheme demonstrated, engaging with downstream supply chain actors will help to identify market opportunities, valorise products of the woody component of agroforestry and identify those who might support credits. The multi-disciplinary nature of agroforestry and the integration of agricultural and forest production, plus its potential to deliver other environmental benefits. all point to a requirement for objectives and result indicators that potentially span and pinpoint key co-benefits, which requires cooperative working from the outset.

4. Setting scheme objectives and demonstrating additionality

a. Objective setting

The objectives of the scheme will determine the overall focus and goals. In the context of the development of an agroforestry results-based scheme there a two key decision points at the objective setting stage. How the scheme will be targeted or tailored to local or regional needs and circumstances, and the extent and which co-benefits will be included within its objectives. Based on this, specific objectives can be defined. For example, to promote carbon storage and biodiversity through retention and improved maintenance of specific forms of mixed hedging (CarboCage); or promote to increase carbon storage infield, promote biodiversity and use of timber for materials uses through planting fruit trees that can be used for timber at end of life (Coop); or to promote restoration of high nature value habitats (Montado). Based on these specific objectives the feasibility of defining associated result indicators can be determined.

1) Targeting and tailoring – Different solutions

Within projects examined and interviews with experts two approaches to the targeting of schemes emerged. One is tailored and specific at farm level, the other more regionalised.

This targeted approach can be combined with other tools to map the opportunities, agroforestry priority areas and potential benefits on farm. For example, as undertaken in Switzerland (Kay et al., 2019c) and under the AGFORWARD project for targeted case study regions (Kay et al. 2018) as well as for EU farmland (Kay et al., 2019a). Importantly these mapping exercises can be used to help those developing ways of targeting schemes effectively, and also as a tool to encourage farmers to establish agroforestry and to communicate the associated potential. It should be noted that even within these specific systems however, a form of on-farm audit, targeting and review to ensure the agroforestry system is properly designed and tailored to needs and local conditions is needed (as for example is incorporated into the Coop and CarboCage approaches).

The regional approach focuses on broader needs, pressures and opportunities and targets agroforestry at those i.e. decline in pollinators and desire to offset supply chain emissions (Switzerland), loss of hedgerows and decline in functionality (France and Germany), loss of habitat quality (Montado).

Alternatively, several experts during interview suggested that a more generalised approach to agroforestry could be developed, more akin to both forestry schemes and whole farm audit approaches. In this model, the approach to agroforestry would be based on the specific threats and opportunities linked to the farm. The mix of agroforestry interventions adopted would be based the solutions that fit with the carbon sequestration opportunities on farm, the market opportunities and diversification opportunities locally and the broader environmental co-benefits. The calculation of GHG savings and co-benefits would then be based on the combination of agroforestry interventions on farm allowing farmers with mixed farms or mixed on-farm conditions to actively take a role in determining which agroforestry options best fit with their farm's needs.

When interviewing stakeholders and farmers Garcia et al. (2018b) concluded that the 'great variability in the opportunities and barriers of the systems suggests enhanced adoption of agroforestry across Europe will be most likely to occur with specific initiatives for each type of system'. Initially schemes seem to be taking this more targeted approach to promoting agroforestry. However, as interest, knowledge and the ability to link up with other on farm carbon audit tools grows a more integrated approach to agroforestry could be incorporated.

2) Taking account of co-benefits

As noted in the introduction, a key opportunity associated with agroforestry is that it can deliver GHG savings, while simultaneously addressing other on farm pressures and promoting other ecosystem services and benefits at farm level and for the benefit of broader society. The ability to recognise co-benefits is integral to the design of all the existing projects and schemes reviewed, with a focus on the associated biodiversity opportunities in particular. This is in part because biodiversity is also a visible parameter and in part because failure to incorporate it into scheme design might result in perverse outcomes. However, the exact co-benefits a scheme should take into account will vary based on the objectives identified. For example, Kay et al. (2019) identified 64 different types of agroforestry intervention suited to the different priority areas identified. These are based on agroforestry system, biogeographic region, the trees and crops involved, the intensity of management and the products of the resulting tree component[8].

The components formally included in the scheme and the benefits on farm may also differ. For example, it has been seen that farmers in the Coop scheme are often drawn to the scheme in part by the desire to address GHG emissions, but also by the desire to manage soil erosion and improve soil management on farm. Other on-farm benefits might include improved nutrient cycling or water management (EIP Agri (2018b). Some of these co-benefits might be included in the scheme design, but some might arise as a result of scheme implementation. Understanding these additional benefits is important when attracting both farmers and investors to support the adoption of the scheme. While such benefits might not be monitored formally as 'result indicators', in the scheme evaluation the interaction with these should be reviewed to provide a broader understanding of the impact of implementation, the benefits and the opportunities improved delivery of co-benefits.

It should be noted that, within the concept of multi-functional agroforestry carbon farming, the potential economic co-benefits -should not be ignored. Specifically, the ability to sell and market products associated with woody component. As noted in the analysis of GHG impacts this is important in terms of avoiding leakage impacts and this is also linked to the design of some projects reviewed i.e. CarboCage and Coop. Opportunities should of course be in line with wider goals of the scheme, and consider the underlying nuances of the climate science to avoid pursuing one goal at the expense of others. For example, the EIP Agri report (2018c) noted that that an experiment comparing a broadleaved species with conifers in terms of capacity to improve soil carbon storage found that the former is able to store carbon in finest soil particles, which in turn store carbon for hundreds of years. It was, therefore, noted that from a climate mitigation point of view broadleaves seem to be a better option than conifers when establishing the woody component of an agroforestry system.

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[8] The full tabulation of the different systems including their potential GHG storage potential based on the literature is compiled in a useful resource which can be downloaded for reference at https://ars.els-cdn.com/content/image/1-s2.0-S0264837718310470-mmc1.pdf and is supplementary material to Kay et al. (2019).

Questions around the productive capacity of the system and innovations are not, however, wholly confined to the woody component. Adoption of the system may involve a change in the crop or pasture component either its management or the varieties grown. This again could potentially be tailored to reduce outgoing expenditure on management or inherent costs such as crop losses or promote alternative crops. For example, research is ongoing (but not yet complete) looking at cereal and other crop varieties that might produce more effectively in shaded conditions or increase their production of a specific valued component.

b. Additionality

1) Securing additionality

Additionality is commonly interpreted as adding something that is not there already, but it can equally apply to the protection and management of something that is there, but which is under threat of decline or removal. There is therefore a need to design agroforestry incentive structures for two situations - to promote restoration and on-going management of existing agroforestry systems that have already generated high carbon stocks (e.g. *dehesa* and *montado*, and hedgerow/*bocage* landscapes), and to promote new, sustainable agroforestry to increase carbon sequestration.

Some schemes examined in this case study, for example, the Woodland Carbon Code, take a very strict line on financial additionality of investments supported. This is in part due to the specific conditions within the forestry sector. When it comes to agroforestry, strict tests for additionality prove difficult; in particular discounting end of life benefits from the sale of products, as these are often inherent to the scheme design and success. The agroforestry focused projects reviewed here have often been established in response to a lack of action to protect existing agroforestry or responding to existing incentives for agroforestry.

Studies show agroforestry can be profitable in its own right. However, that this is not leading to wide uptake of the system. Indeed agroforestry, landscape features, agro-ecological systems, and green infrastructure are still in decline (EIP Agri (2018c)). This implies that the established incentives are insufficient or do not adequately address the problem and actors (Kay et al., 2019). Barriers identified include, in particular, transaction costs and knowledge transfer to support transition, management planning and restructuring profitable systems.

A key attribute of agroforestry in terms of carbon sequestration is that the increased above-ground biomass storage can be accurately determined and externally validated.

The potential of agroforestry, as noted by the IPCC and in EU literature, is the opportunity to apply the techniques to a large area of land and to use the different solutions that sit within it across different types of agricultural land. While the GHG benefits at plot level may be limited, the potential at scale is significant. There is therefore a difference between plot and scheme level additionality. As noted above, the scheme itself needs to be able to justify its additionality from the baseline i.e. in the case of the Montado or CarboCage examples this is in terms of the demonstrable losses of features present. In the case of the Coop scheme it is the lack of increase in tree planting, despite ongoing support for established trees in Switzerland. This additionality of the scheme links back to the targeting of agroforestry interventions at priority areas and threats.

2) Permanence

As noted in the context of the GHG emission review, emissions sequestered and stored in agroforestry systems can be subject to reversal. While agroforestry represents a micro land use change, that change is reversable and not recorded formally as a change of land status (unlike in forestry systems). For hedgerows in some Member States, strict protections do exist requiring their retention. However, this can itself lead to challenges (for example cited in relation to Germany) where farmers are then reluctant to install new hedges as they will then be responsible for future maintenance costs.

The solution being explored within the projects examined (but not yet fully resolved given that many projects are still in the relatively early stages of implementation) is the use of contracts requiring tree retention and replanting if lost in the early stages of establishment. This is combined with specific elements of scheme design including the staggering of ex-ante payments, staggered monitoring (typically including review at 3-5 years when trees have normally become established) and advice stages timed to promote tree retention and transfer of effective maintenance techniques. In some cases (for example the Coop scheme) links are also being made to ongoing support for co-benefits of establishment including the biodiversity benefits for pollinators which are paid for under RDPs. These are not sufficient to fund establishment but are paid once trees exist on land.

c. Eligibility

Agroforestry can be characterised as a transversal land use and the breadth of different types of intervention means that it is potentially applicable across arable and grasslands (see above on securing additionality). Eligibility will largely be dependent on the objectives of the scheme and decisions made specifically in terms of level of targeting of either threats or types of agroforestry intervention. Once a farm appears suitable for entry into the scheme, onsite eligibility should be assessed. This should include an infield survey to identify the exact locations that are most suitable on-farm and how best to target the relevant interventions. This approach is followed by the Coop and CarboCage schemes.

Supply chain/value chain actors have been identified as key to promoting transition within the bioeconomy (ENRD, 2019) and as such are highly relevant to the establishment of schemes for carbon farming linked to agroforestry (and beyond). The link to supply chains can alter eligibility, for example, under the Coop scheme beneficiaries must be part of the Coop's supply chain. Therefore, the ultimate mechanism for payment may also affect eligibility for the scheme.

A final consideration is the GHG legacy of the scheme. As noted in the analysis of GHG emissions and objective setting, the end of life/use of products linked to the integration of the woody biomass is important. To facilitate this, farmers need to have access to markets, while not a specific eligibility requirement this might be a consideration of overall scheme eligibility and robustness. If existing markets do not exist for the additional products this weakens the scheme's overall legacy and the eligibility of farmers to deliver the whole suite of agroforestry benefits. Scheme design should, therefore, consider this need for wider rural development and transformation. Ideally links to the value chains for tree products should evolve and be considered when defining wider eligibility (see Chapter 7 on upscaling).

5. Choosing result indicators and MRV

Agroforestry systems encompass different modalities of integration of trees and woody plants with other agricultural cropping. As noted by the CarboCage project for hedgerows, the exact carbon benefits will depend on the type of hedgerow and its management. However, as noted in Burgess et al. (2019), a review of literature can determine benefits and potential consequences. This helps in setting a baseline for result indicators and in considering what the wider consequences of adoption may be. Specific result indicators and the best practice approach to monitoring will vary depending on the agroforestry practice employed, the exact management practices undertaken of the woody component, and the management of the wider agricultural system. There are, however, overarching trends that are noted in the literature both for soil carbon, above ground carbon and for wider environmental and economic parameters[9]. All of these should be considered within scheme design (Burgess et al., 2019).

As regards the monitoring capacity for carbon sequestration, there are specific limits for agroforestry. It is difficult to have proper estimates of land cover and tree density of agroforestry plots. This comes partly from the fact that agroforestry activities usually combine multiple land uses, and therefore they are difficult to classify. Also, agroforestry is often done on small plot areas, and therefore it is difficult to estimate the area (remote sensing should be developed).

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[9] Burgess et al. 2019 provides useful summaries from the literature looking at the different parameters of interest when establishing silvoarable and silvopastoral systems (among others) and whether impacts can be expected to be positive, negative or neutral. These include soil carbon, biodiversity, yield, broader environmental elements such as soil erosion, GHG emissions and losses of nitrate and broader economic parameters including impacts on labour. These broader trend analyses may be useful when seeking to define result parameters or identify which indicators are likely to be of importance for monitoring on farm 'results' or evaluating mechanism success.

Box 2. Illustrating the linkage and flow between scheme goals, specific objectives, and results in the Montado project in Portugal

The Montado result-based work being led by the university of Evora remains under development and scheme design is being revised in collaboration with farmers. Originally conceived as a biodiversity focused result-based scheme the work is now evolving to encompass both biodiversity and climate parameters.

The *montado/dehesa* agroforestry system represents approximately 4 million ha of farmland in SW Europe, in the Iberian Peninsula. It is a hot spot for biodiversity and some areas are protected under Natura 2000 obligations but is subject to decay in quality, resulting both from inappropriate management and absence of management. Given the importance of Montado retention and effective maintenance for both biodiversity and carbon sequestration, work has begun to conceptualise a result-based scheme that might be used to better valorise the benefits of effective management, focusing on natural regeneration in particular of the tree component.

The team have embarked on a co-construction process working with farmers to define objectives, approaches to monitoring and result indicators. The objectives to be achieved were defined as:

- soil health and functionality of soil is preserved
- the regeneration of the tree layer
- biodiversity of Mediterranean grassland is retained
- biodiversity elements/features of the ecosystem

Collectively the achievement of these objectives is intended to ensure the retention of the system and deliver the biodiversity and GHG mitigation objectives.

The team have developed a manual to use infield for assessment and monitoring based on transects of features that reflect the different objectives they want to achieve. The monitoring approach focuses on the identification of features along the transect line. Indicators are based on visual images, hence the manual often uses photographic guides to the different features and plants that can be used as result indicators. For example, different plant communities are linked to levels of SOC, different habitat types, and evidence of tree regeneration. Indicators and evidence needs are being tested systematically with farmers as part of the co-construction of the project, based on an open group of interested farmers, researchers and officials.

Result indicators remain under development but parameters under consideration include the following examples. It is noted that critically results have to be dependent on management i.e. the farmer’s actions, be easy to measure and be understandable by the farmers enabling them to interpret and adapt their management to results. The project team intends to develop four different tiers for each indicator. This takes time, requires a clear scientific basis and supportive literature to transform this into usable onsite parameters.

- soil – differences in the floristic composition of the pasture underneath the trees reflecting the fertility of the soil.;

- health and function – difference in floristic composition, underneath coppiced trees and outside; indicators of low soil fertility; signs of erosion and bare soil;
- biodiversity – on land between the trees, equilibrium between grasses, legumes and others; indicator species of overgrazing; level of dry pasture.

a. Selection of result indicators

1) The question of carbon sequestration and soil carbon

The addition of agroforestry features can promote carbon sequestration through the generation of above and below ground (root) biomass and SOC. The result indicators selected will depend on the objectives set for the scheme; however, there is an open discussion on how to approach SOC indicators i.e. whether and how this can be effectively integrated into the result indicators. Studies have noted inconsistencies in the results for SOC delivery from agroforestry systems, the ability to replicate results and challenges in identifying changes beyond the 'noise' linked to climatic conditions, annual variability in growth rates linked to microclimatic conditions and previous land management (Kay et al. 2019, Fornara et al. 2018, Felicianoa et al. 2019, Upson, 2016). Key studies estimating agroforestry's carbon sequestration potential exclude additional SOC from the calculations (Kay et al. 2019), thereby potentially underestimating the overall climate mitigation opportunities, but do so on the basis of a lack of a consistent, reliable knowledge base that is essential for a result-based scheme.

Some projects and schemes reviewed do not currently consider the SOC component of carbon sequestration. For example, the Woodland Carbon Code and the Coop scheme. While they have in place mechanisms to measure above ground biomass, other components are considered challenging from an infield monitoring perspective and therefore, less suited to be a result indicator. In the Woodland Carbon Code soil carbon is taken into account in calculations of emissions associated with establishment, and soil carbon accumulation is accounted for in some specific circumstances where planting takes place on mineral soils i.e. to limit establishment on carbon rich soils and focus investment onto soils where additional soil carbon accumulation is most likely. Under the Coop scheme there is a conservative, specific GHG emission reduction allocated per tree. However, monitoring on site is based on the measurement only of above ground biomass 'results'.

Also, data gathering is a challenge, due to the intrinsic heterogeneity of SOC stocks within a single land parcel, which increases the costs of sampling and measuring. Finally, no SOC dynamic model has been validated yet and used widely for MRV. There have been recent developments, such as e.g. the RothC-Yield SAFE, APSIM models, Yasso for forest soils[10], but they really need to progress further to be useful in this context.

Scheme design can also play a part in securing below ground biomass improvements. For example, experts interviewed noted that in silvoarable systems the management of the crop around the woody component is important to encourage deeper root penetration by the different layers of vegetation. This underlines the importance of having farm-level management plans to guide and support effective implementation of agroforestry interventions and delivery of results over extended time horizons.

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[10] https://en.ilmatieteenlaitos.fi/yasso accessed % November 2020

This is not a challenge unique to European result-based schemes, indeed in materials supporting New Zealand's carbon accounting schemes it is noted that 'further research on the sequestration rates for all the types of trees and vegetation [listed, related to agroforestry], along with understanding of the factors that influence these rates, will be required before they can be considered robust enough for inclusion in target accounting' (IPCC, 2019).

Based on the evidence, it is proposed that SOC should not be used as a result indicator within agroforestry schemes, although if soil data relevant a specific agroforestry location is available, this may be useful to support the development of future indicators.

Despite this, longer-term changes in SOC under agroforestry will provide some information on the overall impact. Monitoring of SOC should, therefore, be incorporated into the evaluation of the scheme's impact over time, rather than be used to support result-based payments for farmers. In this context, interviewees noted the importance within any result-based monitoring system of:

- having in place control plots to be able to ascertain change in the intervention plot from a dynamic baseline;
- ensuring that monitoring takes place (at least on a sample of sites) before the adoption of the intervention, to be able to demonstrate change over time (in the literature time horizons of approximately 15 years are used to assess change in soil carbon post adoption).

2) Framing result indicators

The exact indicators to be used will depend on the objectives and associated results to be achieved. Specifically, it is important to assess the feasibility of using combination of result indicators that reliably represent the breadth of objectives a scheme seeks to achieve, including specific co-benefits. For example, the Montado project team are developing result indicators as proxies for four distinct outcomes which, when monitored in combination, will provide an integrated assessment (see Box 2).

Result indicators need to be measurable on farm, within the plot(s) on which the intervention has taken place. As noted in the Coop project, the level of detail expected and identification of result achievement has to be integrated into the wider advice and support structure of the scheme. The EIP Agri group on agroforestry identified several principles on which to determine the assessment of ecosystem services (including GHG sequestration). These include the following and can be seen also as important principles for choosing result indicators:

- the purpose of the assessment i.e. what change are you trying to identify?
- the scale under consideration i.e. plot, farm or catchment scale;
- the stakeholders to be involved in the assessment i.e. farmers, the wider community, with support from advisers or conducted by advisers/experts (as is often the case in existing schemes);
- whether opportunities exist to support monitoring, for example from specialist voluntary networks, to increase capacity and enable improved coverage of result indicators;
- the ability to assess change over time to inform longer term management choices and adaptations, ongoing management and understanding of the impact of management change. Such data can also promote learning, improve the knowledge base and provide feedback to improve the scheme over time.

b. Testing result indicators

In discussions with existing projects and schemes there were two clear messages around the testing of results. Firstly, that testing begins from day one i.e. that development of result indicators is an inherent part of scheme development, critically involving discussions between stakeholders around what is and is not possible in the field. This co-creation process is demonstrated in the Montado work. It is also present in more formalised schemes like the Woodland Carbon Code, where stakeholder/expert groups are established to consider ongoing questions of scheme design.

The importance of infield testing has been noted in discussions with the Montado project, the Coop project and the German work on hedgerows. This is needed, firstly, to establish what objectives, outcomes and result indicators make sense from a scientific perspective - and the level of a result that can be anticipated following the adoption of the agroforestry intervention. Secondly it is necessary to run practical tests infield to assess the approach to and choice of indicators proposed, review them, assess whether monitoring parameters are effective and are providing consistent results, and assess whether the tools supporting measurement of indicators are effective. The Montado experts note that they consider the next step in the development of their approach to be a pilot project to fully test the approaches including the result indicators and tools such as the infield handbook that are under development. The Coop project, while not formally piloted, built on previous research work in the field and expanded pre-tested techniques. It was noted that the process of infield testing and piloting is also important in building confidence in the scheme among farmers and end users of credits, performing a role of a demonstration in tandem.

c. Monitoring successes: the M in MRV

As with the definition of the result indicators, the nature of the monitoring relevant to the scheme will differ, depending on the specific objectives chosen, including integrating co-benefits. Within the projects reviewed the Coop and Woodland Carbon Code have monitoring approaches based more specifically on the above ground biomass; its measurement, quality of establishment, evidence of health, retention of woody component. Based on underlying research and guidelines measurements of the above ground biomass is then translated into a figure for sequestered carbon. Within these schemes the co-benefits are determined separately. In the case of the Coop project through this is through specifying the types of trees that are eligible within the project. In the case of the Woodland Carbon Code, co-benefits are linked to national environmental standards for forest establishment and management.

The Montado and CarboCage approach to the delivery of co-benefits is inherent to the choice of result indicators. In the case of Montado, monitoring involves transects along which data is gathered on the presence of the different result indicator species, and the condition of soil and other features.

Interviewed experts and the literature (for example Garcia et al. 2017) highlight the importance of being able to take into account annual variability in monitoring cycles and the assessment of results. In addition, the projects examined highlight the importance of integrating monitoring with advice windows. For example, to ensure effective tree establishment, monitoring combined with advice on ongoing tree maintenance and health at 3 to 5 years. Longer term monitoring regimes are still under development within most schemes, although checks at 10 years are commonly anticipated to look at growth rates, infield management and delivery of co-benefits.

The importance of integrating farmers into the monitoring process is highlighted. The current projects often still have monitoring formally undertaken by consultants or expert advisers to ensure continuity. The need for farmers to be fully engaged in such a process is identified, both to ensure their understanding of the results of monitoring and to enable them to adapt subsequent management. This is a further reason for the integration of advice with monitoring windows, to ensure the progressive and improved management of the agroforestry system as an integrated whole. As noted in Chapter 3.b, the maintenance of woody biomass requires a different set of skills and knowledge. Transition to agroforestry is an ongoing process, therefore monitoring and advice need to be tailored to the different stages and to evolve to effectively track results.

Monitoring is one element of a wider integrated approach to securing the robust delivery of an agroforestry carbon farming scheme. An example of this is provided in Box 3 below.

Box 3. Integration of farm assessment, planning, monitoring, and payment windows in the CarboCage hedgerow project

Diagnostic visit on farm to evaluate sequestration potential

↓

Identify all of scenarios for each hedge, management plan for the hedges with each scenario described, written a guide to the management plan

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First, baseline diagnostic visit in which hedges are mapped, then software calculates and prepares the plan

↓

Set up rolling five-year contract (negotiated to have first credit after 5 years)

↓

Control visit on the farm after five years, to assess implementation of the management plan

d. Reporting, verification and auditing: RV

Onsite verification by an independent party currently often overlaps with monitoring visits in the projects examined. This is because schemes are still often under development and hence monitoring of results is being integrated into scheme design. As the projects evolve it is anticipated that farmers would take on a greater role in completing monitoring themselves and as a consequence the verification process becomes an increasingly important way point. Most projects considered that, as for monitoring at present, verification points should be integrated with advice to support transition and improvement against result parameters. This suggests that it should be completed by experts or advisers rather than by a separate certifying body. The intention is that by making this linkage between verification windows and advice you support the ongoing retention and quality of the woody features contributing to the permanence of the interventions.

The Woodland Carbon Code has already undertaken on site checks, which are completed at year 5 and considers factors such as tree size, weeding, replanting needs, deaths. This check involves a site visit by the verification body where they review sample plots. At year 15 there is a further forest measurement check looking at tree height and diameter. This is currently in its trial stage.

An important question for verification is how the burden of onsite checks can be managed. Under the CarboCage project a grouped approach can be applied, if associations of up to 10 farms have been established. Within this grouping only some of the farms will be selected to be audited by the controlling authority. However, all farms will be visited at least once within the first 5 years to ensure understanding of the interventions needed and to make links to improvement needs and advice.

6. Paying for results

a. Different modalities for payment – supply chain vs credits

Within the projects examined, different approaches to payment for results are represented. The CarboCage and Woodland Carbon Code are based on carbon credits. In the case of the Woodland Carbon Code these are credits that can be used by the purchaser to offset their emissions, for corporate social responsibility goals. They are allocated to the buyer after purchase and therefore are not openly traded further. Within the CarboCage work there is a specific interest in generating support for the local sale of credits.

In contrast, the Coop scheme is supply chain driven i.e. the scheme has been set up by the Coop retailer, supported by the my-climate foundation, to pay fruit farmers within their own supply chain. The 'credit' from the investment achieved is then accounted exclusively to the Coop climate protection project.

b. Consideration of co-benefits and wider sustainability of delivery

In order to achieve co-benefits these should be integrated fully into scheme and objectives and design. This requires deciding if a co-benefit result indictor is to be part of the suite of result indicators that are monitored and paid for. Alternatively, some co-benefits can be achieved (and the risk of unintended environmental effects mitigated) through other elements of the scheme. These might be such as rules on which types of woody biomass or combinations of biomass are considered eligible, or, in the case of a hybrid scheme, action-based payments for extensive management of pasture vegetation.

A key challenge for agroforestry are the costs associated with transition and the transactional demands associated with adopting the approach. Payment calculations recognise this by establishing baselines for payment and providing ex-ante payments to farmers. These are often staggered to match windows in terms of establishment of the agroforestry system. For example, they may be linked to planting (in the case of new agroforestry interventions) or the completion of a management plan (in the case of the CarboCage project where the focus is on existing hedgerow improvement and retention). Payments are then made at 5 years in response to the next monitoring, verification and advice window linked to woody feature retention and quality of the feature produced.

It should be noted that many of the projects are combining start-up funding or income sources to deliver payments and advice. For example, the Coop project combines knowledge from earlier work under the AGFORWARD project (and other research work in Switzerland) with start-up funding from the Coop (for establishment, advice and support to a certain phase of growth) and then payments from public funds for established trees over a certain size class and age, available under rural development policy in Switzerland.

The Montado project is an example of the stacking of different types of result indicators to develop a weighted system of payment. Farmers would receive payments based on the level of result parameters they achieve (above a threshold) and can progressively improve performance and, as a consequence, payment.

In addition to time-phased payments most of the projects reviewed have put in place other requirements in contracts with those farmers undertaking the interventions. These include commitments to management plans and retention of the agroforestry features.

7. Governance, delivery, scaling up adoption and evaluation

a. Resource needs

it is important to recognise in planning for increased adoption of agroforestry systems that for many farmers this will be a significant change to their farming system, requiring new techniques and skills, plus access to markets they are unfamiliar with. For arable farmers in particular, used to planning their business on annual cropping cycles, the shift to production of timber or other tree products alongside their current crops introduces another time dimension to their business planning. Burgess et al. (2018) found that start-up costs of new agroforestry are a significant issue for farmers to overcome.

This means that, in addition to financial resources for establishment, specific skills, data and training/advisory resources will be required, which are tailored to the needs of 'new adopters', their advisers and funders. Such resources may often be lacking in the institutional framework of regions where agroforestry is unfamiliar, or is present but not recognised or supported for its climate, biodiversity and ecosystem service benefits. Therefore institutional capacity may be a limiting factor, and building it up is likely to be an initial priority.

Interviews for this case study revealed that in the CarboCage and Coop projects critical resource needs included:

- investment upfront in R&D that is relevant to the specific farming/agroforestry systems and situations under consideration;
- structuring the advice component and identifying how to transfer knowledge (in both directions) between experts, advisers, land managers and again back up the chain.

In the Montado project a critical factor is identifying the end use of the woody component and valorising the whole agroforestry system, thus transforming perceived costs into the source of future benefits and opportunities. This requires wider rural investment to support transition in the sector (e.g. knowledge transfer, marketing and processing infrastructure). There is potential to link agroforestry to the use of biomass in the wider bioeconomy to offset GHG emissions elsewhere – for example support materials for those developing new rural bioeconomy value chains[11].

b. Transparency

Transparency was not raised specifically in the interviews, perhaps because the agroforestry schemes reviewed in this case study are not primarily based on open markets (in contrast, for example, to forest production where internationally recognised forest certification schemes exist).

However, the projects do publish their implementation standards for review, and some have advisory groups supporting the project set-up, importantly involving experts and land users to co-create schemes (e.g. the Woodland Carbon Code and Montado).

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[11] See for example https://enrd.ec.europa.eu/enrd-thematic-work/greening-rural-economy/bioeconomy_en

A key factor is the importance of having a trusted, independent operator to validate commitments – working in cooperation with the scheme operators is key to effective validation and appropriate targeting. For example, myclimate[12] is the developer and coordinator of the Coop project; and Scottish Forestry, the Forestry Commission and the Welsh Government (the government forest agencies in the UK) support the credibility of the Woodland Carbon Code scheme and led its development. In France, CarboCage was developed in partnership with the municipality, based on existing RDP baselines and knowledge, with oversight provided by the overarching French Carbon Label (*Label bas-carbone*)[13].

A critical part of transparency under the Woodland Carbon Code is its carbon registry. This registry is operated by Markit Environmental and records the status of all carbon credits generated under the Code. It is key to ensuring market trust in the Code.

c. Upscaling adoption

1) How to promote adoption more widely?

Analysis of potential for upscaling of agroforestry has suggested targeting priority areas where agroforestry can make an impact on a multiple environmental problems associated with agricultural land such as threats to soil health, water quality, climate change and under-provision of biodiversity (Kay et al. 2018 and 2019a). This, together with regional (rather than plot scale) modelling of the GHG impact of increasing agroforestry at regional scale could be a useful approach to targeting upscaling efforts at those areas where the combined benefits for ecosystem services and agriculture are greatest.

In reality upscaling requires not just targeting of interventions but finding the right tools and financial support to ensure sufficient uptake by land managers in that area of the appropriate local practices for the establishment and maintenance of agroforestry at the scale required.

The Coop project, in working with first movers, has used networks in the organic community to upscale and communicate opportunities for agroforestry, based on observations that higher adoption of agroforestry has been observed in this community. The Montado project, working in traditional agroforestry systems, adopted a similar approach, but in this case working with actors inside or neighbouring Natura 2000 sites.

Many farmers perceived a need to create an assurance label for agroforestry products, or to incorporate agroforestry elements into other labels. For example, interviews highlighted a push to increasingly link trees to animal welfare. The example cited was for free range or organic chickens, where trees should be included for shading and well-being of the flocks. Interviewees also highlighted increasing interest in 'pharmaceutical hedges' i.e. planted with a diversity of forage known to promote animal health and their inclusion in high welfare standards for cattle. In Switzerland there is discussion of capturing the traditional value of having trees on the land in a label associated with adopting agroforestry.

There are some examples of using labels and connections with consumers in this way - for example, woodland egg production is integrated with free range egg standards in

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[12] https://www.myclimate.org/

[13] https://www.ecologique-solidaire.gouv.fr/label-bas-carbone

the UK. In France, CarboCage has established a link with the sustainable baseline for energy use of hedgerow timber, hence providing a market in parallel. An important point in using labelling to recognise wider adoption is that the added value link should be with the presence of an agroforestry system not simply compliance with another pre-existing characteristic.

2) Barriers to adoption

Resistance of farmers to adopting agroforestry is a major barrier. For them adopting agroforestry means additional costs, the need for new skills and competencies, and major change to their cropping systems. For example, even in France, a country where agroforestry raises a lot of interest, thanks to very active NGOs, only less than 1% of cropland is used for agroforestry. It is a very small share, compared to what could be possible. In other areas and farming systems where agroforestry is not already established, farmers may be reluctant to embark on this substantial change to their farming system. Sereke et al. (2017) found that farmers in Switzerland were unwilling to adopt agroforestry because they feared reputational damage. It is difficult to persuade farmers to adopt new, long term technologies such as agroforestry, where benefits may take a long time to become apparent and are difficult to demonstrate in the short-term (Graves et al.,2004).

One of the key barriers to upscaling noted in the interviews was access to markets for the woody material and other products from the tree component. These include products of ongoing management and regular harvests, and at the end of life in terms of maximising the benefit and longer term carbon sequestration associated with the use of timber materials. Also noted was the lack of direct market rewards for the increased provision of ecosystem services, for example of pollination and biodiversity in the Coop and Montado projects.

Overcoming these barriers will not be easy. Approaches include:

- advice and support provided by trusted sources from the outset to ensure appropriate tree species are selected and appropriately managed, to access relevant markets for a quality product that is useful[14];
- peer-to peer learning to promote confidence and acceptability;
- involvement of target farmers in result-based mechanism development, from the outset;
- investing in the transition of the wider rural economy and the skills and processing facilities within it. Making such connections with wider regional and rural development planning for transition to a sustainable bioeconomy can be important[15].
- availability of support under both Pillars of the CAP (direct payments and rural development interventions.

One important issue is the role of the 2014-20 CAP in encouraging improved uptake of new agroforestry and management of existing systems. Box 4 illustrates the type of Pillar 2 rural development support that is available for agroforestry (if Member

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[14] For example, the Coop study found that although fruit trees (as a subordinate crop) may not meet supermarket quality standards or be competitive with dedicated commercial orchards, their produce is acceptable for local markets and processed products such as jam.

[15] See for example https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-focus-group-agroforestry-final-report

States/regions choose to programme it) but this has been little used (Mosquera-Losada, 2018). Over recent years the CAP rules on eligibility of farmland with trees for area-based Pillar 1 direct payments have been redefined in a complex way that can have the unintended effect of discouraging farmers from increasing the number of trees on their land. Under the current rules a parcel of arable or pastureland with scattered trees is completely ineligible for the basic direct payment if there are more than 100 trees/ha. Where there are fewer than 100 scattered trees/ha, the area occupied by the tree stems is ineligible (because it cannot be used for agriculture), unless some of the trees are less than 10m apart, or are in a group of more than 3 trees, in which case the total area of the tree canopy is ineligible, regardless of the agricultural benefits of the trees in providing shade, shelter, grazing or browsing for livestock[16]. Farmers are likely to be discouraged from planting new trees in fields or allowing existing trees to develop to their full size, by the possibility of reduced farm payments or even financial penalties, if they fail to adjust the area calculation as the trees grow.

Box 4. Role of the 2014-20 CAP in the delivery of agroforestry carbon farming

The current CAP offers Member States the choice of a range of support measures relevant to carbon farming, and agroforestry in particular. These include:

- investment aid for the establishment and maintenance of new agroforestry systems;
- annual management payments and environmental investment support for the maintenance and restoration of traditional, biodiversity -ich agroforestry systems;
- ‘soft’ measures to support agroforestry – advice, knowledge transfer and training
- support for processing and marketing of products
- support for locally led and initiated ‘operational groups’ bringing together researchers, farmers and others involved in the supply chain to develop innovative solutions in agriculture

Use of these CAP-funded measures are optional – for both Member State managing authorities and individual land managers.

The proposed legislation for the next CAP programming period offers similar options – and importantly requires Member States to justify their choice in terms of both their territorial environmental needs and the contribution to EU environmental legislation.

d. Scheme evaluation

1) Improving knowledge, providing a basis for defining improved schemes and result indicators

In order to effectively assess scheme success, interviewees considered that it was important to have more formalised scientific analysis conducted at least on a subset of sites. Within this, comparison with control plots (no scheme) is important as well as the ability to compare conditions before an intervention is undertaken and then in a controlled way over time following the adoption of the agroforestry actions. This type of evaluation monitoring, which is quite separate from monitoring result indicators, was considered to usefully be applied to soil carbon (where there are key knowledge gaps in the agroforestry literature), and also to other co-benefit parameters that sit outside the scheme's reward framework. The literature highlights that for soil carbon the accumulation at different depths in the soil profile is important to assess (Seitz, 2017) so too is power analysis to control for natural variability in sampling (Upson et al., 2017).

In addition, there are questions in relation to how different types of intervention are interacting with local conditions and responding to different changes in cropping patterns, patterns of woody biomass introduction. Finally, there is a desire to more fully understand the co-benefits being offered to society by the different schemes. A formal monitoring component that enables change to be tracked, scheme success and effective tailoring of actions to be improved and overall scheme design to be improved is seen as vital. This is particularly important given the state of knowledge and early stage of development of result-based carbon farming schemes for agroforestry.

Findings of scheme evaluations do not reflect on the specific performance of an individual farmer but on the construct and delivery of the scheme itself. The evaluation and associated feedback/revision process should involve different stakeholders and enable data and knowledge to be passed on to others seeking to design similar approaches. The Woodland Carbon Code, for example, has a panel of stakeholders who support the ongoing development of the code, its management and any amends to the approach.

The evaluation of a scheme allows for reflection, not only on progress towards achieving the objectives in situ, but on other factors that might be important to promote future farmer uptake. In the case of agroforestry schemes critically this relates to the change in productive output and the opportunities available to valorise products from the woody biomass component. Scheme evaluation should consider how products are being integrated into supply chains and how improvements might be made both to scheme design and support needed more broadly in terms of rural development. Based on this scheme design could evolve to incorporate different woody species that provide more useful products, or alternative management to meet local market needs (i.e. for timber of a certain height, quality and diameter).

8. References

Aertsens, J., L.D. Nocker, A. Gobin (2013) Valuing the carbon sequestration potential for European agriculture. *Land Use Policy*, vol. 31, pp. 584–594.

Alliance Environnement (2020) *Evaluation of the impact of the CAP on habitats, landscapes, biodiversity*. Alliance Environnement (IEEP and Oréade-Brèche), Brussels.

Böttcher, H., C. Zell-Ziegler, A.Herold and A.Siemons (2019) *EU LULUCF Regulation explained: summary of core provisions and expected effects*. Öko Institute, Berlin. https://www.oeko.de/fileadmin/oekodoc/Analysis-of-LULUCF-Regulation.pdf

Burgess P.J., J. Harris, A.R. Graves, L.K. Deeks (2019) *Regenerative Agriculture: Identifying the Impact; Enabling the Potential*. Report for SYSTEMIQ, Cranfield University, Bedfordshire, UK.

Burgess, P.J., A. Rosati (2018) Advances in European agroforestry: results from the AGFORWARD project. *Agroforestry Systems*, vol. 92, no. 4, pp. 801–810.

Colombie, S. (2019) *CarboCage*, Presentation supplied at interview.

den Herder, M., G. Moreno, M.R. Mosquera-Losada *et al.* (2016) *Current extent and trends of agroforestry in the EU27*. Deliverable Report 1.2 for EU FP7 AGFORWARD Research Project (613520).

den Herder, M., P.J. Burgess, M.R. Mosquera-Losada, F. Herzog, T. Hartel, M. Upson, I. Viholainen, and A. Rosati (2015) *Preliminary stratification and quantification of agroforestry in Europe*. Milestone Report 1.1 for EU FP7 AGFORWARD Research Project (613520).

ENRD (2019) *European rural bioeconomy: policy and tools - Conclusions from the ENRD Thematic Group on 'Mainstreaming the bioeconomy'*
https://enrd.ec.europa.eu/sites/enrd/files/enrd_publications/bioeconomy-briefing_1_policy-and-tools.pdf

Felicianoa, D., F.A. Ledoa, J. Hiller (2018) Which agroforestry options give the greatest soil and above ground carbon benefits in different world regions? *Agriculture, Ecosystems & Environment*, vol. 54, pp. 117-129

Fornara, D.A., R. Olave, P. Burgess, *et al.* (2018) Land use change and soil carbon pools: evidence from a long-term silvopastoral experiment. *Agroforestry Systems*, vol. 92, no. 4, pp. 1035–1046.

García de Jalón, S., A. Graves, J. Palma, J. Crous-Duran, M. Giannitsopoulos, P.J. Burgess (2017) *Modelling the economics of agroforestry at field-and farm-scale*. Agforward (Agroforestry for Europe).

García de Jalón, S., A. Graves, J.H.N. Palma, A. Williams, M.A. Upson, P.J. Burgess (2017) Modelling and valuing the environmental impacts of arable, forestry and agroforestry systems: a case study. *Agroforestry Systems*, vol. 92, no. 4, pp. 1059-1073.

García de Jalón, S., P.J. Burgess, A. Graves, *et al*. (2018) How is agroforestry perceived in Europe? An assessment of positive and negative aspects by stakeholders. *Agroforestry Systems*, vol. 92, no. 4, pp. 829–848.

Graves A., R. Matthews, K. Waldie (2004) Low external input technologies for livelihood improvement in subsistence agriculture. *Advances in Agronomy*, vol. 82, pp. 473-555.

Hart K., B. Allen, C. Keenleyside, S. Nanni, A. Maréchal, K. Paquel, M. Nesbit, J. Ziemann (2017) *The Consequences of Climate Change for EU agriculture: Follow-Up to the COP21 UN Paris Climate Change Conference*. Research for the AGRI Committee.

https://www.iccc.mfe.govt.nz/assets/PDF_Library/71f6945caa/FINAL-ICCC-Technical-Appendix-8-Carbon-sequestration-on-farms.pdf

Interim Climate Change Committee (ICCC) (2019) Action on agricultural emissions, Technical 8 appendix, Counting carbon sequestration by trees and vegetation on farms https://www.iccc.mfe.govt.nz/assets/PDF_Library/71f6945caa/FINAL-ICCC-Technical-Appendix-8-Carbon-sequestration-on-farms.pdf

IPCC (2019) *Special Report on Climate Change and Land. An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. https://www.ipcc.ch/srccl/

Joller, P. (2017) *Agroforstwirtschaft in der Schweiz, Das Potential von Wertholzproduktion mit Obstbäumen*. Masterarbeit, Bern University of Applied Sciences.

Kay S., M. Jäger, F. Herzog (2019) Protecting resources with agroforestry systems: regionally adapted solutions. *Agrarforschung Schweiz*, vol. 10, no. 9, pp. 308–315.

Kay, S., A. Graves *et al.* (2019) Agroforestry is paying off. Economic evaluation of ecosystem services in European landscapes with and without agroforestry systems. *Ecosystem Services*, vol. 36, p. 100896.

Kay, S., C. Rega, G. Moreno *et al.* (2019) Agroforestry creates carbon sinks whilst enhancing the environment in agricultural landscapes in Europe. *Land Use Policy*, vol. 83, pp. 581–593.

Kay, S., Crous-Duran, J., Ferreiro-Domínguez, N. *et al*. (2018) Spatial similarities between European agroforestry systems and ecosystem services at the landscape scale. *Agroforestry Systems*, vol. 92, pp. 1075–1089.

Martineau H., J. Wiltshire, J. Webb, K. Hart, C. Keenleyside, D. Baldock, H. Bell, J. Watterson (2016) *Effective performance of tools for climate action policy - meta-review of Common Agricultural Policy (CAP) mainstreaming*. Report for European Commission – DG Climate Action.

Moreno, G., M. Bertomeu, Y. Cáceres, M. Escribano, P. Gaspar, A. Hernández, M.L. López, F. J. Mesias, S. Morales, M. J. Poblaciones, F. Pulido, O. Oscar Santamaría (2017) *Lessons learnt: Iberian dehesa.* Agforward (Agroforestry for Europe), Contribution to Deliverable 2.5 Lessons learnt from innovations within agroforestry systems of high natural and cultural value.

Mosquera-Losada M. R., R. Borek *et al.* (2017) *Agroforestry. Mini-Paper: Introducing woody vegetation into specialised crop and livestock systems.* EIP-AGRI Focus Group. European Commission. Accessed at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_mp9_cc_adaptation_mitigation_2017_en.pdf

Mosquera-Losada M.R., J.J. Santiago-Freijanes, A. Pisanelli *et al.* (2018) Agroforestry in the European Common Agricultural Policy. *Agroforestry Systems*, vol. 92, pp. 1117–1127.

Mosquera-Losada, R. Borek *et al.* (2017) *Agroforestry. Minipaper: Agroforestry as a mitigation and adaptation tool.* EIP-AGRI Focus Group. European Commission. Accessed at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_mp9_cc_adaptation_mitigation_2017_en.pdf

New Zealand Interim Climate Change Committee (2019) *Action on agricultural emissions: Technical 8 appendix: Counting carbon sequestration by trees and vegetation on farms*. Wellington. Accessed at: https://www.iccc.mfe.govt.nz/assets/PDF_Library/71f6945caa/FINAL-ICCC-Technical-Appendix-8-Carbon-sequestration-on-farms.pdf

Olmeda C., C. Keenleyside, G.M. Tucker, E. Underwood (2014) *Farming for Natura 2000. Guidance on how to support Natura 2000 farming systems to achieve conservation objectives, based on Member States good practice experiences*. Report to the European Commission, DG Environment on Contract No.070307/2010/580710/SER/B3, Institute for European Environmental Policy, London.

Ramos Font M.E., F. Balaguer *et al.* (2017) *Agroforestry. Minipaper 8: Important considerations and alternative approaches to assess ecosystem services in agroforestry systems*. EIP-AGRI Focus Group. European Commission. Accessed at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg22_mp8_ecosystem_services_2017_en.pdf

Rois-Díaz, M., N. Lovric, M. Lovric *et al*. (2018) Farmers' reasoning behind the uptake of agroforestry practices: evidence from multiple case-studies across Europe. *Agroforestry Systems*, vol. 92, no. 4, pp. 811–828.

Seitz B., E. Carrard, St. Burgos D. Tatti, F. Herzog, M. Jäger, F. Sereke (2017) Increased SOM stocks in a seven-year-old agroforestry system in central Switzerland, *Agrarforschung Schweiz*, vol. 8, no. 7-8, pp. 318–323.

Sereke F., M. Dobricki, J. Wilkes, A. Kaeser, A.R. Graves, E. Szerencsits, F. Herzog (2017) Swiss farmers don't adopt agroforestry because they fear for their reputation. *Agroforestry Systems*, vol. 90, no.3, pp. 385–394.

Siedler, S. (2016) *Untersuchungen zur Wurzelverteilung in einem Schweizer Agroforstsystem*. Masterarbeit. University of Vienna.

Waldén, P., M. Ollikainen, H. Kahiluoto (2020) Carbon revenue in the profitability of agroforestry relative to monocultures. *Agroforestry Systems*, vol. 94, no. 1, pp. 15–28.

9. Sources of further information

AGFORWARD https://www.agforward.eu/index.php/en/

EURAF (European Agroforestry Federation) http://euraf.isa.utl.pt/welcome

EIP-AGRI Focus Group on agroforestry https://ec.europa.eu/eip/agriculture/en/focus-groups/agroforestry-introducing-woody-vegetation

10. Project descriptions

a. CarboCage

The CarboCage project[16] aims to engage the territories in the sustainable management of hedges, allowing the storage of emitted carbon. This phenomenon has many advantages including the resolution of erosion problems, optimized water management and timber production. This pilot project is funded by the ADEME[17] over 3 years, it makes it possible to design a method ensuring the evaluation of carbon storage by hedges and proposes the experimentation of a local carbon market in 3 pilot territories: the Pays des Mauges, the Land of King Morvant and the Land of the Sarthe Valley. This experience is intended to be scaled up in other territories.

The project originates from an RDP initiative to valorise hedgerows in the Pay de Loire region. The work included fundamentally the balancing of co-benefits, especially carbon with biodiversity. The project set up included research element alongside scheme design intended to develop a knowledge base on sequestered carbon specific to the bocage of the region. The mechanism was developed in response to the loss and decline in effective management of hedgerows in the region that are valued for their landscape value as well as their wider benefits.

b. Woodland Carbon Code

The Woodland Carbon Code is the voluntary standard for UK woodland creation projects where claims are made about the carbon dioxide they sequester. Independent validation and verification to this standard provides assurance and clarity about the carbon savings of these sustainably managed woodlands. The code is managed by Scottish Forestry and the other UK forestry authorities and was developed in collaboration with a broad stakeholder group. It seeks to reward additional carbon sequestered through woodland creation. It bases this on sequestration levels in biomass. Soil carbon is considered in terms of emissions of carbon during and following establishment and of soil carbon accumulation under certain circumstances where planting takes place on mineral soils. To meet the requirements of the Code, parties have to meet national forestry standards that include rules on biodiversity and the sustainable management of forests. Once credits are purchased by organisations wanting to use them, they are allocated to these organisations and cannot be used by another organisation. Organisations use credits both for offsetting purposes and to meet corporate social responsibility goals.

c. Coop project

In Switzerland the Coop retailer has been supporting farmers within its supply chain to plant trees on their land to deliver GHG emission reductions[18]. The emission reductions per tree are calculated and are then accounted exclusively to the Coop

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[16] https://pays-de-la-loire.chambres-agriculture.fr/publications/publications-des-pays-de-la-loire/detail-de-la-publication/actualites/projet-carbocage-valorisez-le-carbone-stocke-par-les-haies-sur-vos-territoires/ https://www.ademe.fr/carbocage-vers-neutralite-carbone-territoires

[17] ADEME (the Ecological Transition Agency) is a public establishment under the supervision of the Ministry of Ecological and Inclusive Transition and the Ministry of Higher Education, Research and Innovation in France.

[18] https://www.myclimate.org/information/partners-in-climate-protection/partner-detail/coop-co2-avoidance-in-the-supply-chain/

climate protection project. However, while the purpose is emission reductions, the scheme is specific in that it provides support and advice to deliver 'fruit trees' and wood of sufficient quality for material use at end of their productive life. This is intended to support diversification of activities and income on farm, and of the landscape promoting other co-benefits linked to biodiversity, water management and climate adaptation. The advice and support is tailored to upskill farmers in more forestry based techniques to promote effective tree sighting, health and increase stand height compared to traditional fruit trees. The Coop supports surveys regarding tree suitability, planting and advice to ensure tree quality and retention; meanwhile this is complemented by government support for existing trees on land.

d. **AGFORWARD** (AGroFORestry that Will Advance Rural Development)

A four-year research project funded by the EU's Seventh Framework Programme for Research and Technological Development (FP7), started in 2014. The overall aim was to promote agroforestry practices in Europe that will advance rural development i.e. improved competitiveness, and social and environmental enhancement. Key to this case study is the analysis completed on the economics and ecosystem service benefits of agroforestry and how upscaling might be undertaken across Europe and its associated benefits. In addition the project developed a definition of agroforestry that has been subsequently adopted in the wider literature and used as the basis for this analysis. Finally, and important in terms of agroforestry carbon farming adoption, the project produced a series of best practice leaflets explaining key agroforestry approaches and also offering advice on key stages of implementation of a new agroforestry intervention[19].

e. Montado

This work originated as a results based scheme intended to promote biodiversity and the wider retention of the Montado's key features. The approach is being developed by the University of Evora in coordination with and collaboration with farmers in the region. It developed from the findings of an earlier H2020 project. The intention is to valorise the effective management of the Montado that is so central to the retention and importantly regeneration of the system (which relies on natural regeneration of the tree element). The approach would look to stack and potentially weight results based indicators (developed in coordination with farmers) to allow different features to be rewarded reflecting soil protection, regeneration and biodiversity goals. The retention of the system would secure the retention of sequestered carbon and better management should promote improvements in carbon storage.

f. CarboHedge

This project led by the Thunen Institute is more research in focus investigating and trying to develop benchmarks to understand the carbon sequestered in hedgerows and field copses in Germany. The project is bringing together the wider literature and then running infield assessments comparing hedgerow parameters to sequestered carbon in biomass and soils.

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[19] https://www.agforward.eu/index.php/en/best-practices-leaflets.html

11. Interviews and reviews

The authors warmly thank the following interviewees for their contribution to this case study and the reviewers* for their helpful comments on the draft report.

Table 3 Interviews and reviews

Name of expert	**Project**	**Organisation**
Pat Snowden*	Woodland Carbon Code	Scottish Forestry
Sarah Colombie	CarboCage	Chambre Regionale d’Agriculture des Pays de la Loire
Paule Pointereau	CarboCage/Hedgerow certification in Pays de la Loire	Afac-agroforesteries (Developing standards for hedgerow extraction to support retention and market access)
Maria Isabel Ferraz de Oliveira	Montado	Universidade de Évora
María Rosa Mosquera-Losada	Lead author of EIP-AGRI report on agroforestry	University of Santiago de Compostela
Teresa Pinto Correia	Montado	mtpc@uevora.pt
Paul Burgess	AGFORWARD	Cranfield University
Elsa Lagerquist		Stockholm University
Sonja Kay*	AGFORWARD	Agroscope
Mareike Jäger	Coop (Switzerland)	Zurich University of Applied Sciences (ZHAW)
Ian Rothwell*	Coop (Switzerland)	myclimate
Bettina Kahlert	Coop (Switzerland)	myclimate
Sophie Drexler	Hedgerow carbon project, Germany	Thunen Institute
Patrick Worms		EURAF

Annex III

MAINTAINING AND ENHANCING SOIL ORGANIC CARBON (SOC) ON MINERAL SOILS

A CARBON FARMING CASE STUDY

Table of Contents

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Summary and recommendations

Context**:** Soil organic carbon (SOC) has proven benefits for soil quality, agricultural productivity, and climate mitigation and adaptation. The potential for SOC sequestration in the EU is estimated to be between 9Mt (Frank et al., 2015) and 58Mt CO_2eq per year (Lugato et al., 2014). Furthermore, maintenance of existing SOC levels is crucial given that many mineral soils continue to lose SOC. The estimated EU annual emissions from mineral soils under cropland are 27 Mt CO_2eq (EC 2018). Research and existing SOC initiatives show that farmers can apply a range of management practices to benefit SOC levels, including cover cropping, improved crop rotations, agroforestry, preventing conversion to arable land, and conversion to grassland. Many of these practices are cost-effective. The heterogeneity of soils, climatic conditions, existing SOC levels and management practices, however, mean that the potential for sequestration can vary significantly at farm and plot level.

Case study's aim and scope: Result-based carbon farming schemes can provide incentives to increase SOC by rewarding farmers for improvements in SOC levels. This case study explores steps and considerations for designing and implementing result-based carbon farming schemes focused on the maintenance and enhancement of SOC in mineral soils, potentially applicable to arable land, grassland, as well as horticulture and permanent crops.

Recommended SOC sequestration scheme - summary

Objective: Incentivise increases in SOC stocks while ensuring that the overall GHG balance is improved as well.

Scale/coverage: arable land, grassland, horticultural use, or permanent crops on any type of farm, with the provision that all applicable land on the farm is included in the scheme.

Climate actions: any actions that maintain and increase SOC levels and benefit soil health

Overarching considerations: (1) the selection of a monitoring, reporting and valuation (MRV) approach (measurement or estimate) and (2) the acceptable level of environmental uncertainty.

Scheme types and governance: Existing schemes can be grouped in four main types:

1. Schemes where farmers are offered a menu of measures from which to choose, but where payments are calculated based on the expected result of the measure rather than the income foregone or additional costs. At the same time, monitoring of SOC levels is done on a subsample of farms so that the overall project impact and measure impact can be estimated. This is a learning-by-doing approach, where experience is gathered on results aspects.

2. Hybrid scheme: where farmers are paid up-front with a guaranteed payment (thus acting similarly to an action-based payment), the monitoring is done at regular intervals, and the farmers receive a top-up at the end of the commitment period which rewards the difference between the upfront payment and the total result.

3. Certified credits or pure result-based schemes: where farmers are paid solely for the measured or estimated result in changes in SOC levels on an ex-post basis.

4. Company efforts as part of reducing carbon footprint in supply chains.

The governance and MRV requirements vary across these schemes.

Monitoring, reporting and valuation (MRV): Farm-level monitoring quantifies improvements in SOC levels (t CO_2eq) as a minimum; schemes should demonstrate steps taken to quantify the full GHG balance associated with soil management (i.e. GHG emissions associated with tillage or fertiliser application are accounted for) since SOC sequestration also has an emission component to it.

Typical project steps include:

Step 1: Baseline level of SOC on the farm is established via sampling and/or calculation that is sufficiently robust. There is strong preference for sampling and where calculation approaches are used, these should be robustly ground-truthed;

Step 2: Farm advisors/consultants assist farmers to identify management actions to maintain/enhance SOC levels and develop a SOC management strategy for the project period as a minimum;

Step 3: Farmers implement the actions and keep records;

Step 4: Farms are visited by farm advisors in selected intervals (a minimum one time during the project); a second sampling is conducted; an evaluation discussion takes place to adjust management if needed; a payment is issued depending on the sequestration that has occurred; or a second guarantee payment is issued;

Step 5: At the end of the project duration, a final measurement takes place;

Step 6: Farmer commits to maintaining the levels for a minimum of 5 years after receiving the last payment. To buffer against short commitment periods, discounting and buffers are applied. Schemes should strive to increase the commitment period to at least 10 – 15 years and include robust buffers.

Rewards: Farmers are rewarded at a set rate of € per tonne of sequestered carbon, as long as they meet eligibility criteria. To reduce the risk for farmers and increase the rates of uptake, a hybrid model may be necessary, whereby farmers are paid for management changes topped up with a bonus for amount of t CO_2eq sequestered.

Design principles: 1) *reduce MRV costs* while maintaining robustness; (2) *shift costs away from farmers* (to maximise farmer uptake and decrease overall scheme costs); (3) *learning-by-doing* through refinement of MRV as improved or more cost efficient methods become available.

Learning from existing projects and methodologies: Scheme designers should draw on experience from ongoing initiatives and projects, in particular from French Carbon Agri SOC methodology (expected in autumn 2020), Indigo AG Carbon Pilot (the draft methodology is open for consultation[1]), Gold Standard SOC Framework Methodology, Ebenrain Humusprojekt and Solothurn Project in Switzerland, LIFE Carbon Farming Project in Finland, CarboCert Germany, Kaindorf Humuszertifikate. Moreover, FAO has published a protocol for SOC monitoring, reporting and valuation (MRV) that should be considered[2].

Scope and knowledge basis: The scheme focuses on mineral soils, including under cropland, horticultural land, grassland and in agroforestry systems (including permanent crops). It is advised to have assessments of the existing SOC levels and expected potential at national / regional scale, as well as more granular understanding of what management practices lead to the greatest SOC sequestration and with what effect. These assessments can also be integrated as research components of pilot scheme developments. They enable targeting of SOC activities to areas with the highest potential for SOC increase, for example degraded soils. Finally, they provide guidance for directing efforts in terms of the design of result-based schemes (for example, in setting payment levels or eligibility criteria). Where the potential for carbon sequestration is large (the change occurs faster and the total amount of carbon

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[1] Methodology for improved agricultural management, currently under consultation with Verra (https://verra.org/wp-content/uploads/2020/06/Methodology-for-Improved-Agricultural-Land-Management-5JUNE2020.pdf)

[2] http://www.fao.org/3/cb0509en/cb0509en.pdf

sequestered leads to higher reward), this leads to improved reward – transaction cost ratio and scheme uptake.

Eligibility: The scheme should operate on the same selection of land through the whole duration of the project. It is also recommended that a whole farm approach is taken, i.e. all mineral soils and eligible land use types on the farm are included in the project. This will avoid that increases in SOC in one part of the farm is offset with losses on another part. Moreover, it is recommended that the SOC increase is achieved without the application of additional organic fertilisers. While this reduces management options and the speed of SOC sequestration, it avoids leakage effects.

Uncertainties and monitoring, reporting and valuation (MRV) costs: Two main approaches for setting the baseline and monitoring of SOC changes are available: a measurement approach via sampling and an estimation approach via combined sampling and modelling. In both cases, costs are currently high, posing barriers to the scheme's feasibility. However, several initiatives and technological developments are ongoing that are anticipated to reduce these costs over the coming years. In the meantime, the scheme designers should ensure that the uncertainty level is clearly acknowledged and addressed in the reward / buffer element of the scheme. As new technological developments that have potential to reduce some of the costs of MRV and increase certainty in assessments become available, these should be utilized. MRV costs borne by farmers should be kept low.

Building knowledge: Having sufficient detailed knowledge on the site-specific potential of agricultural measures to sequester SOC enables scheme designers to better set the reward values and understand the economic costs and benefits of a project in a given area. If this knowledge is not available from the outset, it can be generated during the project duration. Data generated by applying the scheme should be stored and used to evaluate and improve knowledge on SOC levels, and can be used to ground-truth and train models.

Farmer engagement: Actively engaging farmers in the scheme design process and regularly consulting them through the operation can increase farmer buy-in and uptake. Since economic incentives are a key first attractor for farmers, costs borne by farmers can be kept low by accepting greater uncertainty and therefore relaxing MRV requirements, simplifying design (e.g. by restricting participant eligibility to similar participants), or by investing upfront to reduce ongoing transaction costs to farmers. Increased media and public interest in climate issues can increase farmer interest; however, new knowledge and skills are also needed. The scheme should integrate from the outset, training and advisory opportunities that facilitate farmer learning, including peer-to-peer learning.

Additionality: Schemes need to aim for environmental additionality (climate actions that would not have occurred in the absence of the scheme and that lead to improved SOC levels), regulatory additionality (project activities go beyond what is required by law) and financial additionality (without the scheme rewards, the costs of the action would outweigh the benefits).

Results indicators: Currently, the reviewed projects mostly focus on the changes in SOC levels as the key result indicator. However, the schemes should move towards accounting for the whole GHG balance associated with increasing SOC levels to ensure that the full climate impact is captured (including CO_2, CH_4 and N_2O emissions associated with soil management). Monitoring co-benefits (in particular yield, water holding capacity, and economic efficiency) can be used to facilitate farmer recruitment.

Crediting period: The choice of the period should be adjusted depending on the anticipated time after which expected changes can potentially be observed in the specific biophysical and climate context. This should be based on published peer-reviewed scientific results. In general, 5 years is the minimum commitment period set by existing projects. The crediting period can vary from 5 to 20 years.

Non-permanence and buffers: A buffer account should be used as a carbon credit reserve to cover any unintentional reversals. These buffers can be general (i.e. a % set aside from all payments) or targeted, i.e. a % set aside for farms with especially uncertain results in terms of SOC change. For example, farms that only complete less stringent MRV may have a higher % buffer.

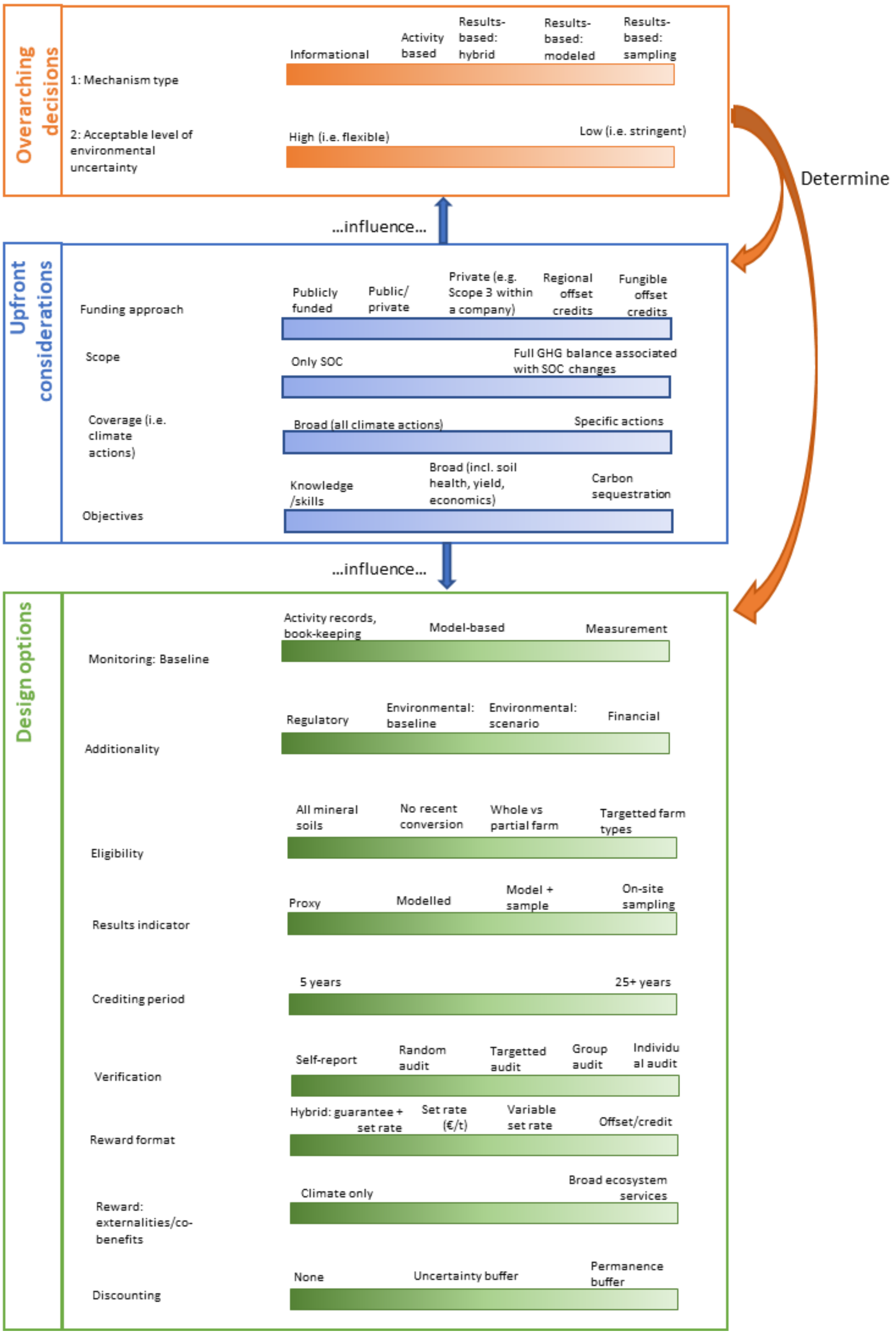
Reward: Depending on the robustness of MRV and the purpose for which the results are used, scheme designers should consider several options. These can also be seen as stepping-stones through which the scheme can move as additional knowledge / MRV capacity and experience are gathered: 1) Payments are calculated based on the expected results of a menu of measures from which the farmer gets to choose. SOC levels are monitored on a subsample of farms so that the overall project and measure impact can be estimated. 2) Hybrid scheme: Farmers receive a guaranteed payment up-front (activity-based). A top-up is paid based on monitoring results, rewarding the difference between upfront, activity-based, payment and total result. 3) Result-based schemes/certified credits: Farmers are paid solely for the measured or estimated changes in SOC levels on an ex-post basis.

Paying farmers **a set payment per tonne** of carbon sequestered over the project period supports farmer uptake, as it reduces their price uncertainty and increases attractiveness of the scheme.

Funding and governance: If schemes want to develop verified, fungible offset credits or verified emissions reduction certificates, schemes must meet the standards set by external verifying authorities and beyond (for example, Label Bas Carbon, Gold Standard, Verra). Schemes can also seek external funding without having external verification. Schemes that do not seek external funding can be more flexible in their governance.

Overall conclusion: SOC maintenance and sequestration is an important mitigation option with significant co-benefits for agriculture and ecosystem health. High MRV costs and uncertainty associated with sequestration potential / impact and risk of reversibility at farm / field level pose a barrier to result-based mechanisms. Ongoing technological developments, increasing knowledge base (on more granular potentials and impacts of agricultural practices) and learning-by-doing can support the transition from more activity-based to hybrid and fully result-based mechanisms. In the short term, management-based payments and hybrid mechanisms may be more attractive and feasible for upscaling.

Figure 1 Visual guide to SOC case study.



Note: Overarching decisions determine upfront considerations and design options. Upfront considerations will influence overarching decisions and shape design options.

1. Introduction

Soil carbon sequestration involves increasing the soil organic carbon stock by creating a positive balance of C inputs to soils compared to losses of C from soils. Given the historical and ongoing losses of existing soil organic carbon (SOC) stocks, preventing further losses of carbon from mineral soils is essential as a large share of agricultural soils would continue losing C without improvements in management (Wiesmeier et al., 2020a).

This case study explores steps and considerations to be taken into account in designing and implementing a result-based carbon farming scheme focused on the maintenance and enhancement of SOC levels in mineral soils, potentially applicable to arable land, grassland, as well as horticulture and permanent crops. The approach potentially applies to agroforestry systems for the below ground component. The report covers elements necessary to establish a result-based scheme in the European context. It outlines the steps and considerations a scheme manager - a regional authority, national government, a private or a not-for-profit initiative - will need to take to establish such a scheme, identifying key trade-offs and open questions to be considered.

This document builds on existing schemes, research projects, and Monitoring, Reporting Valuation (MRV) methods for SOC sequestration. We also analysed elements from result-based schemes focussed on other agricultural areas, especially the relatively longstanding Woodland Carbon Code (active since 2011), MoorFutures (since 2012), and VCS methodologies. The case study is also based on discussions with stakeholders at the 2019 Carbon Farming roundtable, interviews with stakeholders, as well as grey and academic literature.[3]

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[3] See Chapters 8 for references and Chapter 10 for the list of interviewees.

2. Exploring options – choosing the approach

a. Putting the case study in context

The management of SOC levels as a climate action gained more widespread public attention following the launch of the "4 per 1000" initiative during the COP21 in Paris in 2015. Much attention after this launch has been given to the mitigation potential, as explained below. Since then, a number of projects and initiatives have emerged that aim to set up schemes to incentivise SOC sequestration. Within the context of arable farming, the focus has been primarily on sequestration. The issue of the maintenance and historical decline, including in the last decade, has received less explicit public attention. However, maintenance of SOC levels may be a central challenge for some regions given both the continuation of agricultural practices that lead to negative balance of inputs / losses of carbon, as well as anticipated changing climatic conditions which increase mineralisation of organic matter. Schemes need to consider how changing climatic conditions will affect SOC mineralisation and may need to consider rewarding maintenance of existing SOC levels, under the condition that there is sufficient knowledge to establish the counterfactual scenario.

Some of the ongoing initiatives in Europe include:

Result-based schemes already in place:

- Ebenrain Humusprojekt co-funded by Basellandische Kantonalbank, Switzerland
- Kaindorf Humuszertifikate, Austria
- CarboCert, Germany

Activity-based or awareness-raising projects:

- Solothurn Project, Switzerland
- Carbon Action in Finland

Projects in development:

- LIFE Carbon Farming Scheme project, Finland
- Collaborative project among dairy companies developing a common MRV methodology to account for SOC sequestration (CSequ project)
- Earthworm & Nestle project Living Soils
- Development of SOC methodology under the Label Bas Carbon in France
- Climate KIC funded project on carbon farming schemes in France
- Indigo AG Carbon Pilot aiming to create a scalable business model in the EU to reward farmers for SOC sequestration, drawing on their US experience
- Positerra, Germany
- Soil Association project Carbon Assets for Soil Health, UK

In terms of **EU policies**, soils and climate currently do not have an explicit policy target. Various policy documents refer to the role of soils in the context of climate mitigation and adaptation, and the LULUCF Regulation sets up a framework for national accounting of changes in C content of soils (Böttcher et al., 2019). Given the increasing visibility of carbon sinks in climate policy, these are becoming gradually integrated in policy. Specifically, the importance of nature-based carbon sinks is recognized by the Farm to Fork and the Biodiversity 2030 strategies published in May 2020, which also mention the role of agricultural soils. Several initiatives are expected as a result of these strategies that will shape the policy context in the coming years for SOC sequestration. These include: funding under CAP for carbon farming and agroforestry, a framework for certifying carbon removals, a proposal for legally binding restoration targets to be published by 2021, a target of 10% of agricultural area under high-diversity landscape features, and the update to the EU Soil Thematic Strategy in 2021.

b. Soil carbon sequestration potential on mineral soils

The range of estimates for the EU for cropland SOC sequestration ranges from 9 Mt (Frank et al., 2015) to 58 Mt CO_2eq per year (Lugato et al. 2014(. In terms of emission savings from maintaining current stocks of SOC, the 2016 UNFCCC inventories for the EU estimate 27 Mt CO_2eq emissions from mineral soils under cropland and 41 Mt CO_2eq sequestered on mineral soils under grasslands (EC, 2018). The emissions per year are expected to decline by 39% for the total sum of mineral and organic soils even in absence of management changes (Frank et al., 2015). However, the total current and remaining amount underlines the importance of both reversing the continued losses and ensure additional sequestration of SOC.

Following the initial publication of the “4 per 1000” initiative, a debate emerged around the feasibility of the SOC sequestration goal set out by the initiative. The initiative has since emphasized that the goal should be seen more as an aspirational goal than a quantitative target. There is overall scientific consensus that the option is an important contribution to increasing carbon sinks (e.g. EC 2018, Wiesmeier et al., 2020a). However, there remain uncertainties around the estimates and the technologically achievable potential may be more constrained (Batjes, 2019). SOC sequestration on mineral soils is a relevant mitigation option given the ambitious scale of the overall mitigation that needs to be achieved. Nonetheless, its potential should not be over-emphasized at the expense of other mitigation options (in particular, reducing emissions from organic soils, or reducing livestock emissions). Moreover, there is clear agreement that the adaptation effects of SOC maintenance and sequestration are significant, and may even be more important than the mitigation impact (Powlson et al., 2011, Amundson and Biardeau, 2018). Soil carbon projects can fit in well with an adaptation strategy especially in areas increasingly affected by dry periods / droughts, and where improved water storage capacity improves stability of yields and resilience of production.

The choice of management practices that have the most significant potential for the maintenance and sequestration of SOC on mineral soils vary according to climate and biophysical conditions (soil type), as well as to the production system involved. The largest potential is associated with: 1) cover cropping; 2) improved crop rotations (e.g. through inclusion of legumes and other nitrogen fixing crops); 3) agroforestry established on cropland or grassland; 4) preventing conversion of grassland to arable land and additional conversion from arable to grassland; 5) organic farming; 6) and management of grazing and grassland to increase SOC levels.[4]

The SOC sequestration potential and the most relevant practices in specific contexts need to be worked out at a more granular scale to take account of the spatial and

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[4] The Global Soil Partnership is preparing a technical manual on “Best soil management practices for soil organic carbon maintenance and sequestration” to be published by the end of 2020.

temporal complexity, reflecting soil types, climate, and management conditions (FAO 2017). Some of these regional and national assessments within the EU are available or underway (e.g. Pellerin et al., Wiesmeier et al., 2020a). These assessments establish a basis to:

1. Understand what the current stocks are – i.e. the baseline: this requires improved reference values for existing stocks rather than relying on 2006 IPCC Tier1 stock reference values, which are crude and have insufficient granularity with respect to soil types and climatic regions (FAO, 2017);
2. What the saturation points are and how much potential there is for sequestration in a specific regional / farming context;
3. What management practices lead to the greatest SOC sequestration and with what effect: understanding stock change factors;
4. Where the most significant potentials regionally are, as well as where the risks for losses of current SOC are.

This in turn enables targeting of SOC activities to areas with the highest potential to increase SOC levels, for example degraded soils or soils which are far from their saturation potential. These assessments also show where existing high stocks need to be maintained and losses prevented. Finally, they provide guidance for directing efforts in terms of the design of result-based schemes (for example, in setting payment levels or eligibility criteria).

Table 1 gives an overview of the main advantages and challenges of setting up result-based scheme for SOC sequestration.

Table 1. Advantages/challenges of result-based scheme relative to traditional, activity-based approaches

Advantages	**Challenges**
Farmer flexibility: Result-based schemes allow farmers to manage soils without prescriptive rules and this increases their flexibility; the monitoring can provide useful feedback to farmers and increase their knowledge and ability to manage soils for multiple purposes, including SOC levels. Farmers **benefit from the data** that the sampling provides them (in addition to SOC levels, other soil quality parameters can also be measured). Payments are clearly linked to impact, which can provide for **better efficiency and value for money** for the use of public or private funds. The approach can be applicable to a broad range of activities. They provide a **means of channelling private funds into climate action**.	There is still **uncertainty** in estimating the potential for SOC sequestration at a more granular scale, which is relevant for farm-level schemes. Quantification of SOC improvements is dependent on data being available for a number of parameters; given this, the design of the scheme is more difficult. Existing methods cannot accurately measure how quickly carbon accumulates on a particular farm. To gather sufficient data and to enable monitoring and verification of results (MRV component) **increased administrative effort and skills** are required, compared to management schemes. The **costs** of MRV for SOC are currently high and, depending on who bears the costs, they may involve financial risks to farmers. Cost-benefit calculations per hectare improve with economies of scale, which may limit participation of smaller farmers[5]. Future developments are anticipated to reduce these costs. Result-based schemes are more **knowledge-intensive** and have potential **risks** for farmers if the results and therefore payments do not realize. The heterogeneity of fields, (changing) climatic conditions, and potential for sequestration may mean that the sequestration may not realize at a level that would cover the costs of efforts for the farmer.

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[5] The Australian experience indicates that the break-even size for grazing systems to participate in the Carbon Farming Initiative is currently 40 ha, with 100 ha being the commercial minimum.

3. Feasibility, support, and enabling scheme development

The feasibility of the scheme relies on being able to measure or robustly estimate (calculate) changes in SOC levels for different types of soils and climatic conditions. The most important challenges are:

1. Reducing the cost of MRV while ensuring robustness (which is guaranteed by independent scientific peer review);
2. Dealing with uncertainties and missing knowledge with respect to what potentials for SOC there are at a more granular scale and how to navigate these uncertainties – i.e. making progress on SOC whilst not having detailed knowledge and certainty;
3. Reducing the risk of reversal and ensuring permanence;
4. Reducing risks for farmers to increase uptake.

The success of the scheme is easier to ensure where the potential for C sequestration is large (the change occurs faster and the total amount of C sequestered leads to higher reward, thus also improving the reward – transaction cost ratio). The potential may be highest where soils have been degraded (through intensive arable farming or overgrazing on grasslands), and where there are also sufficient nutrients available, such as Mediterranean or cool/temperate regions in Europe (van Groenigen et al., 2017). The potential may be lower in areas with lower precipitation and limited biomass growth due to water scarcity. However, even smaller increases in sequestration in such areas can have significant impacts for soil health and, from a public policy perspective (mitigation and adaptation) are desirable.

The more specific the knowledge on the potential for sequestration is at a regional level, and even more detailed farm-level, the more straightforward the design of the scheme and the setting of objectives will be. Also, if there is enough knowledge on the sequestration potential, targeting the scheme to the right types of soils will be easier, and more transparency will be feasible when managing expectations on what the scheme can achieve, vis-à-vis farmers (i.e. what level of sequestration they could expect, what level of payment) and towards the market (private or public buyers / funders). Since there are inherent uncertainties in predicting the potential sequestration level, it is important to manage expectations and work out more regionalised assessments.

a. Uncertainties and monitoring, reporting and valuation (MRV) costs

Scheme designers should ensure scientific robustness in the design. Robustness refers to the ability to reliably (i.e. with low uncertainty) quantify results (sequestration and other sustainability indicators) based on actions taken (i.e. farm management), under certain conditions (e.g. climate, soil type). The robustness of measurement / quantification is particularly important in case the results are sold as certified credits to offset emissions elsewhere.

A central barrier is the cost associated with measuring and estimating SOC at field / farm level, and the uncertainties resulting from this. Soil sampling reduces uncertainty but it is associated with larger costs, which can currently be prohibitively high. In estimating SOC levels via modelling, sources of uncertainties are cumulative, need to be identified, and uncertainties estimated in quantitative terms. Uncertainties, for example, relate to: limited understanding of factors that influence SOC quantity and stability, time of sampling, sampling depth, processing of data, assumptions and input data in modelling of SOC stock changes, lack of data on current / existing levels of SOC. Several projects are ongoing (e.g. in Finland and in Switzerland) to improve models to estimate changes in SOC levels at field / farm level by ground-truthing the models. Work is also ongoing also at international level to improve research and collaboration in developing monitoring, reporting and verification platforms (Smith et al 2020).

New technological developments are emerging that have potential to reduce costs of MRV and increase certainty in assessments, for example (and not limited to):

- proximal sensing (infrared spectroscopy – its potential reduction in accuracy can be countered by increased sample numbers and data quantity) (FAO, 2017);
- isotope technology to enable detection of short-term changes (FAO, 2017);
- handheld field scanners[6].

(Un)certainty in relation to the type of scheme: The level of environmental uncertainty has flow-on effects on how the GHG reductions can be used. Or, vice versa, the scheme designers' planned use of emissions reductions may limit the level of uncertainty they can accept. In particular, if scheme designers plan to package the emissions reductions and sell them as offset credits or emissions reduction certificates, they will not be able to accept a high level of uncertainty because credit demand depends on high perceived environmental integrity, i.e. credit buyers need to trust that the credits that they purchase are matched by real, additional emissions reductions or permanent carbon storage. Of course, these more stringent requirements will increase MRV costs; as one interviewee identified, the high standard of precision can mean that designing MRV for fungible offset credit markets can be "cripplingly expensive".

In addition to considering the total level of MRV costs, **MRV costs borne by farmers** are a concern, as these "transaction costs" decrease their net benefit of participating in the scheme, which will reduce farmer uptake. Given the proposed scheme is voluntary, uptake is crucial for the scheme to achieve sufficient scale to have impact. Scheme designers should minimise transaction costs borne by farmers, to increase the likelihood of uptake. Transaction costs for farmers can be reduced directly, for example, if the scheme covers part or all of the sampling costs, or indirectly by spending more money up-front to simplify the scheme for farmers and reduce the need for sampling.

The trade-off between up-front set-up costs and lower farmer transaction costs needs to be balanced. One way to do this is to work iteratively, starting with relatively low set-up costs and a less robust scheme, and then progressively invest in the scheme to decrease transaction costs, working with participants to identify most effective actions. This allows for learning and avoids sunk costs in less important aspects of scheme design.

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[6] "The field reflectometer devices are integrated with an easy-to-use mobile app allowing users to collect spectral data and sample information while simultaneously recording their GPS position. These collated data are recorded in the app and automatically pushed to a cloud server whenever an internet connection is available. During model development, a subset of soil samples (~20%) are sent for traditional, highly accurate laboratory analysis, such as gas chromatography-mass spectrometry. This subset of data is then used to build machine learning models relating lab-measured soil carbon levels to the data collected with the field reflectometer. Additionally, freely available remote-sensing data are integrated into these models to improve estimates" (https://www.quickcarbon.org)

Project learning and refinement. Having sufficient detailed knowledge on the potential saturation levels enables scheme designers to better set the reward values and understand the economic costs – benefits of a project in a given area. If this knowledge is not available from the outset, this knowledge can be generated during the project. Data generated by applying the scheme should be stored and used to evaluate and improve knowledge on SOC levels, and can be used to ground-truth and train models.

Box 1. The Ebenrain project, Switzerland

The project is a partnership coordinated by the Ebenrain Technical Centre for Agriculture, Nature and Nutrition, a public agricultural authority in the canton Basel-Landschaft in the north-west of Switzerland. The partnership involves the collaboration of the Ebenrain Technical Center, a subsidiary of Bio-Northwest (a Bio-Suisse member) and Research Institute of Organic Agriculturel (FiBL). The financing for the project comes from the Basellandschaftliche Kantonalbank (BLKB), a Swiss regional bank, and to a limited extent from the Canton government. The BLKB provides funding for the payments to the farmers and it covers two of the three sampling procedures. The Cantonal government funds the coordinator of the project and the advisory component. Starting in 2019, BLKB approached the Ebenrain Center to develop a pilot project for result-based payments for farmers. The BLKB was looking to offset some of their emissions by supporting a regionally-based project. The motivation for the Ebenrain Center was to develop a result-based scheme that had clear monitoring of the environmental effects and also addressed the increasing water scarcity conditions in the region. The experiences and knowledge gained from the project would flow into the advisory services offered to farmers more broadly. The FiBL provides scientific guidance for the development of the sampling methodology, and the Agroscope supported the choice of the analysis method.

b. Resource requirement for delivery – payments, training and oversight

Scheme designers have to consider different elements of scheme feasibility, including resources, knowledge requirements, and farmer and stakeholder engagement. The biggest resource challenges for establishing a new scheme are developing a scheme suitable to local contexts, developing expertise, and recruiting farmers.

Projects involve collaboration of several parties that fulfil complementary roles:

- an organisation that takes responsibility of the overall coordination of the project;
- an advisory branch that recruits farmers, and accompanies them in developing the management strategy for their farm;
- an auditing / monitoring branch that takes the samples and monitors the results;
- a scientific partner that provides guidance on the use of appropriate sampling protocols and supports potential estimates;
- one or more funding partners that provide funding for project development, and depending on the payment scheme, also the financing for farm payments;
- advisory parties to the project (for example, farmers' groups or environmental stakeholders).

Developing the scheme takes time. For example, the first idea for the Ebenrain Humus project was born in 2018, and the development of the project concept took place in 2019. Normally, even when an existing concept is being applied in a new area, this requires piloting and readjusting the concept to the new conditions. As future schemes can learn from and build on existing tools and schemes, they may be able to move faster, especially if they too can leverage existing relationships. At present, the experience shows that scheme development takes at least two years, provided that the project developer can already draw on some pre-existing scientific work. The understanding of potentials and the development of MRVs are also processes that, when started from zero, can take several years.

Recruitment of farmers is a time-consuming process. Growing recognition of climate as an issue and the incentives offered by the scheme will increase farmer interest, but the new knowledge and skills that they will need to acquire and implement take time to learn. The scheme should therefore build in training and advisory opportunities that facilitate farmer learning, including peer-to-peer learning. Where public authorities and existing advisory services are participating in the project, this can be more straightforward, but it still takes time, and possibly needs to be carried out in stages. Depending on the capacities and the extent of interaction / advisory support, this type of on-boarding can take from a few months to more than a year. In the Ebenrain project farmer recruitment began in late 2019 and took several months. By February 2020, the project had achieved 60% of its target area and the first sampling (start of project duration) is planned for Autumn 2020. In the case of Arla Foods, their internal on-boarding for a climate check was considered an enormous effort. Drawing on existing consultant networks and offering large financial incentives, the initiative aims to on-board 8000 dairy farmers to their Climate Check programme (including baseline setting) within six months.

Developing expertise to implement the project also requires time. This applies to scheme operators, who, due to the relative novelty of results-based schemes, will need to extend their skills and knowledge. The scheme operators will also have to train advisors or consultants, who play a central role but who may lack the climate mitigation knowledge or audit tool skills required; this could be a significant bottleneck and should thus be a priority of the scheme designers.

The scheme will have both start-up costs and **ongoing costs of operation**. These include paying consultants for baseline setting, paying rewards to farmers, and all administration (including managing MRV, finding buyers for credits/certificates or alternative funding, etc.). In some of the existing projects, the set up and operational costs are co-funded by public authorities (for example, through funding salaries of project coordinators). In other cases, the operations vary from regional initiatives (e.g. CarboCert or Kaindorf) to large global operations (such as Indigo Ag), and in the case of latter significant upfront investments are required. The set-up costs (and some of the ongoing costs) can be reduced through increased experiences and improved efficiencies (in sampling procedures, for example) and are also subject to economies of scale advantages. Accordingly, supporting widespread farmer uptake is a key cost-control measure.

c. Advice, knowledge transfer

Scheme designers, consultants, and farmers will all need to develop new skills and knowledge to implement the scheme. Scheme designers will need to supplement their own knowledge with scientific expertise related to agricultural emissions and farm audit tools. They must draw on experience and lessons from existing schemes and projects to support scheme design. In addition, they should involve a broad range of stakeholders to ensure they hear diverse perspectives (especially those of farmers). Scheme designers should consider outsourcing specific tasks or buy in ready-made options, e.g. registry software, software development. Consultants play a key (and early) role in the scheme, as the experts who run the audit tools, set baselines and advise farmers. Accordingly, ensuring that local consultants have sufficient training must be an early priority for scheme design. Consultants will need to be trained to run the audit tool and to set baselines in line with scheme methods. They will also need a good understanding of the scheme specifically and climate mitigation and agriculture more generally, so that they can convincingly answer farmers' theoretical questions (e.g. on climate science) and on practical elements related to the scheme (e.g. on reporting, monitoring data requirements). Farmers will also need to develop new knowledge and skills related to climate-efficient farming. To support farmer understanding and uptake, the scheme should organise meetings to present the method and outline the benefits for farmers, and to give a chance for questions. Kitchen table meetings hosted by ambassador farmers could be an important way to share skills and recruit additional farmers. Scheme developers must prepare information material for farmers to support their learning. The baseline setting process and initial audit tool run offers a particular opportunity: farmers should receive summary outputs that include identified climate action plans and the expected outcomes for farmers (with a focus on farmer-relevant indicators, such economic efficiency improvements). While costly and time-consuming, these learning aspects will support attainment of broad objectives. Ultimately, a key co-benefit of the scheme will be to develop agricultural climate mitigation capacity in all agricultural actors.

d. Farmer Engagement

Actively engaging farmers in the scheme design process and regularly consulting them can increase farmer buy-in and uptake. Farmers will be able to provide practical feedback, identify opportunities and challenges, and be crucial communicators of the scheme. Leveraging existing farmer networks, such as farmer associations or farmer support schemes, could help quickly scale up farmer involvement. Targeting leader farmer "ambassadors" (e.g. those who have previously participated in related research projects or leaders within the farming community) could be an effective farmer recruitment approach. To ensure that farmer views are adequately reflected, any advisory board should have at a minimum one farmer participant.

e. Cooperation and Stakeholder Engagement

Scheme designers should involve broader stakeholder groups, including the wider public through communication. The involvement of farmers from early stages can increase buy-in and participation, and their ongoing participation once the project starts facilitates learning and exchange (these, for example, are key success factors in several ongoing projects such as Solothurn and Ebenrain projects).

4. Setting scheme objectives and demonstrating additionality

This chapter considers how to set objectives for the proposed scheme, define additionality, and how to identify baseline emissions.

a. Objective setting

The objective of the scheme is to increase the levels of SOC stocks, measured in terms of change during the project period.

Moreover, the scheme should strive to account for the whole GHG balance associated with increasing SOC levels. SOC sequestration is a process that can involve trade-offs with GHG emissions, in particular associated with fertiliser or machinery use. These additional emissions can be significant (Lugato et al., 2018) and need to be accounted for in calculating the climate benefit. It is important that estimates and monitoring of SOC sequestration takes into account interactions between carbon and nitrogen cycles and includes the full GHG balance (FAO, 2017). Some existing methodologies include formulas to calculate these additional emissions and also set the thresholds above which these need to be evaluated (fossil fuel use and nitrogen fertiliser use calculations in GoldStandard Methodology; material emissions deduction in Australian 2018 SOC measurement method).

Some stakeholders may be more motivated by other objectives and these can be effective recruitment tools for the scheme. Examples of such objectives include:

- Maintain or improve yields;
- Improve water holding capacity;
- Improve soil health (and reduce erosion risk);
- Increase knowledge / skills of farmers;
- Increase economic efficiency on the farm (reduction of synthetic fertilisers and agro-chemicals).

b. Additionality

Environmental additionality refers to whether the scheme induces climate actions that would not have occurred in the absence of the scheme and that lead to improved SOC levels. This requires the farmers to introduce new activities or different activities compared to a previous period. The baseline period can be set for different amounts of time (e.g. the Australian Carbon Farming method sets a 10-year baseline period).

Regulatory additionality is guaranteed by ensuring that project activities go beyond what is required by law. In the EU context, the EU legislative framework for soils is fragmented, which means that the scheme has to ensure that Member State specific regulatory additionality is ensured (for example, going beyond the Good Agricultural and Environmental Conditions – GAEC - standards of the CAP), or beyond national standards for good agricultural practice). This, however, may be challenging if the national standards are not specific enough in relation to the relevant practices.

Financial additionality refers to actions that the farmer would only take if they received rewards from the scheme (i.e. without the scheme rewards, the costs of the action would outweigh the benefits). Given that the SOC management changes are most likely to involve a suite of actions rather than single actions, it is difficult to define financial additionality tests. In addition, it is difficult to capture all costs adequately, e.g. farmer transaction costs involved in learning new farm management approaches can be significant but difficult to measure. Given the complexity, **we suggest that the scheme focuses on environmental and regulatory additionality**.

The basic approach to assess environmental **additionality** is:

1. In using the measurement approach, comparing the value at the start of the project with the value at the end of the project period;
2. If the project uses model-based estimates, the scheme can also compare a baseline scenario (what would happen in the absence of the project or 'business-as-usual' over the project's duration period) with the project scenario. The baseline scenario is calculated by assuming the continuation of management practices followed before the start of the project period (this can be in a single year or multiple years). The project scenario is derived from farm records.

Baseline setting is at the individual farm level. A whole farm approach is used, rather than focusing only on a selection of fields. Baseline is set during an initial visit / audit on the farm. Two approaches are possible to set the baseline:

1. Through on-site measurement to establish SOC stocks;
    - This has the advantage of higher accuracy, lower uncertainty; but higher costs,
2. Through a model-based calculation to estimate the baseline SOC stocks
    - The calculation should be conservative and sufficiently robust for the specific context, farming system and management involved;
    - It can be ground-truthed with a measurement.

The protocols to derive the baseline, either via the measurement approach or via the modelling approach, need to be transparent and publicly available. To increase the robustness and environmental integrity (and communicate this to the public), these protocols should be:

1. either approved by a national or European governance body (for example, Label Bas Carbon in France, or a relevant public authority in a given Member State; or
2. reviewed and approved by an established international organisation (for example, Gold Standard).

The **cost of baseline setting** should not be borne by the farmer, so as to reduce barriers to farmer uptake. The cost of baseline setting varies depending on the amount of input. To decrease the total cost, the scheme could have **differentiated baseline setting requirements** for different participants. Large participants (e.g. over a certain number of animals or hectares) would be subject to more stringent baseline setting (e.g. they would be required to run more complicated versions of the audit tool, which would rely on fewer default factors). The justification would be that larger participants have a larger effect on the scheme as a whole, so the baseline must be more certain and better protected against being gamed.

The consultant’s visit to set the baseline serves a second purpose: **education/training**. During the visit, the farmer has a chance to ask questions, increase knowledge, and feel ownership of the scheme.

Baseline setting is a learning process. Like all elements, the proposed approach aims to enable the establishment and initial running of the scheme, and to provide data and lessons learned to adapt it. To this end, the scheme designers may begin with baseline setting on a group of farms as a pilot study, using this as an opportunity to train consultants and to learn about data availability, farmer capacity, and other aspects that will affect the average baseline setting costs. With these data, they can adjust the baseline - setting approach. In this way, they will be able to identify accurate (enough) baselines at the lowest possible cost, and ways to “automate” the process as much as possible.

Carbon leakage occurs when, as a result reduced production within land covered by the scheme (to sequester carbon), farmers increase their production on land outside the scheme. This decreases the overall climate impact of the scheme. To avoid leakage and account for the leakage that does occur, one option is to require the participating farms to keep records of outputs and yields, and to account for yield changes that are significant. The GoldStandard Framework Methodology sets the leakage threshold at 5% of yield reduction, at which point the yield reduction gets accounted for in the result and payment calculation (GoldStandard, 2020).

c. Eligibility

Eligibility restrictions, i.e. who can participate in the scheme or under what conditions, by definition limit the extent of the scheme and its impact. However, eligibility restrictions can also reduce scheme costs. In order to reduce transaction costs, the scheme could restrict participation to farmers that are likely to achieve significant effects.

The eligibility is set out with the following criteria:

- The scheme focuses on mineral soils and agricultural systems. SOC sequestration can be done on cropland, grassland and in agroforestry systems. The SOC sequestration component in forests and organic soils is not included. Scheme designers can further narrow down eligibility criteria to focus on a specific type of farming systems or geographic context. To be able to identify systems and geographic areas with the highest potential for SOC maintenance / sequestration, it is advantageous to have national / regional assessments of the existing levels and expected potential;
- The scheme needs to operate on the same selection of land through the whole duration of the project. It is also recommended that a whole farm approach is taken, i.e. all mineral soils and eligible land use types on the farm are included in the project. This will avoid that the increase in SOC in one part of the farm is offset with losses on another part;
- Application of organic fertilisers result in translocation of carbon from one part of the system to another (Wiesmeier et al., 2020b). While it can certainly increase the SOC levels and thus improve soil health, the impact in terms of carbon withdrawal from the atmosphere is not additional. Even though excluding additional organic fertilisers reduces management options and the speed of SOC sequestration, leakage effects are avoided and only the additional sequestration effect is rewarded. If strict additionality is to be achieved, then additional organic fertilisers should not be applied.

- Regulatory criteria set out in legislation and the GAEC standards of the CAP apply. For a scheme that operates in different EU countries, the regulatory requirements in each country are set as eligibility requirements.
- No conversion from grassland to arable land has taken place in the five years prior to the start of the project.
- The area cannot be reduced during the project duration, with the exception of pre-defined exceptional circumstances.

In some cases, specific practices can be prohibited or limited in use (for example, the Australian Carbon Farming Initiative does not allow the application of biochar or coal; Ebenrain project allows biochar approved under Swiss fertiliser regulations; see also Wiesmeier et al. 2020b for discussion on biochar).

d. SOC management strategy plan

At the beginning of the commitment period, an advisor supports the farmers in developing a SOC sequestration strategy that lays out the implementation plan for the eligible land management activities.

5. Choosing results indicators and MRV

a. Selecting results indicators

Currently, the reviewed projects mostly focus on the changes in SOC levels as the key result indicator. However, as already mentioned above, the schemes should move towards accounting for the whole GHG balance associated with increasing SOC levels to ensure that the full climate impact is captured.

There is no correct **project duration** across which impacts should be assessed and rewarded. The baseline SOC stock context is measured and/or calculated as a minimum at the beginning and the end of the project time period. In several projects, monitoring is also done during the project duration (e.g. Ebenrain project at a 1 – 3-6-year interval; Kaindorf project between 2 and 5 years).

The result is quantified as the difference between the baseline level and levels after a minimum project duration. The choice of the period, however, can be adjusted depending also on the anticipated time that it might be expected for changes to be potentially observed in the specific biophysical and climate context. This should be based on published peer-reviewed scientific results. In general, 5 years is the minimum commitment period set by existing projects. Results can already be measured before the end of this period, as in some cases significant changes can occur in shorter periods, depending on location, initial SOC levels and management changes. The GoldStandard Framework Methodology envisions that the project duration or crediting period is specified for individual activities, for which additional rules are set. The crediting period can vary from 5 to 20 years. The longest commitment is set out in the Australian 2018 SOC Measurement method, where the permanence commitment is for 25 years, whereby farms can report results and claim credits after shorter intervals (for example, after a 5-year period). However, stakeholders commented that this is a major uptake barrier and that some discussions may be underway to adjust this rule.

b. Monitoring success – the M in MRV

In choosing the specific methods for monitoring, reporting, and verification, scheme designers must decide on their accepted level of uncertainty. This requires balancing up of total and farmer MRV costs, balancing between up-front set-up and ongoing costs, and also considering the requirements set by offset credit or emission reduction certificate markets.

Accepting some uncertainty in the quantification of results enables less stringent MRV, which decreases transaction costs, and increases the likelihood of farmer uptake. A more stringent MRV may undermine the overall uptake of the scheme. However, perceived environmental integrity is a key component for credibility of the scheme and (public or private) demand for sequestration benefits from the scheme.

Two main approaches are used for monitoring the results, as in the setting of the baseline:

1. Through on-site measurement to establish changes in SOC stocks, which has the advantage of higher accuracy, lower uncertainty and the disadvantage of higher costs;
2. Through a model-based calculation to estimate the baseline SOC stocks and the full GHG balance:
    - The calculation should be conservative and sufficiently robust for the specific context, farming system and management involved;
    - Models should be ground-truthed with measurements.

The selection and robustness of monitoring may require pilot studies to develop approaches that work within the specific regional contexts.

Currently, there are several standards and ongoing development of standards that set out MRV requirements. However, there is no overarching framework that sets out requirements for these private standards in the EU. The Farm to Fork Strategy indicates that an overall certification framework for removals will be established. This is a welcome development, as several interviewees commented on a need to create transparency and common standards with regards to MRV protocols. The Global Soil Partnership also calls for "the development of feasible and regionally contextualized guidelines for measuring, mapping, monitoring and reporting on SOC that can be adapted locally to monitor SOC stocks and stock changes to support management decisions" (Vargas-Rojas et al., 2019).

The main existing / or in pipeline standards which include monitoring protocols include:

- Gold Standard SOC Framework Methodology[7],
- Carbon Farming Initiative 2018 Measurement of SOC sequestration in agricultural systems methodology[8],
- Verra Methodology for improved agricultural land management[9] (under public consultation),
- Climate Action Reserve Soil Enrichment Protocol[10] (US, under public consultation),
- FAO. 2020. A protocol for measurement, monitoring, reporting and verification of soil organic carbon in agricultural landscapes – GSOC-MRV Protocol. Rome. https://doi.org/10.4060/cb0509en.

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[7] Recognises two sampling protocols: ICRAF Protocol (http://old.worldagroforestry.org/downloads/Publications/PDFS/TM11192.pdf) and VCS SOC Module (https://verra.org/methodology/vmd0021-estimation-of-stocks-in-the-soil-carbon-pool-v1-0/)

[8] https://www.legislation.gov.au/Details/F2018L00089

[9] https://verra.org/methodology/methodology-for-improved-agricultural-land-management/

[10] http://www.climateactionreserve.org/how/protocols/soil-enrichment/

c. Reporting, verification, auditing – MRV

To minimise MRV costs, reporting and verification approaches can be modelled on the tax system, that is based on farmer self-reporting, accompanied by random and targeted audits.

Site visits would be required if the farm were audited, but most farms would not be visited. This is supported by the use of advisors / consultants at baseline setting and at set intervals during the project duration. Advisors / consultants provide support to farmers and co-develop with them a land management strategy.

Auditing would be based on random audits, with higher rates of random audits for high-risk farms. High-risk farms would be new participants and those who have failed audits in the past. Auditors would be appointed farm consultants who could request additional farm records or visit the farm to ensure that the reported numbers were accurate (i.e. all inputs). Over time, the aim would be to shift to a self-reporting system that did not require inputs from consultants, in order to decrease MRV costs. However, in the initial period a key aim would be increasing farmer knowledge, interest, and capacity to implement climate actions, which requires advisory support. Given that advisors would be already visiting farmers to provide training, they could also be utilised to implement MRV. Based on the farmer, advisor, and scheme designer knowledge developed over this time, the MRV (including reporting and verification) should be adapted.

Projects can also require farmers to record additional farm operations that may not be captured by the CAP subsidy application process (for example, Ebenrain requires farmers to keep records of tillage, depth of tillage, and whether they leave residues on the field or these are ploughed under). Farmers can also be given a questionnaire at the beginning and end of the project to qualitatively assess co-benefits that might otherwise be expensive to monitor in quantitative terms, such as increased soil fertility or improved soil quality. In terms of conveying benefits to farmers, tracking these qualitative perceptions may be very useful (as done, e.g. in Ebenrain). The scheme should store and use these data, also making anonymised versions available to researchers, to increase the knowledge base and increase the perceived trust in the scheme through higher transparency.

6. Paying for results

a. Reward calculation

Result-based scheme means that farmers receive an ex post reward that is based on their climate impact, as measured by the results indicators. This approach contains a number of risks for farmers. Given the current state of knowledge, there is a degree of uncertainty of whether an anticipated rate of sequestration can occur. Heterogeneity at field and regional level in terms of soil type and (micro) climatic conditions can mean that sequestration levels may accrue at different rates on different farms / areas despite best efforts made by farmers. This uncertainty is a significant risk for farmers and a barrier to the uptake of result-based schemes (the same was observed also in result-based schemes aiming at biodiversity conservation).

Paying farmers **a set payment per tonne** of carbon sequestered over the project period supports farmer uptake, as it reduces their price uncertainty and increases attractiveness of the scheme. All existing projects in Europe set a fixed price for the tonne of carbon. To ensure that this does not incentivise climate actions that have negative externalities, the reward payment is conditional on having no negative effect on other sustainability indicators. These are avoided through the setting of eligibility conditions.

The scheme designer needs to set the price at a level that they can either cover from their own funds or that they expect they can recoup, for example by selling offset credits. Farmers should not be rewarded directly with offset credits, as this significantly increases uncertainty and complexity for them, which would decrease uptake. Instead, the proposed approach of set payments efficiently shifts price uncertainty away from farmers and places it on scheme administrators, who have greater knowledge and are more likely to hold relevant skills (i.e. related to credit markets, public financing, etc.) and can act to affect prices (i.e. through scheme design).

In areas where only a small increase in SOC sequestration is feasible (dry areas, for example, or where soils are already close to saturation level), payment levels might need to be increased per tonne of CO_2 to provide sufficient incentives.

In addition to paying a set rate, the scheme can reduce farmer risk by limiting or excluding up-front costs. The scheme can also mitigate risks by ensuring advisors are well-informed and provide good advice, by learning from farmer experiences and results, and sharing lessons learned with farmers. Examples of learning processes include farmer working groups, and ongoing demonstration and exchange, such as in Ebenrain or Kaindorf projects.

Selecting the **timing of payments** involves trade-offs between farmer uptake and increased uncertainty. **Ex-ante payments**, based on expected climate impacts (i.e. paid after the baseline is set), favour farmers and will therefore increase uptake, but it will increase uncertainty and permanence risk. Ex-ante payments enable farmers to invest in mitigation actions, which they may not otherwise be able to do because of liquidity constraints. In addition, the scheme's covering costs for farmer MRV (i.e. baseline setting) is a form of ex ante payment.

Ex-post payments minimize uncertainty since they reward the results that have already occurred. A compromise approach may be most appropriate, where farmers can receive up to a share of expected rewards after baselining, and this is deducted against the reward paid at the end of the project period. The share should be set well below the expected reward (i.e. below 50%), to reduce the risk of non-achievement. This could be voluntary, as not all farmers will want to sign up to the slightly increased complexity and legal obligations. The existence of other economic benefits (in the form of improved soil health and efficiency gains) is likely to be an important motivation for participation.

Hybrid schemes. Another aspect of uncertainty relates to the question of where the liability lies for ensuring that SOC increases are materialized. Given the current state of knowledge and the unpredictable nature of sequestration, there is a question of whether the liability can be placed solely on farmers, who may not be able to control the outcome. This has both an ethical dimension as well as a practical dimension, since the risk for farmers may deter participation in the scheme, as has been seen with result-based schemes for biodiversity conservation. In response to this, an option is to set up a hybrid scheme, where farmers receive a guaranteed payment upfront and possibly at an interval during the project duration, which is then topped up with the difference between the expected and the actual result achieved. If farmers demonstrate that they had done their best and have carried out activities which they committed to in the SOC sequestration strategy, then they are not liable to return any of the upfront payments (this is the case in the Ebenrain project).

b. Non-permanence and buffers

There is a risk that the sequestered SOC may not remain permanently sequestered, reversing the short-term climate gains. **Non-permanence** can arise in two ways, which should be managed differently: 1) due to unintentional reversal of GHG reductions (i.e. outside of the participants' control); 2) participants' negligence or intentional action (i.e. within the participants' control). These risks must be managed to ensure the environmental integrity of the scheme.

Soil carbon storage can be unintentionally reversed (i.e. due to events outside the participants' control), for example because of droughts, fire, erosion or climate change. If this happens, the climate impact of the scheme is nullified. This can also affect uptake, as participants are less likely to participate if they might be punished for actions outside their control.

A **buffer account** can be used as a carbon credit reserve to cover any unintentional reversals. In this case, farmers would only be rewarded for a portion of their expected storage, with the balance held in reserve. In the same way as with a buffer for uncertainty, this would ensure that the reductions claimed by the farmer and the scheme will be achieved, even if unintentional reversals occur. Buffer accounts can ensure environmental integrity of the scheme. Buffer accounts work by only rewarding farmers for a proportion of their estimated results, holding the remainder back as a "buffer". The buffer can be used to ensure that the rewards paid are not in excess of the actual reductions even with uncertainty. They can also act as scheme-wide insurance against non-permanence, or to cover the situation where actual reductions are less than ex-ante payments. These buffers can be general (i.e. a percentage set aside from all reductions) or targeted, i.e. for a percentage set aside for especially uncertain types of farms e.g. farms that only complete less stringent MRV may have a higher buffer. By reducing the payment that farmers receive, buffers have the downside of reducing farmer incentives and therefore uptake. Buffers may be required to meet the level of uncertainty accepted by the scheme designer or to convince offset certificate buyers that the environmental integrity of the scheme is assured (i.e. that any offsets sold will be matched at least by an equivalent GHG impact); this depends on the level of uncertainty required by the scheme designer.

Different existing schemes retain different levels of credits: the Australian CFI retains 5% of carbon credits; the Woodland Carbon Code retains 20% of expected credits. In the Woodland Carbon Code, should participants have unintentional reversals, they can propose actions to re-sequester the lost carbon and/or draw down their reserved credits, before later restocking them. If the reversals go beyond the 20% buffer, they are obliged to cover the additional reversals at their own cost (e.g. the equivalent of buying additional credits). Similar schemes could be developed for non-credit based schemes (e.g. some portion of the payments could be reserved).

Carbon storage reversal/annulment can also occur due to participant negligence or intentional action i.e. within participant control. Given that farmers may face costs of maintaining soil carbon storage over the long term, there is a risk that farmers might later change management in a way that alters carbon storage. This risk can be managed in the following ways:

- Farmers can be made liable for any decreases in carbon storage after they have received payments for SOC sequestration (i.e. after ex-post payments); this liability can be set for a specified commitment period. At the same time, this also acts as a barrier for uptake. The liability can be enforced through contract law and long-term contracts. Due to MRV uncertainties, it might be simpler and fairer to make contracts activity-based, rather than result-based (i.e. limited to things that the farmer can control rather than relatively uncertain results).
- Ex post rewards: farmers could be paid all or a proportion of their rewards only after long time-periods (e.g. after 25 years). This again would likely pose a barrier to uptake.
- In general, the process of developing SOC sequestration management plans and ensuring that a mindset change also occurs would also safeguard against the risk of reversal. In fact, this ensures that farmers can see and experience the value of co-benefits, and in particular those related to the economic performance of farms and soil quality.
- Ongoing stakeholder engagement, learning and buy-in will support permanence. This should include clear communication of the broad benefits of healthy soils (e.g. efficiency, yields, other co-benefits), in addition to carbon sequestration.

Double-funding can undermine additionality. This occurs when the farmer is paid twice under different policies/schemes for the same actions, e.g. if they received additional CAP funding for increasing biodiversity area on farm, and this also reduced their emissions, enabling them to receive a payment also under the carbon farming scheme. This could be considered double-funding if the CAP biodiversity payment is made also expecting climate benefits. However, if the farmer is simply being paid for delivering two different public goods, this is not double-funding. In this case, they receive a payment for biodiversity provision and a separate one for their climate impact. The schemes should therefore clearly define their objectives.

The scheme could identify specific policies or schemes where there is overlap (i.e. other funding/payments for SOC sequestration in the region or through the CAP), and contractually require farmers to report their participation in these, then apply discounts to the results they achieve. For example, if a farm receives separate funding, then their result indicator would be discounted by a certain percentage, or the higher payment could be kept. This will depend on the likely impact of the specific overlapping policies identified by the scheme designers. However, the interaction between the policies and schemes needs to be clearly worked out and the boundaries set.

The scheme could allow farmers to receive payments from multiple sources for the same action, if they are being paid for different outcomes that the action delivers. For example, if they retire land for biodiversity protection they could also receive a payment under the CAP for biodiversity results.

c. Consideration of co-benefits/wider sustainability impacts

Schemes can **reward for multiple sustainability indicators**. This could be done explicitly, i.e. the scheme designer could separately reward participants for sequestered carbon and for a change in another indicator. This could also be done indirectly in offset credit or emissions reduction certificate schemes, as is the case in existing examples of these. For example, the MoorFutures scheme methodology focuses on GHG emissions, but it also includes methods for calculating improved water quality, flood mitigation, groundwater enrichment, evaporative cooling and increased mire typical biodiversity (Joosten et al., 2015). Participants in the scheme generate offset credits, which also list the wider sustainability impacts of the project. This is seen to reflect greater environmental integrity and can generate greater demand and / or higher prices for the offset credits[11]. Other schemes use simpler methods to qualitatively assess impacts on other sustainability indicators with the same aim: the Woodland Carbon Code has a simple self-reporting tool featuring a set of 24 questions to assess impacts on wildlife, water, and community. Monitoring and reporting these co-benefits can theoretically translate into higher credit prices, as these "beyond climate" benefits are valued by participants (Cevallos, Grimault, and Bellassen, 2019).

In the case of ecosystem services associated with SOC sequestration, the downside to this approach is the potentially higher cost associated with sampling or monitoring of results. Due to the cost, it may be more feasible that these are captured via modelling rather than measuring them.

However, **co-benefits can also be observed** by farmers, including for example, improved water holding capacity that immediately translates into better growth under dry conditions. Or farmers can also use qualitative methods to observe soil quality and soil fertility.

Scheme designers or others can also encourage climate actions that deliver co-benefits by granting top-up payments to farmers who implement particular actions.

Rather than rewarding for impacts on multiple sustainability indicators, schemes can **minimise the risk of negative externalities** in other ways. In the Australian Emission Reduction Fund (ERF) system, regulators have a list of excluded activities that have negative impacts on other sustainability outcomes (e.g. water availability, biodiversity, jobs). Farmers cannot be rewarded for these activities, even if they result in avoided emissions.

The sustainability indicators selected will depend on local priorities and pressures, but should as a minimum consider biodiversity outcomes. These should be clearly emphasised in communication with farmers, and reported to scheme operators, who should monitor these. In addition, these should be reported on by the scheme, in addition to carbon sequestered, to support perceived environmental integrity and demand for any offset credits, or broader public support for the scheme.

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[11] Carbon Farming Project Peatlands Webinar, 23/03/2020.

d. Funding the scheme

The scheme designer's funding scheme depend on the funding available to them. Each type of funding comes with different benefits and costs for the scheme designer and other stakeholders. The main options are:

- centrally funded through public funding (e.g. nationally or regionally funded),
- centrally funded by a private company, as part of Scope 3[12] emissions reductions,
- or externally funded by creating and selling emissions offsets or emissions reduction credits (which cannot be traded). External funding has the obvious benefits that the costs of mitigation are borne by a party other than the scheme designer and operator (i.e. by credit/certificate buyers).

In the proposed scheme, the main stakeholder affected by the decision is the scheme designer (as farmers are paid a set, pre-agreed amount per tonne, as discussed in the previous section). Therefore, the discussion of costs and benefits here focuses on the scheme designer's perspective. If the scheme designer decides to link reward payments to the prices they receive for offset credits or emissions reduction credits, this creates significant barriers for farmers due to increased risk and uncertainty.

As shown by Figure 2, the different funding approaches require scheme designers to apply different degrees of MRV stringency.

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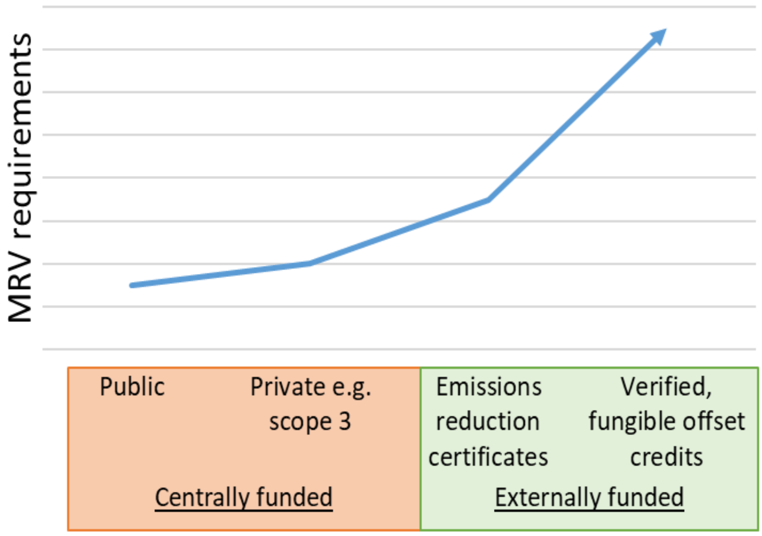
[12] The GHG Protocol is the most used international accounting tool for corporate emissions calculation, categorises GHG emissions into three categories. Scope 1 emissions are direct emissions; Scope 2 emissions are indirect emissions from the generation of purchased energy; Scope 3 emissions are all indirect emissions not included in Scope 2 that occur in the value chain a company, including both upstream and downstream emissions. https://ghgprotocol.org/

Figure 2 MRV requirements under different funding options



Source: own elaboration

Centrally funded schemes offer the scheme designer the most flexibility, as scheme designers are also the scheme funders, so they bear the risk of environmental uncertainty themselves. Privately-funded schemes may have to meet more stringent MRV requirements if they aim to achieve external validation of their approach, as it is the case for GHG Protocol Scope 3 emissions approaches.

External funding has higher MRV stringency requirements as offset or emissions reduction certificate buyers need to trust the environmental integrity of the reductions. The high standards of fungible offset markets, where buyers will only purchase if they expect credits to have equivalent environmental integrity and maintain value in the future, would demand stringent MRV[13]. Given the inherent uncertainties in using audit tools to estimate avoided emissions on livestock farms with current technology, meeting the MRV requirements of verified, fungible offset credits may be so expensive that it is not worthwhile. GoldStandard offers an example: they paused development of a methodology to create offset credits based on Cool Farm Tool, as the tool could not meet their uncertainty requirements and the

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[13] As discussed in earlier sections, increasing MRV stringency increases MRV complexity and cost, for mechanism operators but also for farmers. For example, if using external funding, mechanism operators will have registry costs, and higher ongoing validation and audit costs due to the more complex MRV. Farmers would also face greater costs, as increased MRV may require external verification and increased input data requirements, which increase farmer (time) commitments; these farmer transaction costs will decrease uptake. MRV costs undermine the overall benefits of the mechanism.

large discounts that GoldStandard applies to high-uncertainty credits would make it unfeasible.[14]

Nevertheless, **offset credit markets are attractive to scheme designers as a way to crowd-in private financing for sequestration**. There are already twelve voluntary offset credit markets in Europe, with five schemes launched since 2015 (Cevallos, Grimault, and Bellassen, 2019). Cevallos, Grimault, and Bellassen (2019) find that average prices in European schemes are €13 t CO_2eq, with prices ranging from €6 to 110/t CO_2eq. We find comparable prices in similar projects: €30-40/t CO_2eq in CARBON AGRI, €15-18/t CO_2eq in GoldStandard, €35-67/t CO_2eq in MoorFutures. Ebenrain Project pays CHF100/t CO_2eq. Offset markets credits also offer a way to cover administrative costs. This can be achieved by charging a set rate per tonne offset (GoldStandard charges $0.30USD per credit sold, in addition to verification and registry costs).

Scheme designers can get external funding without fungible offset credits. An option with more flexible MRV would be to create scheme-associated **emissions reduction certificates**, which cannot be traded as a fungible offset credit but would otherwise be similar to an offset credit, i.e. it would list a set amount of emissions reductions, matched by actual reductions from the scheme (recorded in a registry). The certificates would be sold by the scheme in the form of a one-off sale. The certificate would list the amount of offset emissions purchased and would include instructions for how the buyer could report the offsetting, e.g. to customers. The scheme designer would have to decide whether they would sell certificates to any purchaser, or would limit sales to certain buyers (e.g. buyers who provide evidence that they have already decreased emissions within their operation). The value of these certificates would depend on the buyers trust in the scheme. This trust can be achieved in ways that do not require strict MRV: for example, in the MoorFutures scheme, buyers of emission reduction certificates trust the reductions due MoorFuture's association with local university researchers, whose personal reputation underpins the method and the credits; this enables less stringent (and expensive) MRV. Trust in the CARBON AGRI scheme is facilitated by its approval by the French Environment Ministry's Label bas Carbone, which vouches for its integrity.

Should the scheme designer opt for **external funding, additional elements** must be considered:

- Scheme designers will need to budget time and money for staff training to ensure they develop the necessary additional skills (e.g. sales); scheme designers should look to existing schemes as best practice (e.g. Woodland Carbon Code);
- External funding requires a transparent registry that records all results achieved through the scheme, and all purchases of offsets/certificates. This should be publically available to increase transparency and associated perceptions of environmental integrity, which will support demand;
- Offset credits/emissions reduction certificate demand (and prices) can be supported by reporting multiple sustainability indicators (not just emissions reductions), especially when selling to regional buyers (who are also more likely to value these additional sustainability benefits, which may be locally occurring);

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[14] At higher rates of uncertainty, GoldStandard requires projects to apply steep credit discounts (50% for 20-30% uncertainty, i.e. for each tonne of estimated reduction, participants would only receive 0.5 credits), and up to 100% for more than 40% uncertainty (GoldStandard 2018).

- The price received would be determined by supply and demand for credits, though the scheme designer may decide to set price floors to ensure that their costs are covered;
- Scheme designers must also consider if they will limit who can purchase credits/certificates, to ensure that the objectives of the scheme are met. For example, scheme designers may only want to sell credits to buyers who have already reduced their own emissions internally, rather than simply offsetting other emissions;
- The scheme designer may also have to limit sales to domestic buyers or maintain careful records to ensure that trades are correctly recorded in country-level emission reporting (i.e. to avoid double-counting).

7. Governance, delivery, scaling up adoption and evaluation

This section discusses scheme governance, including transparency and evaluation, and opportunities for upscaling the scheme.

a. Governance

There is no one-size-fits all approach to governance. Accordingly, in this section we introduce governance examples from the existing schemes (CARBON AGRI, GoldStandard, MoorFutures, and Arla Climate Check) as potential options.

A key element of governance is methodology or project verification and validation. If schemes want to develop verified, fungible offset credits or verified emissions reduction certificates, schemes must meet the standards set by external verifying authorities (Box 2 summarises the external verifying processes set by GoldStandard and Label Bas Carbone).

Box 2. Examples of governance processes for external approval of methodologies and projects

GoldStandard offset credits

External funding through fungible offset credits has the highest governance requirements, and highest costs. An example is given by GoldStandard, a non-profit foundation that has managed offset standards and credits since 2003. To generate GoldStandard credits, scheme developers must have their method and the implementing projects approved and verified:

Methodology approval: To sell GoldStandard credits, project developers must first have their methodology approved

1. Concept: Scheme developers set up a concept method that outlines and justifies the developed methodology. They need to submit the concept method to the *GoldStandard technical advisory committee* to assess initial eligibility.

2. Full draft: If the concept is approved, scheme developers create a full draft methodology, setting out methods, management, and uncertainty, and re-submit it.

3. Review: *GoldStandard reviewers* (two internal reviewers and one external reviewer, e.g. a scientist) identify issues that the developer must address (up to 3 rounds of review).

4. Final approval: *GoldStandard technical advisory committee* gives the final approval of the method.

Note: For a new method the cost is €50,000, and the approval takes approx. 5 months. For a method already recognised elsewhere (e.g. the Clean Development Mechanism, CDM) the cost is €7,500, and the approval takes approximately 2 months.

Project verification: To generate credits, projects implement already approved methodologies and get certified/verified/registered with an independent verifier (*SustainCert*):

1. Certification: Projects must submit to a preliminary desk review (*SustainCert*), an independent audit (including site visits – by a *3rd party auditor*) and review of audit. Cost: €5,000 for *SustainCert* reviews + €30-40,000 for audits;

2. Verification: Projects must be verified by a *3rd party auditor* within the first two years of project, plus every five years. Cost: €30-40,000 per verification, + €1,500 for *SustainCert* review.

3. Registry: To sell credits, project developers must open a *registry* account (€1,000) and pay a fee of €0.30 per credit sold).

Label bas-carbone programme

The French Ministry for the Ecological and Inclusive Transition launched Label bas-carbone in April 2019 as a public certification scheme for voluntary offsets, as well as a public registry.

The **methodology approval** is an ad-hoc and collaborative process. So far, methods are arising from existing research projects. The Ministry works with the developer to prepare the method, consulting with experts and stakeholders. The Ministry then convenes an ad-hoc scientific board to help the Ministry review and approve the methodology. The Ministry may make the process more formal in the future to increase integrity, for example by establishing a separate technical group with independent terms and nominations. The credits that are produced using the scheme are not fungible i.e. they are project-specific and cannot be resold. CARBON AGRI is one of four currently approved methodologies.

Schemes can also seek **external funding without having external verification**, e.g. the **MoorFutures** project. The MoorFutures project was established by the regional government and local universities. Two key bodies support the development, implementation, and verification of projects: a scientific advisory board (featuring experts from local universities) and a project working group (headed by the local regional environment agency). The credits produced are project-specific and are not re-sellable, i.e. buyers purchase a one-off offset. Given the lack of external validation or verification, the scheme relies on the personal reputation of the researchers and regulators involved.

Schemes that do not seek external funding can be more flexible in their governance. Arla Foods' Climate Check programme is a scheme that aims to meet the internal, science-based, climate targets of reducing emissions by 30% by 2030. The programme is currently activity-based rather than result-based. As the programme does not develop credits or emissions reductions, external verification and validation are carried out in line with science-based targets. The objective is to convince consumers about the credibility of the programme, rather than to increase credit demand. To this end, Arla has made documentation of the tool publicly available and supports its assessment by scientific research projects. At the same time, the standards are not as prescriptive as externally funded schemes.

Existing schemes offer key lessons for governance design. Schemes will be more impactful and efficient if their design **involves key stakeholders** in the objective setting and design process. Key stakeholders include farmers, agricultural business representatives, farm consultants, audit tool developers, local community representatives, and policymakers, at least. If the aim is to develop offset credits or emissions reductions, then key stakeholders should also include potential buyers. The objective setting process could be a co-development process where stakeholders collaborate to identify shared priorities. At a minimum, the scheme designer should consult with the stakeholders to understand their views. The better the scheme reflects all stakeholder objectives, the greater the likelihood of success is. Table 2 summarises the key actors involved in the design of a result-based scheme for SOC and their responsibilities.

Table 2. Illustrating governance throughout scheme development and operation – who does what to secure a robust scheme?

Key actors	Description	Responsibilities
Scheme designers/operators	They develop and then implement the scheme, could be regional/national authorities, associations, downstream companies, or others.	They design and update the scheme, and carry out training activities, administration, supervision and audit of the MRV, registry management, outreach and communication, funding (including establishing credit scales)
Farmers	Participants	They implement climate actions, collect and report input data.
Consultants	They run the audit tool and act as advisors and auditors at different times	They run the audit tool, set the baseline, recommend climate actions to farmers and carry out random/targeted audits.
Other stakeholders	Credit buyers, external verifiers, …	

b. Questions - transparency

Transparency supports the effective operation of the scheme and its ability to achieve its objectives. Transparency builds trust with all stakeholders, especially farmers, policy-makers, and external funders (e.g. credit buyers). **A public registry**, managed by the scheme operator, should publically record all non-commercially sensitive results of the scheme. This should include non-anonymised farm-level reporting on results indicators (i.e. avoided emissions achieved) and other sustainability indicators. The overall impact of the scheme should also be calculated based on this data and publically promoted, for example through website and promotional material. The scheme should also confidentially store the audit tool input and output data as anonymised data to support the development of the scheme. If emissions reduction certificates or offset credits are sold, the purchaser and the amount of credits purchased should be publically listed on the registry.

To support learning and promote transparency, the **scheme should publish all methodologies and cooperate** with external stakeholders, for example farmer participants and external scientists. As well as increasing trust in the scheme, this will provide inputs for the scheme to continue to develop and improve. This will also support the extension of the scheme to other areas, thereby supporting climate action elsewhere.

c. Upscaling adoption

As discussed in the feasibility section, the upscaling of this scheme is primarily limited by the capability of farm carbon audit tools to robustly measure emissions i.e. the coverage and scope of the scheme is first defined by the type of farms, climate actions, and the (geographic) contexts covered by farm audit tools. Apart from these limitations, upscaling efforts should be targeted to areas/farm types where it can deliver the highest impact, most efficiently. Efficiency refers to the ability to take climate actions that deliver net benefit, i.e. the benefits (including climate and other co-benefits) exceed the costs (including all transaction costs).

Existing schemes demonstrate that **diverse methods of upscaling are possible**. Examples include schemes developed and implemented by the public sector[15], the development of research projects into a non-profit association (with public certification)[16], and similar schemes implemented as part of a private supply chain. Upscaling **success factors** identified by the schemes include:

- **Economic incentives**: economic incentives are a key first attractor for farmers.
- **Farmer interest**: increased media and public interest in climate issues is matched by growing farmer interest in how to farm in a climate friendly manner. Farmers respond to positive stories about how their actions can have significant impact. Farmer "champions" disseminate to other farmers, for example at kitchen table meetings, boosting uptake.
- **Broader sustainability impacts**: stakeholders care about more than climate, so broader impacts should be highlighted using indicators that are salient to the stakeholder. For example, offset credit buyers care about local projects and other environmental and animal welfare impacts. Farmers are also motivated by economic co-benefits (e.g. productivity gains).
- **Consultants**: schemes depend on sufficient number and quality of trained consultants, who also play a key role in farmer uptake.
- **Farmer involvement**: scheme design should include stakeholders, especially farmers, to ensure salience and practicality, and to build up interest.
- **Good science**: MRV and farm audit tool capability remain the biggest barrier to uptake. Existing schemes have built on existing tools or research projects and involve scientists in governance and design, to ensure robustness.
- **Learning-by-doing**: all existing schemes have flexibly developed over time, responding to challenges and opportunities as they arose, rather than up-front developing a perfect plan.

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[15] The Woodland Carbon Code (a result-based mechanism for carbon farming that incentivise woodland forest planting in the UK.) was established and is run by a government department (the Forestry Commission). Its advisor board features representatives of scientists, policymakers, carbon market participants, and farming and environmental associations but the executive board is made up of public servants.

[16] The CARBON AGRI mechanism arose from two research projects. To increase uptake of the methodology, involved partners established the CARBON AGRI Association to link farmers, farm consultants/project developers, the ministry, and buyers. The association employs two full-time staff to support uptake and development. The association includes stakeholders from across the sector (farmer associations, audit tool developers, scientists, regional councils, downstream companies, farm consultants, relevant national ministry, among others). The CARBON AGRI mechanism has been publicly certified by the French government's Label bas Carbone offset certification programme but is not a public sector initiative.

Box 3. Role of the CAP and connectivity to the delivery of carbon farming

The **scheme could feasibly be implemented through the new CAP's** proposed eco-schemes funded by the EAGF as well as through the well-established agri-environment-climate measures co-funded by the EAFRD. These instruments are designed to create incentive-based voluntary schemes for farmers and/or other land managers (where applicable). Member States would be able to target and tailor prospective carbon farming schemes supported under these instruments to their climate and other environmental needs provided they can demonstrate how they will contribute to EU climate objectives and corresponding targets. This could be accompanied by CAP support for training and advice, and efforts to increase innovation, including pilot projects. Relevant CAP instruments include knowledge exchange and information (including the farm advisory service, to some extent) as well as cooperation, in particular Operational Group projects under the European Innovation Partnership for agricultural productivity and sustainability.

The **scheme must also be designed to align with the CAP**. To ensure environmental integrity of the scheme and to lower costs for scheme's administrators and farmers, designers need to be aware of related CAP measures. Solutions identified include, where possible, aligning MRV requirements with the CAP (e.g. data reporting, timing), and specifying exclusion criteria or financial additionality requirements to avoid double funding or double counting.

d. Scheme evaluation

The scheme operator should **regularly evaluate** the scheme to assess progress towards objectives and to identify ways to improve the scheme. The evaluation should focus on effectiveness, efficiency, and equity issues. Effectiveness will assess progress towards objectives, using the indicators identified in the objective setting phase, i.e. scheme-wide impact on emissions, number of farmers participating, broader environmental impact, economic impact. This should include specific focus on potential negative externalities. Efficiency will focus on the cost of implementing the scheme, including administrative costs and MRV costs, in absolute and relative terms (i.e. € per tonne CO_2eq, € per farm). Equity considerations should consider whether costs and benefits are spread fairly across different farm types (e.g. large/small, first-movers, young farmers etc.). The evaluation should draw on aggregated scheme data as well as interviews or focus groups with stakeholders. These evaluations should be completed annually to identify trends over time. The feedback and evaluation results should be used to improve the scheme in an ongoing way e.g. to improve the audit tool's usability, changing eligibility rules to limit negative externalities, or to adapt communication to target new farmer groups.

Generally, the experience of existing result-based carbon farming schemes shows that all schemes develop through **ongoing evaluation and adaptation**. This process begins with the adapting of the scheme proposed above to the local context, priorities, challenges, and opportunities. This will continue as scheme operators and participants gather new data and experience, learn from research and practical applications elsewhere, and as they trial new approaches. Applying a versioning approach to the methodology and audit tool can enable the scheme designer to implement and start learning early, while development continues, then transitioning to improved versions of the tool and methodology as they become available, without affecting the participants who have already acted.

8. References

Amundson, R. and Biardeau, L. (2018) Opinion: Soil carbon sequestration is an elusive climate mitigation tool. Proceedings of the National Academy of Sciences of the United States of America, vol. 115, no. 46, pp. 11652–11656.

Batjes, N. H. (2019) Technologically achievable soil organic carbon sequestration in world croplands and grasslands. Land Degradation & Development, vol. 30, no. 1, pp. 25–32.

Böttcher, H., C. Zell-Ziegler, A.Herold and A.Siemons (2019) EU LULUCF Regulation explained: summary of core provisions and expected effects. Öko Institute, Berlin.

Cevallos, G., J. Grimault, and V. Bellassen (2019) Domestic Carbon Standards in Europe: Overview and Perspectives. Institute for Climate Economics, Paris.

European Commission EC (2018). In-depth analysis in support on the COM (2018) 773: A Clean Planet for all - European strategic long-term vision a prosperous, modern, competitive and climate neutral economy Knowledge policy Commission. Hg. v. European Commission (EC). Brussels. Available online at https://ec.europa.eu/knowledge4policy/publication/depth-analysis-support-com2018-773-clean-planet-all-european-strategic-long-term-vision_en

FAO (2017) Unlocking the potential of soil organic carbon. Outcome Document. Food and Agriculture Organization of the United Nations, Rome.

Frank, S., E. Schmid, P. Havlík et al. (2015) The dynamic soil organic carbon mitigation potential of European cropland. Global Environmental Change, vol. 35, pp. 269–278.

Gold Standard (2020) A new climate solution – Soil Organic Carbon [Video]. https://www.goldstandard.org/blog-item/webinar-new-climate-solution-soil-organic-carbon

Joosten H., K. Brust, J. Couwenberg et al. (2015) MoorFutures®: Integration of Additional Ecosystem Services (Including Biodiversity) into Carbon Credits – Standard, Methodology and Transferability to Other Regions. Bundesamt für Naturschutz (German Federal Agency for Nature Conservation).

Lugato, E, F. Bampa, P. Panagos et al. (2014) Potential carbon sequestration of European arable soils estimated by modelling a comprehensive set of management practices. Global change biology, vol. 20, no. 11, pp. 3557–3567.

Lugato, E., A. Leip, A. Jones (2018) Mitigation potential of soil carbon management overestimated by neglecting N2O emissions. Nature Climate Change, vol. 8, no.3, pp. 219–223.

Pellerin S. and Bamière L. (main scientists), Camille Launay, Raphaël Martin, Michele Schiavo, Denis Angers, Laurent Augusto, Jérôme Balesdent, Isabelle Basile-Doelsch, Valentin Bellassen, Rémi Cardinael, Lauric Cécillon, Eric Ceschia, Claire Chenu, Julie Constantin, JoëlDarroussin, Philippe Delacote, Nathalie Delame, François Gastal, Daniel Gilbert, Anne-Isabelle Graux, Bertrand Guenet, Sabine Houot, Katja Klumpp, Elodie Letort, Isabelle Litrico, Manuel Martin, Safya Menasseri, Delphine Mézière, Thierry Morvan, Claire Mosnier, Jean Roger-Estrade, Laurent Saint-André, Jorge

Sierra, Olivier Thérond, Valérie Viaud,Régis Grateau, Sophie Le Perchec, Isabelle Savini, Olivier Réchauchère (2019). "Stocker du carbone dans les sols français, Quel potentiel au regard de l'objectif 4 pour 1000 et à quel coût ?Synthèse du rapport d'étude", INRA (France), 114p. https://www.inrae.fr/sites/default/files/pdf/etude-4-pour-1000-synthese-en-francais-pdf-2_0.pdf Powlson, D. S., A. P. Whitmore, K. W. T. Goulding (2011) Soil carbon sequestration to mitigate climate change: A critical re-examination to identify the true and the false. European Journal of Soil Science, vol. 62, no. 1, pp. 42–55.

Smith, P., J.-F. Soussana, D. Angers et al. (2020) How to measure, report and verify soil carbon change to realize the potential of soil carbon sequestration for atmospheric greenhouse gas removal. Global Change Biology, vol. 26, no. 1, pp. 219–241.

van Groenigen, J. W., C. van Kessel, B.A. Hungate, O. Oenema, D.S. Powlson, K. J. van Groenigen (2017), Sequestering Soil Organic Carbon: A Nitrogen Dilemma. Environmental Science Technology, vol. 51, pp. 4738–4739.

Vargas-Rojas, R., R. Cuevas-Corona, Y. Yigini, Y. Tong, Z. Bazza, L. Wiese (2018) Unlocking the Potential of Soil Organic Carbon: A Feasible Way Forward. International Yearbook of Soil Law and Policy.

Wiesmeier, M., S. Mayer, J. Burmeister, R. Hübner, I. Kögel-Knabner (2020a). Feasibility of the 4 per 1000 initiative in Bavaria: A reality check of agricultural soil management and carbon sequestration scenarios. Geoderma, vol. 369, 114333.

Wiesmeier, M., S. Mayer, C. Paul, K. Helming, A. Don, U. Franko, M. Steffens, and I. Kögel-Knabner (2020b). CO2-Zertifikate für die Festlegung atmosphärischen Kohlenstoffs in Böden: Methoden, Maßnahmen und Grenzen. BonaRes Series, vol. 1, pp. 1-24

9. Project descriptions

Climate protection through soil carbon sequestration - Ebenrain Project**, Switzerland**

The project is a partnership coordinated by the Ebenrain Center for Agriculture, Nature and Nutrition, a public agricultural authority in the canton Basel-Lanschaft in the NW of Switzerland. The partnership involves the collaboration of the Ebenrain Center and FiBL. The financing for the project[17] comes from the Basellandschaftliche Kantonalbank (BLKB), a Swiss regional bank. The BLKB provides funding for the payments to the farmers as well as covers two of the three sampling procedures. The Cantonal government funds the coordinator of the project and the advisory component. Starting in 2019, BLKB approached the Ebenrain Center about developing a pilot project for result-based payments for farmers. The BLKB was looking to offset some of their emissions by supporting a regionally-based project. The motivation for the Ebenrain Center was to develop result-based scheme that had clear monitoring of the environmental effects and also addressed the increasing water scarcity conditions in the region. The experiences and knowledge gained from the project would flow into the advisory services offered to farmers more broadly. The Research Institute of Organic Agriculturel (FiBL) provides scientific guidance for the development of the sampling methodology, and the choice of the analysis method.

The project aims to cover 1,000ha of arable land and permanent crops over a period of six years (estimated to be able to secure 6,000tonnes of CO_2eq in sequestration to offset the bank's emissions over the period). The estimate of the sequestration potential is derived from regional experiences and calculations carried out by FiBL. The scheme estimates that 1t of CO_2eq per ha is feasible. Uncertainty in relation to actual sequestration rates is recognized, including through unexpected factors such as drought or extreme rainfall events.

Farmers commit to carry out SOC sequestration measures for a minimum period of six years, with a minimum commitment of 3ha for arable land, and a minimum of 1ha for orchards, vineyards and horticultural land. The scheme is a full-farm scheme. The exception to this is if a farmer manages parcels that lie outside of Switzerland (since this is a border region); those areas are not compulsory to be included but rather farmers are advised to integrate them in SOC management.

The first sampling was planned for Autumn 2020. Sampling is done in year 1, 3 and 6. One composite sample is taken per field which is the sampling unit (which may include several parcels, and range in sizes from 0.5 to 3-4ha). The sample is gathered from 25 locations within the sampling unit, from depth 0-20cm. The costs of the first two samples are covered by BLKB, whereas farmers themselves cover the cost of the last. The estimated cost of sampling and analysis is 80 – 100CHF per sample.

Farmers receive an initial advisory session in year 1 and a follow-up with the advisor in year 3. They can choose from a menu of measures that they discuss with the advisor. To avoid leakage, farmers can only bring in organic matter (compost) from

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[17] https://www.baselland.ch/politik-und-behorden/direktionen/volkswirtschafts-und-gesundheitsdirektion/landw-zentrum-ebenrain/files/humusaufbau/humusaufbau-blkb.pdf/@@download/file/humusaufbau_blkb.pdf

within a 80km radius. Farmers can apply biochar types as approved by the Swiss fertiliser regulation.

To counter the uncertainty and reduce risk for farmers, each participating farmer receives an upfront payment of 100CHF pro ha following the sampling and the advisory session. In the third year, another guaranteed payment of 100CHF is given. The 200CHF guaranteed payment make up an estimated one third of the total anticipated total payment for the 6 year period per ha. The envisioned price per tonne of CO_2eq is 100CHF. If the result exceeds the value of the guaranteed payment, this is paid out in year three and year six. Farmers that demonstrate that they have taken measures that are expected to increase SOC levels (followed the strategy developed with advisors) do not need to reimburse any of the guaranteed payments even if the SOC increase that they achieve is less than the pre-payment value.

The scheme also emphasizes wider benefits for farmers: 1) increase in water and nutrient storing capacity and associated yield stability; 2) soil fertility and reduced risk of erosion; 3) reduced need for synthetic fertilisers; 4) advisory support and development of a strategy for SOC sequestration and soil fertility.

Solothurn SOM Programme

The project is primarily funded by the Swiss Federal Innovation Programme for Agriculture (Ressourcenprogramm) and with co-funding by the Kanton Solothurn. The programme supports pilot and innovative projects, which can also feed into the development of the Swiss agricultural policy. The project is a cooperation between the Solothurn Technical Authorities for Agriculture and for Environment and the regional farmers' association, with scientific support provided by the Bern University of Applied Sciences (School of Agricultural, Forest and Food Sciences or HAFL). Starting in Autumn 2017, the project runs for a total of eight years, with six years dedicated to the implementation of measures with farmers and two additional years for evaluation and synthesis of results. The aim is to implement and evaluate the effects of a series of management measures that are deemed to improve the SOM content on arable land. A working group (Arbeitskreis) has been formed with farmers in order to facilitate exchange and peer-to-peer learning as the project evolves.

The focus of the project is on arable land and farms with little or no livestock. Any arable farm with at least 4.5ha is eligible to participate, as well as mixed farms with at least 4.5ha of arable land and with less than 1.1 LU/ha on fertilised land[18] . Farmers decide how much area they dedicate to carrying out the measures, ranging from farms that include only 10% of their arable land to near full farm coverage. All farms receive payments for the annual humus balance for the duration of six years, and the remaining payments are done depending on the mix of measures applied each year. By the end of year 2 (2019) 221 farms applied to participate, of which 166 farms meet the eligibility requirement of less than 1.1 LU/ha on fertilised land. These farms implemented measures on an area covering 840ha. This makes up for 38% of the potential participants (with less than 1.1LU /ha on fertilised land), which is a relatively high rate of uptake. Those farms with above 1.1LU/ha on fertilised land can still participate with the humus balance assessment, but cannot receive payments for the agronomic measures.

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[18] This LU/ha refers to land area that is fertilised and excludes non-fertilised areas such as extensive grasslands, wildflower strips or rotational fallows.

The project evaluation and monitoring has two components. First, the feasibility and acceptance of measures is evaluated, as well as their practical implementation and design, and costs and benefits of measures (based on survey with farmers in years 1, 3, and 6). Secondly, HAFL supports in the monitoring of effects on SOC content and soil structure. Soil sampling is conducted on a subsample of farms on a yearly basis to determine C_{org} values, soil texture is analysed at the beginning of the project, and aggregate stability and bulk density in year 1 and year 6. Sampling is GPS guided, with composite sampling on fields with the least variability in soil characteristics. Sampling is done at no cost to farmers on those farms that participate in the working group (14 farms).

The measures are complementary to those supported under the Swiss federal agricultural policy and the minimum requirements for good agricultural practice (Ökologischer Leistungsnachweis). In case there is overlap with the federal agricultural policy, the payments are reduced. Each farm participating in the programme has to perform a humus balance every year, and all farms with livestock density under 1.1LU/ha on fertilised land has a choice of implementing other measures on an annual basis depending on their production and crop rotation. The focus is to improve the carbon balance of existing crop rotations.. Reduced or minimum tillage is not eligible for payments since it can be supported by other programmes. Eligible measures include: humus balance (compulsory), manure composting and application, under sowing, green manure, catch crops, non-perennial grass with alfalfa (more than 3 years), non-perennial grass (3years). The measures contribute to continuous winter soil cover and thus also address a regulatory baseline gap (i.e. winter cover is only compulsory if the preceding crop is harvested before 31.8). Conversion from arable to grassland is not an eligible measure for receiving payment.

The project includes several aspects that are relevant for result-oriented schemes. First, the payments are calculated not on income foregone or additional cost basis, but rather the anticipated SOC sequestration effect. The payment in most cases does not fully cover the costs of the measure. Second, the monitoring of the measures and their effects is a central aim of the project. Third, the project also specifically evaluates whether the humus balance tool could potentially be used as a monitoring tool to provide result-based payments. For this, the initial experience indicates that it would need to be further improved. The improved precision of the tool would need to be balanced against the higher administrative and data efforts associated with this.

Two key success factors for the project are: 1) inclusion of farmers from the initial stages of the project, including the partnership with the farmers' association, and 2) the working group with farmers where exchange and learning takes place around experiences with the measures and any other project-related aspects. Farmers receive a participation cost for the working group meetings, as well as the incentive of having their fields sampled and monitored. Both of these success factors built on long-term relationships that the Technical Authority has in the region.

Kaindorf Certificates[19]

The project is a run by EcoRegion Kaindorf in Austria, a cooperation of three municipalities in East Steiermark, in collaboration with the Institute for Soil Research at the University of Natural Resources and Life Sciences (BOKU) in Vienna. The SOC sequestration programme was launched in 2007, with the aim to test and develop

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[19] https://www.oekoregion-kaindorf.at/index.php?id=191

practical options for SOC sequestration and increase uptake of SOC sequestration in agricultural practice, including through a CO_2-certificate programme. The programme also aims to better understand the impact of management measures on SOC levels and SOC changes, to further improve the practice. The programme contributes to the regional goal of climate neutrality.

The aim of the project is to incentivize widespread improvements in SOC management, with a strong focus on demonstrating concrete improvements. Farmers sign a contract with the EcoRegion, with a commitment for 12 years. Criteria for area inclusion are that the field sizes are between 1 to 5ha, and each field has to have a single land use type. No conversion of land use is allowed during the commitment period. Sampling is done at the beginning of the commitment, after 3 to 7 years (result sampling) and after another 5 years (control sampling). GPS guided sampling ensures that the same locations are sampled. A composite sample is taken per field which is the sampling unit from 25 locations within the sampling unit, from depth 0-25cm. Bulk density is currently not measured, but rather coefficients are used. The sampling unit is between 1 – 5 ha, which can cover a lot of variability in the SOC content. One option being considered by the programme is to take a subsample of plots where all 25 individual samples would be tested separately, rather than as a composite sample. Moreover, the option is envisioned to also test the subsoil, below 25cm depth.

The programme sells CO_2 certificates to regional / national companies that aim to offset their emissions. Currently 320 participating farmers are included and 4,000 ha across Austria. The price for tonne of CO_2 is €45, of which €30 go to farmers directly.

As a pilot project, the programme puts value on:

- Farmers' exchange and capacity building.
- Some risk on the side of the farmer (soil sampling costs) and flexibility (free choice of measures).
- Societal recognition of the role of agriculture in climate crisis.

Carbon Assets for Soil Health Project[20], Soil Association, UK

The aims to develop an evidence base for building the case for setting up a reward system for the public goods associated with good soil health management. In the initial three years (2020 – 2022) the project aims to develop:

- a better understanding of the techniques which are increasing soil carbon sequestration.
- a clear understanding of the capacity of different soil to sequester carbon in the UK.
- an understanding of the opportunities available for farmers from public funding and regulatory standards to maximise carbon sequestration through improved soil management.
- an understanding of the difference between farming systems and practices in their ability to improve soil quality and carbon.

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[20] https://www.thefarmernetwork.co.uk/carbon-assets-for-soil-health-rewarding-farmers-providing-a-public-good/

The project is crowd-sourcing data to from both organic and non-organic farmers who have been monitoring soil organic matter (SOM) on their farms via an online survey. The evidence gathering will provide insights and evidence base on the relationships between cropping history, management practices, soil types and SOM levels. By participating in the project, farmers will also receive free soil tests over two years and receive feedback from research results.

10. Interviews and reviews

The authors are also thankful to external reviewers for their comments: Mark Titterington / Martin Voss, colleagues from Finnish LIFE Carbon Farming Scheme project, Axel Don, and Martin Wiesmeier.

Table 3. Interviews and reviews

Name of Expert	**Project**	**Organisation**
Axel Don	German Agricultural Soil Survey	Thünen Institut
Gerald Dunst	Kaindorf Certificates	Kaindorf EcoRegion (scheduled 17/6/20)
Guy Hudson	Soil Carbon	Soil Carbon Co
Dr. Jacqueline Gehrig-Fasel, Dr Martin Gehrig	Co-drafted the GoldStandard SOC methodology	Trees*
Jean-Francois Sousanna	Circasa	INRA
Jennifer Meier	Solothurn SOC Programme	Solothurn Amt für Landwirtschaft
Jenni Kahkonen, Tikkanen Marianne , Ilvesniemi Hannu, Kaj Granholm, Juuso.joona, Laura Hoijer and others	LIFE Carbon Farming Scheme	St1 Oy, Fortum, LUKE,
Laura Hoijer - BSAG juuso.joona@soilfood.fi Höckerstedt Layla - FMI, Kaj Granholm - BSAG, Pieta Jarva, Michaela Ramm-Schmidt, Eija Hagelberg	Carbon Action (FI)	Small Roundtable with Carbon Action members - BSAG, FMI, ST1Fi
Manon Puehlacher	Ebenrain Project	Ebenrain Agricultural Center
Mark Titterington / Martin Voss	Indigo Ag Pilot in Europe	Indigo Ag

Name of Expert	**Project**	**Organisation**
Matthew Warnken	Australian Carbon Farming Initiative – SOC measurement method	AgriProve
Nestle Webinar	Living Soils	Nestle / Earthworm Foundation
Peter Kuikman	Dutch method for SOC MRV	Wageningen University
Daniel Bretscher	Swiss national inventory	Agroscope
Tiago Domingos	Terraprima sown pastures	Terraprima
Wolfgang Abler	CarboCert Certificates	Carbo Cert
Karen Fisher	Carbon Assets for Soil Health	Soil Association

Annex IV

LIVESTOCK FARM CARBON AUDIT

A CARBON FARMING CASE STUDY

Table of Contents

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Summary and recommendations

Context**:** the **European livestock** sector– such as beef, dairy, sheep and pork farms - is responsible for 81% of all Europe's agricultural emissions (Liep et al. 2015). Including its induced impacts on other sectors such as energy, industry, land-use change, and feed importation, the EU livestock sector has a global warming impact equivalent to almost 20% of EU total emissions (Leip et al. 2015). On-farm climate actions such as herd management and feeding, animal waste management, crop management, fertiliser/energy consumption, can reduce livestock GHG emissions cost-effectively. International research and existing European demonstration projects suggest that by applying these climate actions European livestock farms could potentially reduce their emissions by 12-30% by 2030. Result-based carbon farming schemes offer a promising way to incentivise farmers to take effective and efficient climate actions on their farms, because the farmer gets paid in accordance with the amount of GHG emission reductions they achieve (i.e. there is a direct link between their reward and the actual impact they have on the climate). Result-based carbon farming schemes can be based on **whole farm carbon audit tools** - computer programmes that calculate a farm's GHG emissions (and other indicators such as for example nitrogen balance, economic profit), based on input data that summarise the farm's management elements (e.g. animal number and type, feed type, etc.); existing examples include CAP2'ER, Solagro, Cool Farm Tool.

Case study's aim and scope: This case study outlines **how a farm carbon audit tool can form the basis of a result-based scheme to incentivise emission reductions on European livestock farms.** It focuses on GHG reductions below a baseline level of emissions; it does not reward carbon sequestration in e.g. soil carbon or agroforestry (covered in other case studies). This document discusses all elements that are necessary for implementation, including monitoring, reporting, and verification, scheme scope and participant eligibility, baseline setting and additionality, reward calculation, monetisation of emission reductions (e.g. offset credits) and governance.

Recommended livestock carbon audit scheme - Summary

Objective: Incentivise real and additional voluntary GHG emission reductions on livestock farms.

Scale/coverage: livestock farms (any that can be robustly assessed by farm audit tools), i.e. dairy, sheep, beef, goat farms in diverse geographic contexts.

Climate actions: any actions to avoid emissions that can be robustly measured by audit tools. *Note: the scheme does not include carbon sequestration or storage (due to uncertainty and permanence risk).*

Monitoring, reporting and valuation (MRV): the farm carbon audit tool quantifies whole-farm GHG emissions (t CO_2eq).

Typical project steps include:

Step 1: A trained farm consultant visit the farm, calculates a baseline emission level and identifies climate actions to avoid emissions.

Step 2: The farmer implements the actions and keeps records.

Step 3: After five years, a consultant visits the farm again to calculate emission reductions over the period.

Rewards: The farmer is rewarded at a set rate per tonne of emission reductions, as long as they meet eligibility criteria (including "doing no harm" to other environmental and socio-economic indicators). Farmers do not receive offset credits or certificates.

Funding and governance: The scheme can be funded either by a public body, internally within a company, or by external sale of offset credits/certificates. This funding decision determines governance requirements.

Design principles: 1) *Minimise MRV costs* and (2) *shift costs away from farmers* (to maximise farmer uptake and decrease overall scheme costs); (3) *learning-by-doing* (the proposed scheme is a strawman that will need to be adapted to the local context, evaluated and improved based on experience).

Recommendations related to upfront decisions

Two key up-front decisions overwhelmingly shape the scheme design: 1. The selection of the farm audit tool, 2. The level of environmental uncertainty to accept.

1 - Farm carbon audit tools estimate GHG emissions (i.e. the baseline) and emission reductions (i.e. results), with moderate levels of robustness for many EU farm types and on-farm climate mitigation actions. A number of farm carbon audit tools are already available, while some schemes have custom built their own audit tools. Audit tools are increasingly being designed in such a way that they can be parameterised or adapted to different local contexts or different types of farms. Tool accuracy increases with relevant scientific data (i.e. it is higher for estimating methane emissions for livestock in French farms than for estimating soil carbon storage in Romanian farms). Emission reductions can be more reliably estimated than carbon storage or sequestration, as soil carbon estimates depend on geographic and temporal features that can be difficult or costly to capture in farm carbon audit tools. This scheme also excludes soil carbon to avoid permanence issues. To ensure robustness, audit tools must apply scientifically recognised approaches (e.g. at least IPCC Tier 2 methods). While interviewees considered carbon audit tools relatively robust, because the tools are models based on experimental data rather than measurement, it is very difficult to quantify the uncertainty of audit tool estimates.

2 – Environmental uncertainty: Scheme designers and participants face and must accept some degree of **environmental uncertainty** in the estimated emission reductions. This uncertainty arises due to farm audit tool calculation methods (e.g. reliance on average emissions factors), input data monitoring and inputting, and other scheme design elements. Up to a point, scheme designers can reduce uncertainty through more stringent scheme requirements (e.g. strict verification, conservative audit tool calculation assumptions, etc.); however, this comes with a trade-off: cost, which will decrease the net benefit of the scheme and reduce farmer uptake.

Scheme designers must also consider the following **additional upfront issues**:

- **Funding approach**: i.e. will the emission reductions be sold as offset credits or financed by external parties? If they are sold as credits, this can demand stringent environmental certainty/tool robustness and hence costly MRV.
- **Scope and coverage**: what types of farms and climate mitigation actions, and what geographic context will be targeted? The farm carbon audit tool must be able to estimate baseline emissions and reductions on the target types of farms (e.g. beef cattle), in the geographic context (e.g. Brittany), and impact of climate actions (e.g. efficiency improvements) at an acceptable level of environmental certainty.
- **Objectives**: i.e. does the scheme aim just at emission reductions, or also at other negative externalities (e.g. nitrogen runoff), or co-benefits (e.g. biodiversity outcomes or farmer income)? Does it consider long-run land-use efficiency or other systemic issues?

Recommendations related to scheme design

Generally, **there is no one-size-fits-all design**. Local context and objectives will determine the "best" type of scheme in each case (i.e. tool, level of environmental uncertainty, type and timing of farmer reward, etc.). Many design decisions have trade-offs, which will need to be weighed up given that local context. Given that the scheme is voluntary, the scheme should aim to keep costs low to **increase farmer uptake**. Costs can be kept low by accepting greater uncertainty and therefore reducing MRV requirements, simplifying design (e.g. by restricting participant eligibility to similar participants), or by investing upfront to reduce ongoing transaction costs to farmers. Generally, the scheme should reduce farmer transaction costs to boost uptake. Farm consultants and farmers will be key recruiters of other farmers. Higher farmer and stakeholder engagement and involvement will be important for design, feedback, and uptake of scheme.

Additionality: Emission reductions are additional if the scheme induces actions that would not otherwise have occurred. We propose considering all reductions below a historical emissions baseline as additional. To set baselines, consultants run the farm audit tool on the individual farm on historical data (e.g. previous year). The scheme (or the tool) can manage carbon leakage by discounting estimated emissions (i.e. awarding less than are estimated). Financial additionality tests are not appropriate for this scheme. During the baseline setting, the consultant will identify mitigation options for the farmer, thereby educating and training the farmer.

While farmer rewards could be based on intensity gains, farmers should only be rewarded if they deliver absolute emission reductions, to guarantee real climate impact at the farm level. Other secondary objectives (i.e. co-benefits and addressing negative externalities) can be monitored by farm audit tools but should not be the primary focus of the scheme. Schemes could have a do-no-harm eligibility requirement for secondary objectives. Secondary objectives should be monitored and evaluated at the project level.

Farmers should receive a set reward price per tonne of carbon reduced. This option results in less uncertainty and transaction costs for the farmer, compared to being rewarded tradeable credits, and hence it will increase uptake. To boost farmer uptake, it would be advisable to reward some portion of expected impacts upfront and also highlight significant efficiency gains (which can be double carbon payments).

Monitoring, reporting, and verification should depend exclusively on the farm carbon audit tool (not on on-site testing), with random audits and high penalties for cheating or other non-compliance. To reduce MRV costs, data inputs should be aligned with CAP reporting and existing data, as far as possible. The Farming Sustainability Tool (FaST), which is under development, could be a source of data or have a whole farm carbon audit module.

Recommendations regarding funding, governance, and upscaling

Externally funding the scheme by selling fungible offset credits or non-tradeable emissions certificates demands high environmental certainty, which requires stringent MRV, external verification, and/or a solid reputation. The resulting transaction costs may be too expensive and therefore undermine uptake and the impact of the scheme.

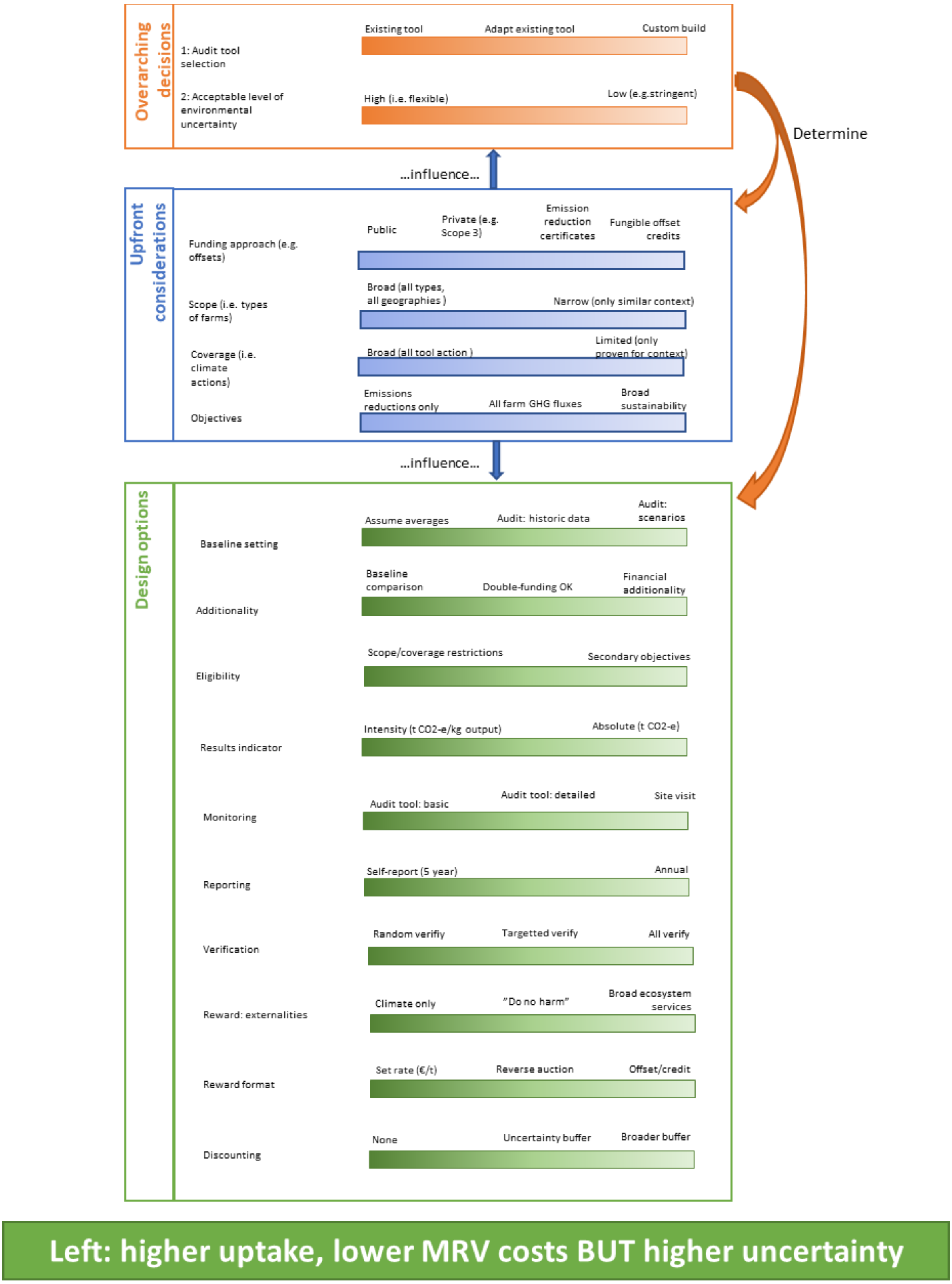
Learning-by-doing has been central to the development of existing schemes (e.g. Carbon Agri, Woodland Carbon Code, MoorFutures). It is through the process of implementing their scheme that barriers and solutions were identified, and trade-offs, costs and benefits became measurable. For this reason, schemes must have evaluation processes, including a stakeholder review and monitoring of impact on GHG emissions and other secondary objectives. High transparency is essential to ensure credibility and buy-in.

Upscaling should occur at the local level, as local context (objectives, trade-offs, geographical context, farm types) will determine "optimal" scheme design. Schemes should target areas/farm types where there is robust audit tool coverage, large sources of emissions, and cost-efficient mitigation options. Schemes rely on skilled/trained farm consultants and farmer interest. Involving stakeholders in design/evaluation supports efficient, effective, high-uptake schemes.

At the European scale, **upscaling will need to be supported by knowledge sharing and networking**. This includes exchanges between existing schemes and scheme under development, and ongoing scientific development/validation of farm carbon audit tools. The Biodiversity 2030 and Farm to Fork Strategies, as well as ecoschemes in the new CAP, offer opportunities to develop local schemes.

Overall Conclusion: There are sufficient knowledge, experience and technical capacity to develop result-based carbon farming schemes to incentivise emission reductions on European livestock farms using whole-farm carbon audit tools. However, due to the importance of the local context (including objectives, farmer/consultant knowledge and interest, as well as geography), there is no one-size-fits-all approach. Accordingly, schemes must adapt to the local circumstances, ensure ongoing evaluation and engage stakeholders on scheme development and implementation.

Figure 1 Visual guide to the livestock case study.



Source: own elaboration
Note: Overarching decisions determine upfront considerations and design options. Upfront considerations will influence overarching decisions and shape design options.

1. Introduction

This case study report describes how to design and implement a result-based carbon farming scheme on livestock farms using whole farm carbon audit tools. Result-based schemes reward farmers for their measurable climate benefits, rather than for putting in place climate-friendly agricultural practices (as action-based schemes do).

The aim is to incentivise emission reductions compared to a baseline. The scheme focuses on agricultural emissions (excluding removals or storage of carbon e.g. through soil carbon)[1]. The report covers all elements necessary to establish such a "scheme" (i.e. scheme or policy) in the European context. It outlines the steps and considerations that a scheme manager - a regional authority, a national government, a private or a not-for-profit initiative - will need to take to establish such a scheme, identifying key trade-offs and open questions to be considered.

The scheme explored in this document builds on existing schemes and research projects. Key references include:

- The CARBON AGRI scheme, which since 2019 incentivises emission reductions and/or increased carbon efficiency on French dairy and beef farms using the CAP2ER farm audit tool, with farmers rewarded for results achieved. This in turn builds on the LIFE projects Beef Carbon and La Ferme laitière bas carbone.
- Gold Standard livestock emissions management methodologies from 2018 and 2019. These are specific methodologies for quantifying emission reductions on livestock farms to create certified offset credits.
- Australian Government's Emission Reduction Fund methodologies for carbon farming from 2015. These include specific methods for reducing emissions on beef and dairy farms in order to earn result-based carbon credits or payment.
- New Zealand Interim Climate Change Committee's 2019 work on agriculture emissions, which investigated how agricultural emissions could enter the New Zealand Emissions Trading Scheme.
- Arla Food's Climate Check sustainable dairy project, a corporate supply chain action to reduce emissions on Arla dairy farms.

We also analysed cross-cutting design elements from result-based schemes focussed on other agricultural topics, especially:

- Woodland Carbon Code, a UK-based voluntary standard for verified carbon sequestration on woodlands and voluntary offsetting, which has been active since 2011.
- MoorFutures, a Germany-based voluntary standard for verified emission reductions through peatland creation, which has been active since 2012.
- International methodologies developed under Verified Carbon Standard (VCS), and UN Clean Development Mechanism and Joint Implementation.

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[1] Removals are covered in the other case studies: Peatland Restoration and Rewetting (Annex I), Agroforestry (Annex II) and Maintaining and Enhancing Soil Organic Carbon on Mineral Soils (Annex III).

The suggested scheme design builds on these projects, and complements them with discussions with stakeholders at the 2019 Carbon Farming roundtable and interviews with existing scheme designers and stakeholders, including policy makers and farmers, as well as wider grey and academic literature[2].

The report is structured as follows[3]: this introduction summarises the proposed scheme and contains a short glossary. Chapter 2 provides context, identifying the potential for result-based approaches to manage livestock emissions. The following chapters outlines the scheme design. Chapter 3 identifies essential components for feasibility, including two overarching considerations: 1) selecting the whole-farm audit tool and 2) deciding an acceptable level of environmental uncertainty. Chapter 4 describes objective setting and how to ensure additionality through baselines and eligibility. Chapter 5 introduces the selection of results indicators and monitoring, reporting and verification (MRV). Chapter 6 considers farmer reward payments and the funding of the scheme: this includes reward calculation and eligibility criteria (including broader sustainability indicators), and funding options including offset markets. Chapter 7 discusses governance, enabling factors for upscaling, including stakeholder outreach. Figure 1 presents a visual overview of the scheme.

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[2] See Chapter 9 for a list of interviews and references

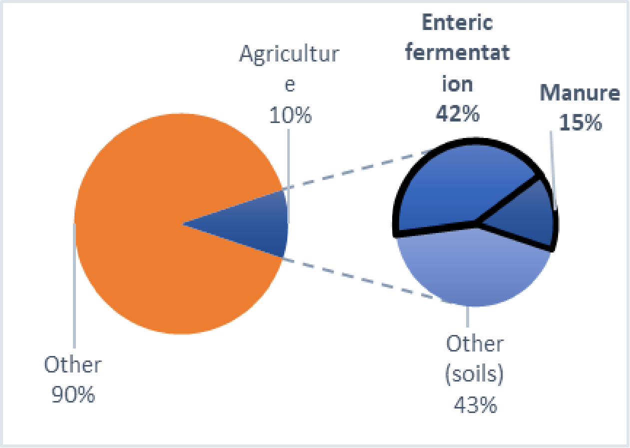
[3] Existing examples demonstrate that the process of developing a result-based carbon farming scheme is uncertain and iterative, with multiple potential starting points. To increase readability, this case study presents one possible order of steps and proposes one scheme design, whilst also identifying key considerations for each design element. Any scheme designer may start at a different point, follow a different order, and given their specific local context and objectives, select different design options. They will definitely need to iterate back and revise design over time.

2 Exploring options – choosing the approach

a. Putting the case study in context

The livestock sector is a significant source of EU greenhouse gas (GHG) emissions. Research and existing carbon farming projects offer evidence that it can also offer a significant potential for reductions. In 2015, the agricultural sector was directly responsible for 513Mt CO_2eq, equivalent to 10% of Europe's GHG emissions[4] (European Environmental Agency 2019). Of this 10%, livestock-related emissions were a significant source: enteric fermentation accounts for 42% and manure management for 15% (with the majority of the remainder related to agricultural soils) (European Environmental Agency 2020). If indirect emissions (e.g. feed importation, on-farm energy use, land-use change) are also included, agriculture's absolute GHG contribution can as much as double these numbers (Leip et al. 2015)[5].

Figure 2 Breakdown of agricultural contribution to European GHG emissions, with emissions covered by this scheme with black border



Source: European Environmental Agency, 2020)

Numerous on-farm climate actions can cost-effectively reduce livestock GHG emissions, including herd management and feeding, animal waste management, crop management, consumption of fertiliser and energy, and carbon storage actions, among others (Frelih-Larsen et al. 2014). At a global level it is estimated that the agricultural sector could reduce emissions by 13.7% at a cost of €37-55/t CO_2eq through on-farm mitigation actions (OECD 2019). Existing schemes suggest that the potential to decrease emissions on livestock farms is similar in Europe: the Ferme laitière bas carbone project aims to reduce the carbon footprint of French dairy farms by 20% over ten years (2015-2025); the LIFE Green Sheep project aims to reduce emissions by 12% over four years on sheep farms in France, Ireland, Italy, Romania and Spain; the LIFE Beef Carbon projects aims at reducing the GHG footprint of French, Spanish, Irish, Italian beef cattle farms by 15% over ten years; CARBON AGRI aims to achieve emission reductions of 15-20% on French livestock farms; Arla Food's Climate Check programme aims to reduce emissions intensity of their dairy production by 30% between 2015 and

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[4] This excludes land use, land use change, and forestry (LULUCF) – i.e. does not include emissions associated with land use change due to livestock.

[5] The GHG emissions of the agriculture sector at the global scale are similarly large: direct emissions are 12% of global emissions, with indirect emissions contributing an additional 9% (OECD 2019).

2030. These project reductions build on existing decreases: from 1990-2012 EU agricultural GHG emissions fell by 23% (Eurostat, 2018).

These levels of technically possible mitigation face economic, market, and socio-political barriers, which limit their uptake (OECD 2019). A whole farm result-based approach is a promising method to reduce the GHG emissions of the livestock sector (see **Table 1**).

Table 1: Advantages/disadvantages of a result-based scheme, compared to traditional, activity-based approaches[6]

Advantages	**Downsides**
Farmer flexibility: Audit tools capture many management options exercised on a farm and can therefore reward a very wide variety of climate actions. Farmers can use their expertise and local knowledge to select the most efficient management actions for their farm (i.e. those where the benefits outweigh the costs most, including climate impacts as well as other criteria). ***Quantified whole farm impact***: Whole-farm audit tools cover the entire management on the farm (rather than focussing on specific actions), which means they better capture interaction effects as well as leakage within farm that can be missed by activity-based schemes (such as would be the case where a farmer is rewarded for planting hedgerows on one part of their farm, but the climate impact is undermined by increasing stocking rates on other parts of the farm). Quantification supports value for money and can enable offset credits (i.e. external funding). ***Sustainability monitoring***: Audit tools calculate multiple sustainability indicators based on the same inputs e.g. nutrient leaching, area set aside for biodiversity protection, economic efficiency, etc. Farmers and scheme managers can use them to avoid externalities/promote actions with co-benefits.	***Set-up costs***: Selecting and parametrising audit tools for use in a specific context can be time-consuming and costly, relative to establishing management-based tools. ***Consultant demands***: The scheme relies on skilled consultants advising farmers: training sufficient consultants could be a bottleneck. ***Complexity***: Relative to activity-based schemes, result-based schemes are more complex, requiring farmers to gather, record and report more data, and scheme managers to record and manage more data. This additional complexity can be a barrier to uptake from all sides.

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[6] Activity-based management refers to when farmers are paid for implementing climate actions, independently from the resulting impact of those actions.

Given the potential, there is **increased public, corporate, scientific, and farmer interest** – and progress – on reducing agricultural emissions using result-based approaches and audit tools. This is evident through the development of result-based schemes financed by the public sector (e.g. Label bas Carbone, Woodland Carbon Code), often building on existing approaches developed by non-profit organisations (e.g. VCS, GoldStandard). This is also evident in the private sector, with corporations seeking to reduce agricultural supply chain emissions (e.g. Arla Foods Climate Check programme, Cool Farm Alliance development and implementation of Cool Farm Tool). This results in an increased demand for offset credits or verified emission reduction certificates generated in result-based schemes (Cevallos, Grimault, and Bellassen 2019). The increasing interest in audit tools builds on and fuels ongoing scientific development, testing of farm audit tools and their use in research and pilot projects, including on livestock farms in Europe (such as the Solagro tool, CAP'2ER tool, Cool Farm Tool, etc.). Further, in light of ever-growing social, scientific, and sectoral recognition of the need to act on climate change, farmers are also seeking ways to farm in climate friendly ways.

Policy – at the EU and national level – also has a role in driving or limiting the development of result-based schemes. With minor adjustments, the scheme that we propose could be developed and implemented by different scheme managers. This could occur through national, regional or EU policies, as part of corporate sustainability efforts, private market development, or through associations of actors with farmer groups. Regardless of who establishes the scheme, it will inevitably interact with existing policies, in particular the Common Agricultural Policy (CAP); consistency with CAP strategic plans will be important. The CAP cross-compliance baseline will need to be considered in baseline settings to ensure that the actions rewarded through the scheme are additional (i.e. CAP cross-compliance requirements for buffer strips along water courses would be considered part of the baseline). CAP cross-compliance will also affect what farmers are able to implement and be rewarded for under the scheme. For example, CAP cross-compliance requirements related to the Nitrates Directive sets limits on annual applications per hectare of nitrogen from livestock manure that effectively limit farm stocking rates in some areas. These cross compliance requirements also effectively set a baseline which set a minimum level against which additionality of actions can be measured. The scheme could be established under the CAP or alongside it. If it were established alongside the CAP, the scheme would need to deduct any CAP payment for additional climate actions to avoid double payment. A final policy consideration is the potential for compliance-generated demand for offset credits. If national governments require corporates or others to offset (some portion of) their emissions or allow agricultural offsets to fulfil regulatory obligation, then the scheme may want to adjust to ensure any credits it produces align with these requirements, as this will generate significant demand (e.g. as arises through linking agricultural offsets to California cap-and-trade, or Swiss obligations on fuel importers, or Colombian carbon tax exemption) (Cevallos, Grimault, and Bellassen 2019).

3 Feasibility, support, and enabling scheme development

This chapter introduces two overarching issues that determine the feasibility of the scheme, and greatly influence its overall design: **1) the selection of the auditing tool** and (relatedly) **2) the degree of acceptable environmental uncertainty.** This chapter also identifies the resources, knowledge development and stakeholder engagement needed to enable scheme development.

Overarching issue 1: Selecting an appropriate farm carbon audit tool

Farm carbon audit tools are computer applications that calculate a farm's GHG emissions and/or carbon sequestrations based on input data that summarise the farm's management. They can also calculate other outputs, including sustainability indicators such as nutrient runoff or emissions intensity. Selecting the kind of farm carbon audit tool to be used defines the scope and coverage of the scheme, as only those types of farms and climate actions covered by the tool can participate. The tool is the only method for quantifying results (i.e. Monitoring, Reporting, and Verification – MRV), and therefore it determines the baseline and reward calculations.

Scheme designers can **choose from existing tools,** such as CAP'2ER, which is used in the Carbon AGRI scheme, the EU Commission-funded Solagro or FaST tools (the latter is under development), and Cool Farm Tool, among many others. Chapter 10 summarises the key features of existing tools, including their coverage of geographic characteristics, farm types and climate actions, as well as their robustness, practicality and ability to calculate broader sustainability impacts.

Scheme designers can **develop a custom tool**[7], rather than using an existing one. Building a custom tool will ensure that it captures the scheme's context (e.g. geography), and covers the farm types and climate actions desired by the scheme designers. However, developing a stand-alone tool will be costly, time-consuming and may result in new uncertainties. A halfway option is to **adapt existing tools** to specific requirements and conditions. The Cool Farm Alliance's current development priority is "versioning", which will enable specific versions of the tool (with local defaults, emissions factors, etc.) to be tailored to specific schemes. Similarly, the CAP2ER tool is being extended to cover sheep farming, veal and horses in four additional EU countries, as well as other extensions. These adaptations are relatively straightforward, as the methods and basic structure remain based on IPCC methods and therefore will not change, with the largest challenge being calculating important reference default inputs (e.g. default feed mix)[8]. This involves identifying appropriate values for key calculation variables (e.g. emissions factors, feed mixes). Some of these data may be available

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[7] The CARBON AGRI scheme developed a purpose-built tool, CAP2ER, which was built specifically for the French context of the scheme. The tool was developed before and then alongside the development of the CARBON AGRI scheme, beginning development in 2012, and in earnest since 2014. Up until 2020, the cost of developing the CAP2ER software was approximately €200-300,000. There are also ongoing costs: in addition to software development, there is now one full time engineer employed to develop the tool by adding new methods and farm management options.

[8] As feed is traded across borders, there is a risk of creating arbitrage opportunities if feed mixes receive different emissions factors in different schemes/across borders, unless this is justified by research.

from national inventories at the national (Tier 2) even sub-national (Tier 3)[9] level, for example, some GHG inventories have standard feed rations which can be used in Tier 2 models[10]. Pilot studies may be required to develop these data sets. These data sets should enable the calculation of the average emission factor as well as the uncertainty (i.e. confidence interval). For example, the CARBON AGRI scheme builds on previous multi-year research projects including LIFE Beef Carbon. This enables the tools to be parametrised, tested and improved, before rolling out the methodology more widely.

In the future, there is the potential for the **Farm Sustainability Tool (FaST)**[11] to either support or replace existing or custom tools. FaST is currently being developed by DG AGRI, the EU Space Programme (DG DEFIS) and the EU ISA² Programme (DG DIGIT). It aims to provide a singular digital platform that links Copernicus and Galileo satellite data, other public data (e.g. IACS data used for CAP payments) and farmer and managing authority-inputted data. In addition to centralising administrative data, FaST aims to support compliance checks and payments. Moreover, it aims to use these data to support sustainable farming. Initially, it was designed to focus on nutrient management (i.e. recording and recommending when and how much nutrients are applied, calculating nutrient budgets and recommending best practices to farmers). The tool has been designed as a modular system, with the possibility of adding additional modules and functionality. As only pilot versions of the tool have so far been completed and the tool is still under development, it is not clear what data and what sustainability management information will be included. However, it is clear that FaST could significantly support a result-based livestock emission reductions scheme. At a minimum, the data collected in the FaST tool would lower costs of data collection and MRV for whole farm audit tools. In the best case, add-on modules could be designed for FaST to replace whole farm carbon audit tools to calculate baselines and emissions, and potentially even linking the changes in emissions to the payments. In addition to lowering costs for farmers, the inclusion of such a module for all EU farmers (if mandatory) would avoid adverse selection and baseline setting challenges. To speed and decrease costs of developing any such module, existing whole farm audit tool experience should be built upon, building on calculation methods and input data requirements.

When deciding on whether to use existing tools or develop a new one, scheme designers' primary criteria must be scientific robustness. Robustness refers to the ability of audit tools to quantify results (GHG emissions and other sustainability indicators) reliably (i.e. with low uncertainty), based on inputs (i.e. farm management) under certain conditions (e.g. geography, farm type).

Using audit tools to estimate GHG emissions inherently involves some **uncertainty**. This uncertainty arises due to data and the calculation. Tools rely on input data, which is measured and entered with some uncertainty (e.g. the feed mix is approximated and based on potentially erroneous farm records). The tool then calculates GHG emissions by multiplying these uncertain inputs by either average emissions factors or approximate equations (another source of uncertainty), which approximate the relationship between the input data and emissions. The uncertainty will be higher in simpler tools (where factors that affect this relationship, such as specific timing of manure application, are not included as input data). Uncertainty is also higher when the

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[9] A significant trade-off of more sophisticated but complicated Tier 3 models is that their additional complexity can make them inaccessible to most farmers.

[10] It is important that models follow IPCC-approved methodologies to facilitate inclusion of the scheme's emissions reductions in national GHG inventories.

[11] See https://fastplatform.eu/

tools are used on farms that differ greatly from the farms upon which the emissions factors/equations were developed, i.e. the tools should reflect local context[12].

In general, farm carbon audit tools estimate results with moderate levels of uncertainty. There are different opinions on the degree of uncertainty of the tool:

- Some experts think that carbon audits tools are not robust enough (e.g. one of the experts interviewed for this research recommended approximately three years of additional research and development before using them).
- Other existing initiatives (e.g. CarbonAgri, CoolFarmTool) report being confident of the reliability of their tool despite lacking clear metrics for uncertainty, stating that the reliability of the tools mainly depends on the quality and quantity of the data: uncertainty is lowest in sectors with more data (e.g. livestock emissions) and greater where there is less data (e.g. soil carbon sequestration).
- Evidence from the literature is similarly mixed: some comparisons of different tools report inconsistent audit results (Sykes et al. 2017) while others are more confident that audit tools could be reliably used to identify and quantify climate actions for mitigation (O'Brien et al. 2020).
- Overall, while all experts acknowledge that uncertainty is an issue, they concluded that it is clear that it uncertainty is lower when GHG emissions are estimated using farm carbon audit tools than when based on management measures or technologies alone.

As explored in chapter 10**, existing schemes did not have a consistent method for assessing the robustness and reliability of the farm carbon audit tool used:**

- **Gold Standard** requires that new methodologies are approved by a scientific-technical advisory committee and internal reviewers, as well as through public consultation. The Committee did not approve the use of the Cool Farm Tool, as it was not possible to calculate the uncertainties associated with estimates. This doesn't imply that the tool is not robust; rather, that the robustness could not be sufficiently thoroughly estimated[13].
- **CarbonAgri** co-developed the CAP'2ER tool alongside the methodology. No specific method for calculating uncertainty/verifying robustness and reliability was developed, beyond using the best scientific methods available (building on IPCC and FAO methods), parametrising to local conditions as far as possible, and employing expert opinion.
- **Label bas Carbone** does not yet have a specific method for determining robustness/reliability, or calculating uncertainty. Instead, it relies on an ad-hoc scientific expert review and on having input into methodology design. Label bas

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[12] Local geographic context is crucial when modelling soil carbon emissions. However, as livestock emissions models are less dependent on locally-specific factors (e.g. soil types), this generates less uncertainty when soil carbon is excluded, as in this proposed scheme.

[13] Given that the uncertainty of results cannot be directly quantified, Gold Standard aims that inputs (emissions factors, data, and other inputs/coefficients) have an uncertainty level of less than 20% at the 90% confidence level, where uncertainty is known based on statistical sampling, published data or defaults from IPCC. The uncertainty level of some parameters and data underlining the audit tool did not meet this standard, and for this reason the development of the Gold Standard methodology was paused (GoldStandard 2018).

Carbone approved the CarbonAgri scheme (and their use of the CAP2'ER tool) in this manner.

The scheme's tool validation challenges are reflected in the academic literature, which concludes that it is very difficult to objectively compare robustness of different tools: while the uncertainty of some input data (e.g. emissions factors) or calculations can be quantified, the complexity and number of elements make objective calculation challenging. Therefore, Sykes et al (2017), Leinonen et al. (2019) and McConkey et al (2019) evaluate tools based on transparency (i.e. is the method clearly documented and publicly available?) and methodology (are the methods aligned with best practice or standards like IPCC Tier 2, PAS2050?; and have they gone through scientific review?). Generally, tools will calculate emission reductions with lower uncertainties when:

- tools apply scientifically robust methodologies, for example, (at least) IPCC Tier 2 methods, which already capture diverse farm types and do a relatively good job of estimating associated GHG emissions
- tools are parameterised to local conditions (i.e. local emissions factors, any default input data should be locally parametrised)
- only one tool is used
- only "similar" farms are participating (i.e. similar farm types and geographic contexts)
- they build on more certain science or larger sets of scientific data. i.e. as livestock methane emissions science is more certain (in part due to a greater number of studies and data), audit tool estimates of livestock emissions are considered more certain than estimates of carbon storage or sequestration.[14]

In addition to robustness, **other criteria** are also important[15], including practicality and ability to estimate broad sustainability impacts:

- **Practicality:** i.e. is the tool is freely available and relatively easy and fast to use, drawing on data that farmers have/or can be supported by consultants to gather[16]? This lowers cost of applying the tools and will increase uptake.
- **Broader sustainability:** i.e. can the tool reliably calculate other sustainability indicators (nitrogen balance, soil impacts, economic profit, biodiversity impacts), which enables monitoring wider environmental impacts and is important to stakeholders (e.g. farmers interested in yield, etc)?

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[14] For this and permanence risk reasons, this scheme only considers emission reductions. Carbon sequestration and storage are discussed in other the case studies Agroforestry (Annex II) and Maintenance and Enhancement of Soil Organic Carbon in Mineral Soils (Annex III)

[15] See Chapter 10 for additional information on existing tools applying these and additional criteria.

[16] There is a tradeoff between the accuracy of the farm carbon audit tool's calculation method and how costly it is to use cost, which will be increasing in data requirements (New Zealand Interim Climate Change Committee 2019).

In summary, the key criteria recommended for evaluating farm carbon audit tool reliability are 1) scientific robustness (i.e. transparent; best available methodology), **2) practicality** (i.e. easy and free to use; data availability); **3)** use of other sustainability indicators (i.e. environmental and economic indicators). See chapter 10 for an extended discussion and example evaluation of CAP2ER, Solagro, and Cool Farm Tool under these criteria.

IPCC Greenhouse Gas Methodology – Tiers

The IPCC develops guidance based on best available scientific knowledge to guide countries to calculate their GHG inventories under international climate agreements (i.e. UNFCCC and Kyoto) (IPCC, 2006). While their methodologies are designed for national reporting, many aspects are transferable and form the basis of carbon farming methodologies. Indeed, carbon farming methodologies should be aligned so that scheme results can be reflected in national GHG accounts.

IPCC guidance includes three different tiers of approaches, increasing in complexity, data, and accuracy:
Tier 1: Uses IPCC-provided default emissions factors, simplifying assumptions. and simple methodology for calculating GHG fluxes.
Tier 2: The same methodology is applied but instead of default emissions factors, countries have to use country-specific emissions factors (in some cases, regional-specific emissions factors and parameters) based on local monitoring data and research.
Tier 3: Most complex methods that use models and high-resolution land-use and land-use change data.

Result-based carbon farming methodologies must align with at least Tier 2 methods, which can relatively accurately capture most sources of emissions and the impact of management actions on similar farms. Tier 3 approaches are likely to be necessary to robustly model soil carbon, which requires higher resolution land-use data. Scheme designers must always consider the trade-off of higher costs and complexity associated with higher tier approaches, and weigh them up against the increased environmental certainty.

Overarching issue 2: Acceptable level of environmental uncertainty

When selecting an audit tool, it important to decide **what level of environmental uncertainty is acceptable.** That is, up until what level of expected error in the estimation of GHG emissions will the audit tool consider robust? Or inversely, what level of accuracy must a tool (or the scheme in general) meet? The scheme designer's level of acceptable environmental uncertainty affects not just the choice of the audit tool[17], but also the overall scheme design, as all steps in the baseline setting and MRV process are sources of potential uncertainty.

Scheme designers **can minimise uncertainty by implementing more stringent approaches** in each element of their scheme's design, e.g. setting a higher bar for

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[17] Audit tools could also be designed to give the scheme designer the ability to define their acceptable level of uncertainty. They could allow the scheme designers to input their own emissions factors or other calculation elements, based on their acceptance of uncertainty.

audit tool robustness, imposing stricter eligibility, stringent MRV and baseline setting (see Table 2 for examples). However, **stringent scheme design comes with a trade-off**: more stringent design increases costs for participants and administrators through additional MRV requirements and narrows the type of farms or climate actions that can participate (as it restricts eligibility to "certain" farm types). This lowers farmer uptake, increases transaction and overall costs, decreasing scheme impact. These costs can fall on the scheme designer/operator in the form of higher set-up costs (e.g. to develop a more accurate audit tool) or ongoing operating costs (e.g. costs of verifying farmer reports. Alternatively, farmers are the one who may face additional MRV costs. Even if costs of verification are borne by the scheme operators, farmers will have to provide more support and time to verifiers, which will increase with stringency, frequency, and novelty of MRV requirements. Scheme designers must balance benefits of decreasing uncertainty with the additional costs, which can significantly undermine the net benefits of the scheme[18].

In addition to considering the total level of MRV costs, **MRV costs borne by farmers** are a particular concern, as these transaction costs decrease their net benefit of participating in the scheme, which will reduce farmer uptake. Given the proposed scheme is voluntary, uptake is crucial for the scheme to achieve sufficient scale to have impact. Scheme designers can influence whether farmers or the scheme operator bears costs directly (e.g. by choosing who pays verification costs or the cost of setting a baseline) or indirectly by spending more money up-front to simplify the scheme for farmers (e.g. through a well-designed, user-friendly audit tool). The trade-off between up-front set-up costs and lower farmer transaction costs needs to be balanced. One way to do this is to work iteratively, starting with relatively low set-up costs and a somewhat inefficient scheme, and then progressively invest in the scheme to decrease transaction costs, working with participants to identify most effective actions. This allows for learning and avoids sunk costs in unimportant aspects of scheme design.

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[18] See Chapter 5 for cost estimates.

Table 2 Scheme design: examples of certainty/cost trade-off[19]

Scheme design element	Decision to reduce uncertainty	Cost
Tool selection, set-up	Invest in extensive tool development to ensure local parameterisation, testing	High up-front tool design cost
Eligibility	Limit participation to narrow band of similar participants	Exclude many (less certain) cost-efficient participants. Overall: low uptake and lower impact
Baseline setting	Require external verifier to set baseline; require extensive data for baseline	Cost of verifier (admin costs); high transaction cost of data collection (for farmer). Overall: low uptake and lower impact.
MRV	Require extensive data, external verification. Require measurement (e.g. of soil carbon) in addition to audit tool.	Same as baseline setting, plus measurement costs
Reward mechanism	Require financial additionality tests	Same as baseline setting

Environmental (un)certainty and offset credits: The level of environmental uncertainty has flow-on effects on how the GHG reductions can be used. In other words, the planned use of emission reductions may limit the level of uncertainty that can be accepted. Accordingly, the decision of the final use of the credits is a crucial up-front design decision, as the scheme designer will need to consider the standards of the buyer of credits and design the scheme to meet the associated requirements. In particular, if scheme designers plan to sell the emission reductions as offset credits or emission reduction certificates, they will not be able to accept a high level of uncertainty because credit demand depends on the level of perceived environmental integrity. Credit buyers need to trust that the credits that they purchase are matched be real, additional emission reductions or permanent carbon storage. Of course, more stringent requirements will increase MRV costs; as one interviewee stated, a high standard of precision can mean that designing MRV for fungible offset credit markets can be "cripplingly expensive".[20]

Resource needs - Resource requirement for delivery – payments, training and oversight?

In addition to farm audit tool selection and deciding upon an acceptable level of uncertainty, **scheme designers must consider other elements of scheme feasibility**, including resources, knowledge requirements, and farmer and stakeholder engagement. The biggest resource challenges for establishing a new scheme are

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[19] This trade-off can also be managed by treating uncertain reductions differently from certain reductions (e.g. discounting for uncertainty). See the discussion on buffer accounts in Chapter 6.

[20] See Chapter 6 for further discussion of links between environmental uncertainty and the issuance of offset credits.

developing the scheme (including audit tool) suitable to local contexts, developing expertise, and recruiting farmers.

Developing the scheme takes time. For example, overall, it took the CARBON AGRI scheme took 2 years to go from idea to launching the first call for participants, with 1 year to create the association (France CARBON AGRI Association) that administers the scheme, and another one year to develop the methodology. This built on more than five years of closely related work (e.g. LIFE projects and previous development of the CAP'2ER farm audit tool) and on existing relationships with key actors. As future schemes can learn from and build on existing tools and schemes, they may be able to move faster, especially if they too can leverage existing relationships.

Developing expertise also requires time. This applies to scheme operators, who, due to the relative novelty of the results-based scheme, will need to extend their skills and knowledge. The scheme operator will also have to train consultants, who play a central role in the scheme but who may lack the climate mitigation knowledge or audit tool skill required; this could be a significant bottleneck and should thus be a scheme designer priority.

Farmer recruitment could be challenging. Growing recognition of climate as an issue and the incentives offered by the scheme will increase farmer interest, but the new knowledge and skills that they will need to acquire and implement take time to learn, which will be a barrier. Scheme designers should use workshops and farmer ambassadors to assist. Another option is to engage intermediaries between the scheme operator and the farmers and can facilitate farmer involvement. These may be farmer associations, downstream companies, or private actors who could negotiate contracts with farmers for payment. Scheme designers should build on existing farmer networks and use consultants to recruit farmers. Where sufficient funding and will is present these challenges can be overcome, as demonstrated by Arla Foods, who by utilising existing consultant networks and offering large financial incentives to on-board 8000 dairy farmers to their Climate Check programme (including baseline setting). The aim to achieve full on-boarding within less than two years, including discussions and registrations, data input into the climate data reporting tool, followed by 6-9 months for consultant visits.

The scheme will both start-up costs and **ongoing costs of operation**. These include paying consultants for baseline setting, paying rewards to farmers, and all administration (including managing MRV, finding buyers for credits/certificates or alternative funding, etc.). As an example of ongoing costs, the CARBON AGRI scheme currently has 1.5 full-time employees, as well as input from the governing body. In addition, the farm audit tool CAP2ER has a full-time engineer to develop the tool. Covering ongoing costs can be done through internal funding (i.e. public or internal company funding), or by selling offset credit/reduction certificates to external parties to cover the amount paid to farmers. In the initial development and learning stages of the scheme, costs to farmers should be minimised as much as possible to encourage uptake (e.g. transaction costs). However, in the long-run, if this is profitable for farmers, then the scheme could transfer costs to them (GoldStandard charges participants for MRV and registry registration, for example). These set-up costs (and some of the ongoing costs) are subject to economies of scale advantages. Accordingly, supporting widespread farmer uptake will be a key cost-control measure.

Advice, knowledge transfer

Scheme designers, consultants, and farmers will all need to develop new skills and knowledge to implement the scheme. **Scheme designers** will need to gain expertise related to agricultural emissions and farm audit tools, and draw on experience and lessons from existing schemes. In addition, they should involve a broad range of stakeholders to ensure they take diverse perspectives into account (especially those of farmers). Scheme designers should consider outsourcing specific tasks or buy ready-made options, e.g. registry software, software development. **Consultants** play a key (and early) role in the scheme, as they run the audit tools, set baselines, and advise farmers. Accordingly, ensuring that local consultants have sufficient training must be an early priority for scheme design. Consultants will need to be trained to run the audit tool and set baselines in line with the approach of the scheme. They will also need a good understanding not only of the scheme, but also of climate mitigation and agricultural practices more generally, so that they can convincingly answer farmers' questions (e.g. on climate science and on practical elements related to reporting or monitoring data requirements). **Farmers** will also need to develop new knowledge and skills related to climate-efficient farming. To support farmer understanding and uptake, the scheme developers should hold open meetings to present the method and outline the benefits for farmers, and to give a chance for questions. Kitchen table meetings hosted by ambassador farmers could be an important way to share skills and recruit additional farmers. Scheme developers must prepare information material for farmers to support their learning. The baseline setting process and initial audit tool run offers a particularly useful opportunity for that: farmers should receive summary outputs that include identified climate action plans and the expected outcomes for farmers (with a focus on farmer-relevant indicators, such economic efficiency improvements). While costly and time-consuming, these learning aspects will support attainment of broad objectives. Ultimately, a key co-benefit of the scheme will be to develop agricultural climate mitigation capacity in all agricultural actors.

Farmer engagement

To ensure high farmer uptake, farmers should be actively engaged in the scheme design process and regularly consulted through its operation. Farmers will be able to provide practical feedback, identify opportunities and challenges, and disseminate information about the scheme among other farmers. Leveraging existing farmer networks, such as farmer associations or farmer support mechanisms, could help quickly scale up farmer involvement. Targeting farmer "ambassadors" (e.g. those who have previously participated in related research projects and leaders within the farming community) could be an effective farmer recruitment approach. To ensure that farmer views are adequately reflected, any advisory boards should have at a minimum one farmer participant.

Cooperation and stakeholder engagement

Scheme designers should communicate to a wide range of stakeholder groups, including the wider public and representatives of the agricultural sector, such as farmer cooperatives or companies that purchase agricultural output. Cooperation mechanisms such as EIP Agri could offer a model for outreach and engagement. See Chapter 7 for a discussion on governance and uptake.

4 Setting scheme objectives and demonstrating additionality

This chapter considers how to set objectives for the proposed whole farm audit livestock scheme, define additionality, and how to identify baseline emissions.

a. Objective setting

Objectives for the scheme need to reflect the local context, and the related challenges and opportunities. An **overarching objective of the scheme** in all cases will be to **efficiently reduce GHG emissions from livestock farms** (i.e. where the benefits of decreased emissions outweigh the costs[21]). This objective can be set in terms of tonne of CO_2eq, as well as average scheme cost per tonne of CO_2eq. The scheme should principally aim to achieve this within the scheme itself (i.e. on farms involved in the scheme). However, scheme designers should also consider systemic and long-run impacts of the scheme, to avoid maladaptation. To achieve this overarching objective, the scheme should

- have environmental integrity, i.e. estimated results should match actual, permanent, additional GHG impact, and this GHG impact should be real at a global scale[22],
- be cost-effective (i.e. it should minimise transaction costs for all participants, including MRV, so as to ensure that overall benefits of the scheme are as high as possible),
- achieve maximum farmer uptake (so that the impact will be as large as possible).

Sometimes, these objectives involve trade-offs, e.g. trying to be cost-effective through low MRV costs may increase farmer uptake but decrease environmental integrity. These objectives need to be balanced against one another within their local context and priorities.

The scheme can deliver more GHG impact if it can also support reductions elsewhere, i.e. it can provide a **GHG impact beyond the scheme**. To this end, the scheme should support learning and uptake at higher levels through data collection, research, and transparency. In addition, it should communicate and disseminate the scheme's story to the public and key stakeholders (e.g. the agriculture sector), and its results and lessons-learned to policy makers, researchers, and other impactful stakeholders.

The scheme designer should also consider the **potential long-run and systemic impacts of the scheme**. In the long-run, optimal land use is likely to be required to efficiently meet climate goals whilst maintaining food security. That is, land use should consider the relative efficiency at which the land can produce human food (measured in kJ of energy or grams of protein) with low carbon emissions. This may mean that, at a system level, land that is highly suited to crop production (which has a high ratio of energy/protein per unit of GHG emissions) should not be used for dairy products, which on such land has a relatively low ratio of energy/protein per unit of GHG emissions (van Zanten et al., 2016)[23]. Accordingly, schemes should avoid lock-in of climate inefficient

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[21] Where benefits and costs are broadly defined, including environmental and social costs and benefits as well as more narrow financial measures.

[22] That is, the scheme should ensure that the overall impact on climate is positive, accounting for carbon leakage, food substitution, long-run systemic impacts on land-use etc.

[23] Indeed, the authors conclude that no land that is suitable for food production should be used for growing feed.

farming. There is a risk that schemes could improve profitability or incentivise long-run investments in farming systems or land use that are not aligned with long-term climate goals. In addition to incentivising inefficient land use, there is a risk that schemes could encourage climate actions that are inefficient at a system-wide level, for example, by incentivising increased use of feedstuffs, which could be more efficiently used as food for humans (the so-called feed-food competition, see Zumwald et al., 2019). Scheme designers should consider whether feed-food competition and optimal land-use can be considered into schemes, potentially through indicators in farm carbon audit tools, through eligibility restrictions (e.g. negative lists that exclude certain farm types), or potentially by using an emissions intensity approach.

Actions incentivised by the scheme will affect more than just climate emissions. Accordingly, **other, secondary objectives** need to be identified and taken into account in design decisions. Secondary objectives can be targeted directly (e.g. by providing additional rewards for increased land used for biodiversity protection or setting "do no harm" eligibility requirements) or indirectly (i.e. providing a facilitating environment for co-benefits). Secondary objectives are context-specific, depending on local priorities, challenges and opportunities, but could include:

- Environmental objectives: e.g. increase biodiversity provision, decrease nutrient run-off, decrease water use, decrease ammonia emissions, etc.
- Socio-economic objectives: e.g. increase farmer profitability and economic efficiency, diversify agricultural incomes, increase regional GVA, jobs, etc.
- Capacity objectives: e.g. increase knowledge and skills of farmers, consultants, scheme operator, academic research etc.
- Other objectives: food production, animal welfare, etc.

Some stakeholders will be more motivated by secondary objectives than by the climate objectives. For example, farmers may be more interested in the expected economic efficiency gains. Accordingly, these secondary objectives can be effective recruitment tools for the scheme.

In addition to identifying objectives, the scheme should select **indicators** for these objectives and **monitor** these at the scheme scale (see the discussion on MRV in chapter 5). To simplify this process, farm audit tools have the ability to calculate expected impacts on a broad range of sustainability indicators, based on the same input required to calculate emissions (e.g. nutrient runoff, area used for biodiversity conservation, ammonia emissions, economic indicators). Scheme operators must monitor these indicators and adjust the scheme if necessary.

b. Additionality

Environmental additionality refers to whether the scheme induces climate actions that lead to a reduction of emissions that would not have happened otherwise. In the proposed scheme, each farm has a baseline, which is set using the farm audit tool with support from a consultant. This baseline establishes what would have happened without the scheme. Any reductions below this are considered environmentally additional. This chapter explains the baseline setting method and other additionality considerations, including financial additionality and double payment, and carbon leakage.

Baseline setting should be done at the individual farm level, based on historic data. The aim of the baseline setting is to establish the expected level of the results indicator, i.e. the level of GHG emissions from the farm in absence of the scheme defined as a set quantity of emissions[24]. This will be calculated using the farm audit tool. Each participating farm will be visited by a consultant, who will run the audit tool for their farm (i.e. by identifying with the farmer the necessary input data, checking it for consistency, inputting it into the tool, and reporting the results to the scheme operator). The input data required depends on the selected farm audit tool but will at a minimum include animal numbers and types, farm characteristics, manure management, nitrogen application, etc. While the baseline will focus on GHG emissions, it should also record secondary objective indicators (e.g. environmental, economic, and socio-economic indicators measured by the tool).

Different baseline-setting methods have different strengths and weaknesses. Individualised baseline setting disadvantages farmers that are already climate efficient, as they will not be rewarded for emission reductions they have already achieved[25]. In addition, as farmers face increasing marginal costs of mitigation, first-movers will face higher costs to further reduce emissions than those farmers who can implement low-hanging fruit options. Perceived fairness is important to farmers and if a scheme is perceived as unfair uptake will be low. One alternative is an average baseline for similar farm types. While this would reward first movers (who would likely be below the average), it would be at significant risk of adverse selection. This means that those who already have emissions below the average would be more likely to participate than those above the average, meaning the “average” would not represent participating farms[26]. This adverse selection undermines additionality, as many farms would choose to participate if their actual baseline emissions are below this average baseline, and would then receive payments without taking additional action. This would also decrease incentives for farms with real baseline emissions above this average baseline, as they would not get paid for any reductions between their real baseline and the average baseline (even if they are truly additional, i.e. if they achieve reductions that would not have occurred without the scheme incentive). This will decrease farmer uptake and impacts. While setting the average baseline at smaller scales (e.g. at a regional scale) would decrease the gap between average and individual farm’s real baseline, given the variability across farms in the same region, the same adverse selection risks would apply.

Historic data should be drawn from CAP payment claims and other farm records. To avoid farmers and/or farm consultants gaming the baseline by boosting current year production and emissions so that the estimated baseline is above the farms average, the baseline should be set on a year prior to the announcement of the scheme. To minimise the risk that natural variability biases the baseline, ideally, the baseline should be set on multiple years of data. To avoid blowing up the cost of baseline setting, consultants should be empowered to decide: if data availability means that the additional cost of multiple baseline years will be relatively low, an average of multiple years should form the baseline. For those cases where multiple year baselines mean baseline setting costs would go beyond a set figure (e.g. two consultant days’ work), then a single year baseline should be used. Carbon AGRI applies a different approach to manage this risk: based on data harvested from applying the farm audit tool in 5500 farms, the tool developers have identified the average annual variation in output (i.e.

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[24] Alternatively, some schemes develop “baseline scenarios” (e.g. MoorFutures). Rather than a baseline of a set level of emissions, these define a varying level of baseline emissions into the future. However, this approach is costly and also uncertain.

[25] Baseline setting inherently picks winners and losers and as such is as much a political decision as a technical decision. Other baseline setting rules are also possible.

[26] If the scheme were not voluntary, this issue would be avoided and the sectoral baseline would effectively reward efficient farms, providing good long-term incentives to shift production to these farms.

which years were, on average, "good" years) and normalised this into an index. If farmers have had a previous audit within the past five years, they can use this year as their baseline, otherwise they use the previous year; the results are then adjusted using the index. This accounts for natural variability, although it does not avoid the farmer selecting an above-average year (i.e. where they worked harder or had more animals). While increased time and effort will increase the accuracy of the baseline, these transaction costs reduce the overall benefits of the scheme and are also a barrier to farmer uptake. Scheme designers should monitor baseline setting costs and consultants should be empowered to weigh up this trade-off in the field.

Baselines can be forward looking, that is, rather than staying the same forever, they can incorporate trends or be adjusted at a later date. Falling agricultural emissions within the EU[27] imply that even without the implementation of the scheme, emissions may be expected to fall. If these reduction were occurring for reasons outside farmer control (i.e. improved stock) and the baseline did not reflect this, this could result in non-additionality (as farmers would be rewarded for reductions below a historical baseline that would have occurred regardless). The scheme designer should assess whether significant decreases are evident in the farms covered by the scheme. If so, the baseline could be set incorporating this trend. Or, more simply, when the farm receives a follow-up visit by the consultant after five years, the baseline could be adjusted to reflect the average decrease of non-participating similar farms, based on national data. This adjusted baseline would then apply in the following period.

To decrease the total cost, the scheme could have **differentiated baseline setting requirements** for different participants. Large participants (e.g. over a set number of animals or ha) would be subject to more stringent baseline setting (e.g. they would be required to run more complicated versions of the audit tool which rely on fewer default factors). The justification would be that larger participants have a larger impact on the scheme as a whole, so the baseline must be more certain and better protected against being gamed.

The **cost of baseline setting** should not be borne by the farmer, so as to reduce barriers to farmer uptake. The cost of baseline setting varies depending on the amount of input data necessary and the state of farm records. Existing schemes put the range of likely costs at €300-€2400 per farm, not including farmer transaction costs (e.g. their time, other data collection costs). This could be covered by the scheme operator or another stakeholder, e.g. corporates who purchase farm output and therefore share objectives with farmers (e.g. support farmer incomes, environmental objectives, advertising). For example, the initial running of farm audit tools in the Arla Foods Climate Check programme are covered by the Arla Cooperative, who also incentivise participation by paying farmers an additional €0.01 per litre of milk for six months (equivalent to approximately 4% of standard milk payment).

The consultant's visit to set baseline serves a second purpose: **education/training**. In addition to setting the baseline, this is a chance to identify effective climate actions with the farmer. After completing the baseline, the consultant would be expected to suggest climate actions to the farmer, and use the tool to estimate the expected impact on the results indicator, as well as other indicators relevant to the farmer (such as feed efficiency, economic efficiency, etc.), as well as to monitor impacts on secondary objectives (such as nutrient runoff, biodiversity areas), which the consultant would also discuss with the farmer. The consultant would then develop a farm carbon management plan with the farmer, so that they would have a record of the conversation to support

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[27] For example, between 1990 and 2012 agricultural GHG emissions fell by 23% (Eurostat, 2018)

the management of the farm, whose expected impact can be demonstrated using the tool. The baseline setting session would offer the farmer a chance to ask questions, increase knowledge, and feel ownership of the scheme.

Baseline setting will be a learning process. Like all elements, the proposed scheme aims to enable the establishment and initial running of the scheme, and to provide data and lessons learned for adapting the scheme. To this end, baseline setting could begin with a select group of farms as a pilot study, using this as an opportunity to train consultants and to learn about data availability, farmer capacity, and other aspects that will affect average baseline setting costs. With this data, the baseline setting approach can be adapted to improve its ability to identify accurate (enough) baselines at lowest possible cost, and find ways to "automate" the process as much as possible, including by selecting default audit tool inputs. This data collection could be used as default inputs for farms with insufficient data to set their own baseline. This is crucial, as the initial baseline setting costs can be high relative to the expected reward payment. In the long run, once farmers are familiar with the audit tool and have knowledge about climate-friendly farm management, the aim would be to reduce the need to have consultant site-visits in general, to reduce overall costs. However, this will be dependent on learnings from the initial stages of implementation.

The scheme should not apply financial additionality tests. Financial additionality tests require that it would be uneconomic for the farmer to act without the scheme reward (i.e. without the scheme rewards, the costs of the action would outweigh the benefits). As the farmer implements not one discrete climate action but a suite of management changes, it would be difficult to define financial additionality tests for the scheme. In addition, it is difficult to capture all costs adequately, e.g. farmer transaction costs involved in learning new farm management approaches can be significant but difficult to measure.

Double-funding can undermine additionality. This occurs when the farmer is paid twice under different policies/schemes for the same actions, e.g. if they received additional CAP funding for increasing the area set aside to protect biodiversity on the farm, and the resulting reduction of emissions would also be rewarded by the proposed scheme. This could be considered double-funding if the CAP biodiversity payment is made also expecting climate benefits. However, if the farmer is simply being paid for delivering two different public goods, this is not double-funding: i.e. they receive payment for biodiversity provision and separately receive payment for emission reductions. The scheme could identify specific policies or schemes where there is overlap (i.e. other funding/payments for climate mitigation on livestock farms in the targeted region), and contractually require farmers to report their participation in these, then apply discounts to the results they achieve.

Carbon leakage occurs when, as a result of emissions falling within the scheme, they increase outside the scheme, decreasing the scheme's overall GHG impact. As the livestock audit is a whole farm scheme, there is no potential of leakage within the farm unit, as the whole farm is covered by the tool. However, this could occur if farmers decrease emissions in a participant farm and shift them to another (e.g. by moving stock outside the scheme, or increasing farming effort or intensity on other farms). To avoid this, farms would be obligated to report on any change in land use or emissions outside the participating farm as a result of their participation in the scheme using a transparent reporting scheme. If any change occurs, the farmer would be obliged to assess the GHG impact as part of MRV. Any leakage would then be subtracted from the emission reductions on farm. The scheme will also be subject to market leakage, i.e. if many farmers reduce output due to the scheme, this leads to increased market prices for output, inducing additional farming activities to occur elsewhere (outside the carbon farming scheme). To compensate for this, scheme designers could discount the estimated on-farm results to reflect that these are partially offset by induced increases elsewhere, though it is challenging to estimate what share of reduction should apply. The scheme must also protect against other forms of leakage, i.e. feed substitution, by monitoring this at a farm and scheme level, and through either adapting carbon leakage compensation or negative lists.

c. Eligibility

Eligibility restrictions, i.e. who can participate in the scheme or under what conditions, by definition limit the extent of the scheme and its impact. **However, eligibility restrictions can reduce scheme costs**[28]**.** The scheme should restrict participation to farmers that are likely to achieve significant emission reductions (i.e. large farms). The definition of large farm will depend on the scheme type but it could be based on animal numbers or hectares. The eligibility criteria should be set at a level that ensures that the payment to farmers will significantly outweigh the transaction costs involved (e.g. baseline setting and MRV costs). Given that the scheme focuses on the farm unit scale, there would be little benefits from allowing group registration to reduce fixed costs (as the farm unit scale requires all farms to be included individually). In addition, eligibility can be used to narrow the scheme's focus to a specific type of farm or geographic context, which can be tailored to be more specific and less complex, reducing participants' transaction costs.

Eligibility can also be used to achieve secondary objectives, i.e. to avoid negative externalities. Given that the scheme does not cover **carbon sequestration or storage**, eligibility should be used to limit the potential for negative externalities affecting GHG emissions through lost storage or sequestration. For example, given that peatlands and organic soils can release sequestered carbon under standard livestock management, farms with this type of land should be excluded from the scheme, and instead targeted with a scheme that accounts for soil carbon, or by combining a soil carbon and livestock scheme for application on these farms. In addition, the scheme should only reward farms that remain in operation (the scheme may not want to pay farms to cease their agricultural activities, as this may contradict other objectives and damage the reputation of the scheme). In addition, there would be a significant risk of being gamed, especially in absence of financial additionality restrictions i.e. farms that plan to cease their activities anyway would have a large incentive to join the scheme.

The question of how the farm audit livestock scheme would **interact with other schemes** depends on design decisions related to the scope and coverage of the scheme and additionality/eligibility restrictions. The proposed general scope for this scheme is emission reductions on livestock farms that can be measured using the farm audit tool, and targeted at a specific geographic context. All that is outside the scheme (e.g. climate actions such as replacing agricultural land with forested land or farm types not covered by the scheme such as pig factory farms) can be targeted by other schemes to deliver additional results. Over time, there is also the potential to build external schemes into the proposed scheme by expanding its scope. For example, additional climate actions could be included in the audit tool or the coverage could extend to include additional farm types or geographic regions. However, expanding the proposed scheme will imply drawbacks, including a lack of local specificity and increases in complexity and audit tool uncertainty.

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[28] They can also reduce scheme environmental uncertainty, as discussed in Chapter 3 (overarching issue N.2)

5 Choosing results indicators & MRV

As discussed in Chapter 2, before deciding on specific methods for monitoring, reporting, and verification, scheme designers must decide on an acceptable level of uncertainty, and select a farm carbon audit tool and level of MRV stringency that can deliver this. This requires balancing up total and farmer MRV costs, balancing between up-front, set-up and ongoing costs, and also a consideration of the requirements set by offset credit or emission reduction certificate markets. **As a general proposal,** in order to maximise farmer uptake and minimise farmer transaction costs and overall MRV costs, **we recommend that scheme designers accept a medium level of environmental uncertainty**, even if this means that they cannot sell fungible offset credits. In the following chapter we identify how a result-based schemes based on the use of an audit tool for the livestock sector could be implemented to minimise costs and uncertainty.

a. Selecting result indicators

The **result indicator should be tonnes of CO_2eq avoided** on the farm unit over the time period of five years (i.e. the reduction from baseline levels of CO_2eq), as estimated by the audit tool. Due to the higher uncertainty associated with carbon storage and sequestration (as well as permanence concerns), this scheme should not reward carbon storage.

Emission reductions can be calculated as an **absolute number** (i.e. total change in emissions on the farm unit) **or** can be based on changes in **emissions intensity** (changes in emissions per produced unit)[29], as in CARBON AGRI. The motivation for an intensity approach is that the average EU farm size is growing. If an intensity approach were not applied, total emissions might increase simply as a result of the increase in the farm size, and the audit tool would therefore fail to capture the impact of climate actions. This could be a significant barrier to uptake, as any farmer wanting to keep the option of increasing farm size would not participate in the scheme. However, a carbon intensity approach has the risk that the absolute emissions of individual farms or the project as a whole may increase, which would contradict the scheme's overarching aim of reducing emissions. While it has been argued that this more efficient production will replace less efficient production outside the scheme, the IPCC Special Report on land identified rebound effects (where increased production efficiency increases production and potentially emissions) as a justification for production limits (IPCC 2019)[30]. Given that reducing emissions on participating livestock farms is the schemes overarching aim, scheme designers can use an emissions intensity approach but only reward farms that also achieve absolute emission reductions (e.g. of at least a certain share)[31].

The **carbon sequestration or storage** at this stage cannot be calculated in a reliable manner by the audit tools. Moreover, unlike emission reductions sequestration or carbon

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[29] The emissions intensity approach calculates a total emission reductions number but rather than absolute change, this is calculated as the change in emissions intensity per unit of output over the time period (i.e. kg CO_2eq/kg meat or milk) multiplied by output at the end of period.

[30] These system-wide effects depend on system-wide demand elasticities that will be beyond the ability of the scheme to affect. EU policy, such as Farm-to-Fork, can help protect against these rebound effects e.g. by also targeting sustainable dietary change.

[31] This minimum level should depend on potential: the level should be set high enough that it is unlikely to be met without effort. However, if it is set too high, this will increase farmer uncertainty and decrease uptake. Similar existing or planned schemes expect *emissions intensity* gains of 15-30% over five years; based this a minimum absolute reduction of 10% may be reasonable.

storage can be intentionally or unintentionally reversed. Global policy (e.g. IPCC net zero targets) and methodology developments (e.g. GHG Protocol) increasingly treat flows and stocks separately. Accordingly, if a scheme designer decides nevertheless to also reward sequestration or storage this should be recorded and reported separately.

Following CARBON AGRI, we propose five years as the **time period** over which impacts should be calculated, but other time periods are possible too. The baseline annual emissions are calculated at the beginning of the time period. The emission reductions are then quantified as the difference between five times the baseline emissions and the actual emissions over the time period. A five year time period should be sufficient to balance out natural and farmer variation (i.e. years with higher yields than usual, or bad weather or sickness). The scheme should be rewarding additional emission reductions that arise due to deliberate climate actions, not natural variation. If only a one-year time period were allowed, then these natural variations could outweigh the impact of climate actions. They would also create opportunities for farmers to game the system, where they join before a year that they expect to have low emissions.

To **evaluate overall scheme success**, the key indicator is the total sum of emission reductions (in t CO_2eq), defined in absolute terms. A secondary indicator would be change in emissions intensity. This can be calculated by summing all individual farm results, which will be generated by the farm carbon audit tool. See discussion on broader sustainability impacts in the subsequent chapter.

b. Testing result indicators

Chapter 4 (‘Overarching issue 1’) discusses the up-front assessment of the robustness of audit tools. In addition to this up-front assessment, data generated by applying the scheme should be stored and used to evaluate and improve the accuracy of the employed farm audit tool. The evaluation of methods and tools should involve all key stakeholders: farmers, consultants, scientists, and scheme designers.

c. Monitoring success – the M in MRV

All **measurement** of result indicators is run through the farm carbon audit tool (i.e. it is modelled based on inputs). On-site testing or monitoring is not part of the system. Rather, the scheme relies solely on self-recorded and reported data from farmers (with support from consultants to set the initial baseline and identify climate actions). This minimises MRV costs for the scheme as a whole and decreases demands on farmers, including the need to allow site-visits. It is in part made possible by the focus on emission reductions and exclusion of carbon sequestration or storage. In particular, if the audit tool aimed at measuring soil carbon, it would have to rely at least partly on monitoring, rather than only on modelling (see case study Maintenance and Enhancement of Soil Organic Carbon in Mineral Soils - Annex III).

Existing schemes and projects can give an order of magnitude of **MRV costs**. Setup costs include the development of a farm audit tool, which in the CARBON AGRI scheme costs approximately €200-300,000 (in addition, the tool requires the employment of a full-time engineer). In terms of ongoing costs, the most significant MRV costs are those associated with a consultant visiting the farm to set up and run the audit tool. In established systems, the consultant costs would be expected to be approximately €300-500 per visit[32], but they could be considerably higher for the initial visit. This estimate

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[32] In the CARBON AGRI scheme, consultants cost approximately €2,000 per farm in the first five years of their participation. This includes two or three visits to set up the basic version of the audit tool (with 25 parameters, i.e. inputs) and then the detailed version

excluded transaction costs borne by the farmer and administrative costs borne by the scheme operator.

The **data required** will differ depending on the tool selected. The costs to the farmer, consultant and administrator are higher for tools that require a larger amount of data. Increased data generally increases accuracy and decreases uncertainty, though likely at a decreasing rate. Scheme designers should therefore identify crucial inputs (i.e. those that have significant effects on estimated GHGs) and wherever possible require these, whilst using defaults for less significant inputs. Existing schemes and research suggest that simpler tools (i.e. relying on defaults to require only e.g. up to 30 inputs)[33] may be an acceptable starting approach to motivate quick action while more complex farm audit tools are tested. A key condition should be that the impact of key mitigation methods will be captured by the input data and tool (i.e. that the data is sufficient to identify effective climate actions).

Another way to **decrease the costs of collecting input data** is to align requirements with existing policy reporting requirements and farm records. CARBON AGRI have found that data provided through the CAP direct payment applications are sufficient to cover 25% of CAP’2ER level 2 needs. However, a lot of additional information is also required (e.g. regarding fodder, concentrate, fertilizer use, etc.)[34]. A 2013 study estimated that approximately 60% of data necessary to run complex farm audit tools would be available from farm records, with farmers able to provide accurate estimates to bring this to 90% (Kuikman, P. et al. 2013). If local regulations require additional data records and reporting, this data should be used as inputs wherever possible. An example comes from the Arla ClimateCheck programme, which requires participating dairy farmers to provide 200 inputs to calculate a footprint.In Denmark, to decrease data collection and

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(with 150 parameters), as well as the co-development of a farm management plan. The costs can vary significantly depending on availability and quality of farm records and input data, with the farm consultant requiring anywhere from 0.5 to 4 days to set up the tool and develop a management plan (at a rate of approximately €600 per day). The cost of performing a farm audit on a New Zealand farm using a comparable tool was budgeted at between $500-900NZD (€295-529) per farm, with the expectation that this could fall to $400NZD (€235) over time (New Zealand Interim Climate Change Committee 2019).

[33] As an illustration, the CAP2er tool can be run at two levels of detail: the simpler level 1 requires 30 parameters, and the more detailed level 2 has 150 parameters. The CARBON AGRI methodology only requires level 1 to be applied to set the baseline, and on the basis of this the consultant makes climate action recommendations, though requires the farm to move to level 2 for the end-of-period evaluation. The simpler level 1 method doesn’t fully capture whole farm effects. In fact, it only covers beef and dairy units, and does not cover interactions with crops on the same farm e.g. fertilisation with manure. It does not allow to do a nitrogen management plan or to capture the full impact of mitigation practices (as, for example, it assumes average feed mix rather than a specific farm feed mix). However, level 1 is sufficient to recommend climate actions and the estimated gross GHG emissions under level 1 very closely match those estimated using level 2 (an R^2 of 97%, i.e. level 1 variation predicts 97% of level 2 variation). The New Zealand Interim Climate Change Committee (2019) also finds that simplistic methods (e.g. national average emissions factors x stock units or production animals) are relatively good proxies of more complicated farm audit tools at an aggregated level ($R^2$of 83-86%), though with some significant variation at the individual farm level.

[34] Low data approaches can still lead to relatively good results. For example, rather than requiring detailed data on fertiliser use, estimates could be based on fertiliser purchase plus assumptions regarding e.g. the proportion applied to irrigated/non-irrigated fields.

input costs, regulators are sending farmers a compilation of existing relevant data that they have already reported elsewhere. There is also potential for technological solutions to lower cost. For example, the CoolFarmTool and CAP'2ER use APIs (application programming interfaces) to automatically fill in data inputs. Mullender et al. (2017) propose convergence of farm audit tools to make it easier to develop APIs that will increase automation and decrease complexity and time required of farmers and consultants, for example by pre-filling online forms. Farmers should be consulted to identify low-cost data input options. In addition, to maximise uptake, scheme designers should bear up-front baseline-setting costs.

d. Reporting, verification, auditing – MRV

To minimise MRV costs, we propose that the reporting and verification approach is modelled on the tax system, that is, farmer **self-reporting** of emission reductions plus random and targeted audits, accompanied by threat of significant fines and criminal charges for false reporting (as done for example in the New Zealand ETS system). Site visits would only be required if the farm was to be audited but most farms would not be visited. This is supported by visits from consultants to set the baseline and after five years: the main aim of the consultants will be to train farmers and interpret the tool results to identify effective and efficient climate actions, not to verify data (though they can check for any glaringly obvious errors or omissions). To maximise learning, in addition to result indicator data and sustainability indicator data, farmers should also report all input data. The costs of this could be kept low by requiring farmers only to report the outputs of the audit tool run files, which would include all of the input data that they entered. They would not be required to report it in any other form (though they would have to have records of input data, in case they were audited). The scheme should store and use this data, also making anonymised versions available to researchers, to increase knowledge base and increase perceived trust in the scheme through higher transparency.

Natural variations and events outside farmers' control shouldn't be a major concern as:

- the five-year calculation period will average out much of the natural variation (though scheme designers should ensure that this is the case for their specific context).
- the scheme only covers reduced emissions, and only considers carbon storage or sequestration as an exclusion criterion (see Chapter 5). For this reason, there is a lower risk of reversal due to intentional farmer actions or events outside of their control[35].

Timing: Farmers would be required to keep annual data to cover all inputs necessary to run the audit tool. At the end of the five year period, with the support of the farm consultant, the farmer would calculate emissions over the five year period based on this annual data, and accordingly the emission reductions achieved over the period. In the future, the scheme could require farmers to complete annual self-reporting (e.g. at the same time as submitting their CAP payment claims). This would allow scheme operators to monitor annually for any glaring omissions or errors, thus improving accuracy. However, as the calculation of emission reductions will be over five years rather than

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[35] In addition, farmers may be less concerned as emission reductions payments could work as a form of insurance against bad times. For example, if the farmer experienced a drought and therefore had to lower stocking rates, this would be measured by the audit tool as a decrease in emissions, which would be rewarded.

annually, this would not be essential (and would likely come with higher costs for the farmer and administrator).

Audit: We recommend random audits, with higher rates of random audits for high-risk farms. High-risk farms would be new participants and those who have failed audits in the past. Auditors would be appointed farm consultants who could request additional farm records or visit the farm to ensure that reported numbers were accurate[36]. Over time, the aim would be to shift to a self-reporting system that did not require inputs from consultants, in order to decrease MRV costs. However, in the first five year application period, a key aim would be increasing farmer knowledge, interest and capacity to implement climate actions, which requires consultant support. Given that they are already visiting farmers to provide training, consultants should also be utilised to implement MRV. Based on the farmer, consultant and scheme designer knowledge developed over this time, the MRV (including reporting and verification) should be adapted.

To decrease total MRV costs and also reduce the burden for smaller farms whilst balancing overall scheme uncertainty, the scheme could set **differentiated MRV requirements** for different farm types. For example, large farms would be required to complete more stringent MRV (e.g. a more detailed analysis run by the audit tool with more inputs e.g. CAP2ER level 2), while small farms would only be required to complete a more simple run of the audit tool requiring less input data (and assuming more average emissions factors). The division of large/small farms should be based on an indicator closely linked to expected total emissions, e.g. animal numbers. Some existing schemes allow farmers to voluntarily opt-in to more stringent MRV, with the incentive being that they can then use less conservative, calculated rather than assumed emissions factors. However, voluntary options such as this invite gaming of the system and an adverse selection bias that will decrease scientific reliability of the scheme. Farmers will only opt-in to more stringent MRV when they expect that they will benefit (i.e. through high estimated emission reductions); those who do not expect this, will not take on higher MRV. This bias will mean that the less stringent MRV farms are no longer averages, and the assumed average emissions factors will no longer apply.

Group certification is not appropriate for the livestock audit, as the farm audit is run on the farm unit scale, so there are unlikely to be savings available from grouping together.

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[36] There is some risk that if consultants audit the same farms that they initially consulted on, the audit will lack reliability due to lack of independence.

6 Paying for results

The scheme should be principally results-based, that is, farmers receive a payment relative to their impact on the climate. To reduce farmer risk, we propose that they receive a set rate of € per tonne of carbon, rather than paying farmers with offset credits. To ensure that the payment does not incentivise climate actions that have negative externalities, the reward payment will be conditional on having a non-negative effect on important sustainability indicators estimated by the farm audit tool (including nutrient runoff, area set aside to protect biodiversity, food production, and others).

This chapter analyses key issues related to paying for results, including eligibility criteria and the use of broader sustainability indicators. The emission reductions generated and rewarded in the livestock scheme do not face permanence risk, as they cannot be reversed (unlike carbon storage or sequestration). Accordingly, managing permanence is not a focus. However, we do discuss ways to manage uncertainty and maximise environmental integrity through the reward scheme using buffer accounts. We also discuss how the scheme should be funded, including options and requirements for external funding (offset credits or emission reduction certificates).

a. Co-benefits/wider sustainability impacts

It is important to consider co-benefits or externalities because farms are complex systems, and farmer actions to decrease emissions incentivised by the scheme will have impacts on outcomes other than climate emissions. These additional impacts may be desirable (i.e. co-benefits) or not (negative externalities)[37]. If externalities are not considered, there is the chance the shifts in farm management that arise from the scheme can potentially significantly affect other socio-economic or environmental outcomes that are important to the scheme designer, farmer, offset credit buyer or stakeholder.

Farm audit tools can calculate multiple sustainability indicators with the same input data. For example, the CAP2ER tool, in addition to emission reductions, reports energy consumption, ammonia emissions, nutrient runoff, carbon storage, area set aside for biodiversity protection, amount of people fed, and economic performance (see Chapter 10). This is a key strength of farm audit tools, as it can allow the monitoring and even targeting of multiple co-benefits. As discussed before, uncertainty associated with the calculation of other sustainability indicators can be lower or higher than the calculation of emission reductions. Given the focus of many audit tools has been on carbon emissions, the uncertainties associated with other indicators may be expected to be higher[38]. It may also require additional or alternative data inputs. For example, to calculate nitrogen balance, the CAP2ER tool creators state that it requires 150 inputs (i.e. indicators), while it can calculate emission reductions with medium uncertainty using 30 inputs, though others argue that simpler approaches can be applied to relatively robustly calculate nitrogen balance (Leip, Carmona-Garcia, Rossi, 2017).

Schemes could **reward for multiple sustainability indicators**. This could be done explicitly, i.e. the scheme designer could separately reward participants for emission reductions and for a change in another valued indicator. This could also be done

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[37] For example, feed additives may decrease methane emissions in livestock but may have negative externalities in the form of decreasing local water quality. A co-benefit example: improved manure management decreases the need for nitrogen fertiliser, improving farm profits and decreasing nitrogen run-off.

[38] This may not apply to audit tools that have evolved from nutrient budgeting tools, such as New Zealand's OVERSEER.

indirectly in offset credit or emission reduction certificate schemes, as is the case in existing examples. For example, the MoorFutures scheme methodology focuses on GHG emissions but also includes methods for calculating improved water quality, flood mitigation, groundwater enrichment, evaporative cooling and increased mire typical biodiversity (Joosten et al. 2015). Participants in the scheme generate offset credits, which also list the wider sustainability impacts of the project. This is seen to reflect greater environmental integrity and can generate greater demand and/or higher prices for the offset credits. Other schemes use more simple methods to qualitatively assess impact on other sustainability indicators with the same aim: the Woodland Carbon Code has a simple self-reporting tool featuring a set of 24 questions to assess impacts on wildlife, water and community. Monitoring and reporting these co-benefits can theoretically translate into higher credit prices, as these "beyond climate" benefits are valued by participants (Cevallos, Grimault, and Bellassen 2019). The Gold Standard schemes are required to support the attainment of multiple UN Sustainable Development Goals (SDGs).

Co-benefits can also be encouraged by increasing farmer knowledge or through supplementary support. Consultants should provide farmers with advice on how different climate actions will also affect other sustainability indicators. When developing the baseline and identifying climate actions, they can inform farmers of the impacts estimated by the tool on nutrient runoff or biodiversity, which will enable farmers to choose actions with greater co-benefits. Some co-benefits will be of particular interest to farmers, such as improved economic efficiency (i.e. the ratio between income and input costs). The CARBON AGRI results suggest that improving output per unit of input (e.g. growing fewer cows faster) is an effective mitigation strategy (i.e. it decreases emissions per kg of milk or meat) that also increases farm profitability. Other co-benefits such as improved soil health can also deliver efficiency gains. Consultants and farm audit tools should emphasise these co-benefits in discussions with farmers, as they will be an important method for maintaining farmer uptake. They have the additional benefit that they are immediate, whereas payments for emission reductions will only occur at the end of the five-year period. Scheme designers or others can also encourage climate actions that deliver co-benefits by granting top-up payments to farmers who implement particular actions, as already happens through the CAP. The scheme could allow farmers to receive payments from multiple sources for the same action, if they are being paid for different outcomes that the action delivers. For example, if they retire land for biodiversity protection they could receive rewards under the livestock audit scheme for the resulting emission reductions, as well as payments under CAP for biodiversity results.

Impact on soil carbon storage and carbon sequestration should be carefully considered, as any reduction in carbon storage would undermine any emission reductions (i.e. both are measured using related GHG flux indicators). This is discussed in detail in two accompanying case studies: Agroforestry (Annex II) and Maintaining and Enhancing Soil Organic Carbon on Mineral Soils (Annex III)[39].

Rather than rewarding for impacts on multiple sustainability indicators, schemes can **minimise the risk of negative externalities** in other ways. In the Australian ERF

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[39] Carbon storage in above-ground biomass can be monitored more easily than below ground soil carbon. Monitoring of soil carbon is associated with higher costs due to large variability both within fields and at landscape level. A basic condition for result-based schemes could be for farmers to demonstrate that they do not cause any loss of carbon above or below ground. Details on this are provided in the case studies Agroforestry (Annex II) and Maintaining and Enhancing Soil Organic Carbon on Mineral Soils (Annex III).

system, regulators have a list of excluded activities that have negative impacts on other sustainability outcomes (e.g. water availability, biodiversity, jobs). Farmers cannot be rewarded for these activities, even if they result in emission reductions. Other schemes rely on policies or regulations to limit negative externalities. For example, the Woodland Carbon Code requires participants to comply with the UK Forestry Standard, which includes sustainable forestry requirements; the CARBON AGRI scheme relies on limits set under the EU Nitrates Directive to limit farm intensity increases. Another option is to limit reward payments to farmers who also meet a series of sustainability indicator thresholds. For example, the scheme could require farmers to "do no harm" in relation to other important sustainability indicators (including nitrogen balance, land set aside for biodiversity, number of animals per area (i.e. animal welfare), number of employed staff, etc.), all calculated through the audit tool or, if simple indicators, reported by the farmer. Participants would only be rewarded for emission reductions if the impact on these other sustainability indicators were non-negative. Here, scheme designers will need to consider the local context. The requirements to meet externality thresholds will depend on local concerns and on the scheme designers' aims for the scheme (which may go beyond GHG impact). For example, in high water availability areas, water use would not be a concern, whereas in regions prone to drought or in schemes where designers also aimed to decrease water usage, then water quantity requirements should be considered.

Concluding recommendations on sustainability indicators: Given that the main aim for the scheme is to deliver emission reductions, only those should be rewarded, rather than rewarding a set of sustainability indicators. In this way, the establishment of the payment would be simple and the uncertainty low. However, broader sustainability impacts are important to farmers and to scheme designers (who are likely to have multiple goals), as well as to purchasers of offset credits/emission reduction credits, if these are the end goal. Any sustainability indicator that can be monitored at low additional cost through the farm audit tool (or additional basic reporting e.g. employment numbers) should be monitored and reported. Scheme administrators should monitor changes in sustainability indicators to ensure that, if large negative externalities are occurring, the scheme can respond. In addition, to minimise the risk of significant negative externalities, where existing regulation does not already provide limits (e.g. through the Nitrates Directive limits), the scheme should set exclusion criteria that limit payments to participants who "do no harm" (with allowances for uncertainty)[40]. The sustainability indicators selected will depend on local priorities and pressures. They could include carbon storage, nutrient runoff, biodiversity outcomes, farm profit, food production, animal welfare (e.g. measured in terms of food supplement % or use of antibiotics), among others. These should be clearly displayed by farm audit tools, emphasised by consultants in communication with farmers and reported to scheme operators, who should monitor these for trends. In addition, these should be reported on by the scheme, in addition to reduced GHG emissions, to support perceived environmental integrity and demand for any offset credits or emission reduction credits, or broader public support for the scheme.

b. Reward calculation

We propose that farmers receive an **ex-post reward that is completely result-based** (i.e. based on their climate impact, as measured by the results indicator) at **a set rate per tonne of emissions reduced**. Rewards will only be paid to farmers who also met

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[40] This requirement of non-negative impact on all sustainability indicators may be very challenging (or limiting) in some contexts. This could potentially be loosened if the benefits of loosening were judged to outweigh the costs. However, quantitative limits for additional sustainability indicators should be set at some level.

other eligibility criteria (i.e. "do no harm" to other sustainability indicators). The scheme can be funded either internally (i.e. through public or corporate funds) or externally (through offset credits or emission reduction certificate sales), which have different costs and benefits. This chapter explains the selection of these reward settings and relative costs and benefits of different scheme funding options.

Form of payment: The farmer should **receive a set payment per tonne** of emission reductions achieved over the time period, set before the beginning of the five year period by the scheme designer[41]. This will support farmer uptake, as it reduces price uncertainty[42]. The scheme designers will need to set the price at a level that they can either cover from their own funds or that they expect they can recoup, for example by selling offset credits or emission reduction certificates. Farmers should not be rewarded directly with offset credits, as this significantly increases uncertainty and complexity for them, which will decrease uptake. Instead, the proposed approach of set payments shifts price uncertainty away from farmers and places it on scheme administrators, who have greater knowledge, are more likely to hold relevant skills (i.e. related to credit markets, public financing, etc.) and can act to affect prices (i.e. through scheme design).

One option for setting the payment level is to run a **reverse auction**, as in the Australian ERF. In a reverse auction, farms who have completed the baseline setting and have an indicative idea of how many emission reductions they will be able to achieve offer "bids" to the regulator, which detail how many GHG fluxes would be reduced (in t CO_2eq) and at what price. The regulator then closes contracts with the lowest price offers up to a set budget or set amount of GHG flux reductions. They could decide to pay at the bid price or could pay all farmers the same price (i.e. the price at which they would close their final contract), which would deliver some windfall gains to famers with more efficient emission reduction gains and would result in fewer emission reductions due to the quicker exhaustion of budget, but might be perceived as more fair. The reverse auction would also reveal information on farmer costs of achieving emission reductions, which would be useful for scheme administrators. However, we do not recommend this approach in the livestock audit, as it entails high up-front MRV costs (for all farms who want to get baselines) and is an additional uncertainty and complexity barrier for farmer uptake.

Farmers that reduce their emissions often enjoy **additional economic benefits**, as increased emissions efficiency is often correlated with increased economic efficiency, in part through soil health improvements, at least at the current operating level of many European livestock farms. The CARBON AGRI scheme provides illustrative evidence: they expect that by shifting the median farmer (measured in terms of carbon efficiency) to the efficiency of a top 10% farmer, the farmer will have economic efficiency gains of 18%. Assuming an average dairy farm output of 500t of milk per year and translating this efficiency gain into increased profits of €10-12 per t, this results in €5000-6000 per year of efficiency gains. This is more than double the expected reward from GHG reductions through the scheme, which average to an annual value of approx. €1500-2400. Even if such economic efficiency gains are overstated (they do not include private farmer transaction costs of shifting production, including learning, developing of

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[41] In the Carbon AGRI scheme, farmers sign a contract with the France Carbon Agri Association and the scheme operator at the time that they agree to a mitigation plan. This includes a mitigation price, which is generally the same for all farmers at €30 per t/CO_2eq. If farmers implement climate actions that require investments (e.g. hedge planting), Carbon Agri can increase this price. The Carbon Agri Association pays farmers directly.

[42] The SPAR-WWF Austria Healthy Soils scheme found that reward uncertainty is a significant barrier to farmer uptake.

technical skills) (Eory et al. 2018), it is clear that these efficiency gains are very significant and should be advertised to the farmer as a significant drawcard to increase uptake. There is also the potential to boost participant farm income using eco-labelling, e.g. especially efficient farms could be allowed to sell their output with a sticker certifying low-emissions production.

Selecting the **timing of payments** involves trade-offs between farmer uptake and increased uncertainty. Ex-ante payments, based on expected climate impacts (i.e. paid after baseline is set), favour farmers and will therefore increase uptake but increase uncertainty and permanence risk. Ex-ante payments enable farmers to invest in mitigation actions, which they may not otherwise be able to do because of liquidity constraints. Ex-post payments have no uncertainty or permanence risk, as the GHG savings have already occurred. A compromise approach may be most appropriate, where farmers can receive up to x% of expected rewards after baselining, which is then deducted from the reward paid after five years and have the contractual obligation to pay back the ex-ante reward if the expected emission reductions are not achieved. The % should be set well below the expected reward (i.e. below 50%), to reduce the risk of non-achievement[43]. This hybrid approach could be voluntary, as not all farmers will want to sign up to the slightly increased complexity and legal obligations. The existence of additional economic benefits (in the form of efficiency gains) will somewhat decrease the need for an ex-ante payment, as these additional benefits will be immediate. In addition, the scheme's covering of farmers' costs for MRV (i.e. baseline setting) is a form of ex ante payment.

Buffer accounts can ensure the environmental integrity of the scheme. Buffer accounts work by only rewarding farmers for a proportion of their estimated results, holding the remainder back as a "buffer", to ensure that the rewards paid are not in excess of the actual reductions. For schemes where there is a risk of reversal of emission reductions/sequestration, buffers can be kept as an insurance against later releases of rewarded sequestration. These buffers can be general (i.e. a share set aside from all reductions) or targeted, i.e. a share set aside for especially uncertain types of farms. For example, farms that only complete less stringent MRV may have a higher buffer. By reducing the payment that farmers receive, buffers have the downside of reducing farmer incentives and therefore uptake. The scheme we propose does not need to use buffer accounts to protect against non-permanence (because the scheme only rewards GHG reductions and not sequestration or storage). However, uncertainty buffers may be required to meet the level of uncertainty accepted by the scheme designer or to convince offset credit buyers/emission reduction certificate buyers that the environmental integrity of the scheme is assured (i.e. that any offsets sold will be matched by at least an equivalent GHG impact). This depends on the level of uncertainty required by the scheme designer.

Risks to farmers risk decrease uptake, which is why the proposed scheme design minimises them as much as possible. The proposed design places no price risk on farmers (as they are paid a set rate), low non-permanence risk (as it only includes limited ex ante payments and no carbon storage), and low up-front costs (as the scheme covers the baseline setting and MRV costs). As the same audit tool will be used at the start and end of the five year period, there is no calculation risk. The only remaining risk is that the consultant-recommended climate actions implemented by the farmer have less of an impact than expected, and therefore lower results (and hence lower payments) are achieved. The scheme can mitigate this risk by ensuring consultants are

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[43] The Carbon AGRI scheme pays 40% of the expected payments after 2.5 of the 5 year time period, after verifying the implementation of climate actions through farmer or consultant data.

well-informed and providing good advice, by learning from farmer experiences and results and sharing lessons learned with farmers.

c. Funding the scheme

The scheme designer's funding scheme will depend on the funding available to them. Each type of funding comes with different benefits and costs for the scheme designer and other stakeholders. The main options are:

- centrally funded through public funding (e.g. nationally or regionally funded),
- centrally funded by a private company, as part of Scope 3[44] emission reductions,
- externally funded by creating and selling fungible emissions offset credits (i.e. credits that can be exchanged in the market) or (non-tradeable) emission reduction certificates.
- External funding has the obvious benefits that the costs of mitigation are borne by a party other than the scheme designer and operator (i.e. by credit/certificate buyers).

In the proposed scheme, the main stakeholder affected by the decision is the scheme designer (as farmers are paid a set, pre-agreed amount per tonne, as discussed in the previous chapter). Therefore, the discussion on costs and benefits here focuses on the scheme designer's perspective. If the scheme designer decides to link reward payments to the prices they receive for offset credits or emission reduction credits, this creates significant barriers for farmers due to increased risk and uncertainty.

As shown in Figure 3, the **different funding approaches require scheme designers to apply different degrees of MRV stringency.**

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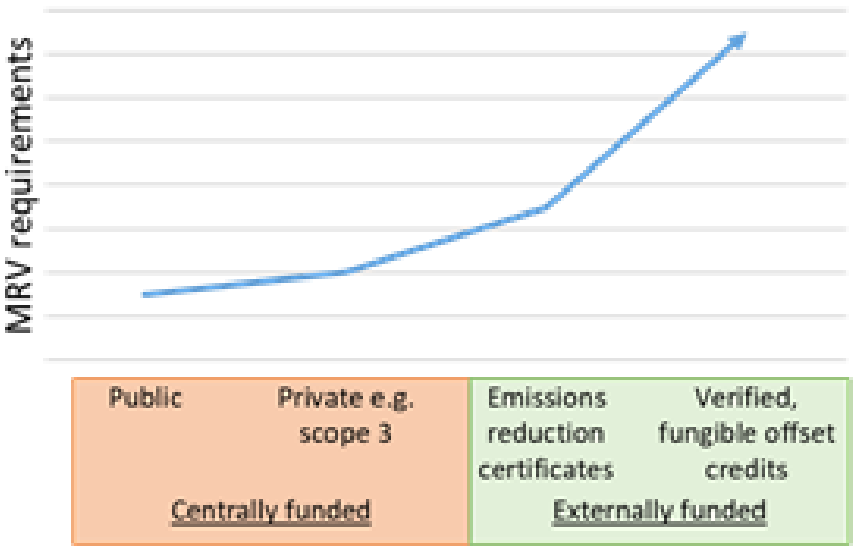
[44] The GHG Protocol, the most used international accounting tool, categorises GHG emissions into three categories. Scope 1 emissions are direct emissions; Scope 2 emissions are indirect emissions from the generation of purchased energy; Scope 3 emissions are all indirect emissions not included in Scope 2 that occur in the value chain of a company, including both upstream and downstream emissions (i.e. emissions generated in the supply of inputs and the delivery and disposal of company products/services.

Figure 3 MRV requirements under different funding options



Source: own elaboration

Centrally funded schemes offer the scheme designer the most flexibility, as scheme designers are also the scheme's funders, and hence they bear the risk of environmental uncertainty themselves. Privately-funded schemes may have to meet more stringent MRV requirements if they aim to achieve external validation of their approach, as it is the case for GHG Protocol Scope 3 emissions approaches. Such approaches will also require more strict international oversight to ensure that there is no double counting of Scope 3 reductions by the upstream company and the farmer host country.

External funding has higher MRV stringency requirements, as offset or emission reduction certificate buyers need to trust in the environmental integrity of the reductions. The relationship between the farmer and the credit buyer should determine the required degree of environmental integrity. The key issue is whether the farmer is compensating (i.e. offsetting) the buyers' emissions, or the farmer's reductions are just being financed by the buyer. Compensation demands higher standards and higher MRV. This is the case for fungible offset markets, where buyers will only purchase if they expect credits to have equivalent environmental integrity to their own reductions and to maintain value in the future, and therefore demand stringent MRV to ensure they are highly additional[45]. Given the inherent uncertainties in using audit tools to estimate emission reductions on livestock farms with currently available technology, meeting the MRV requirements of verified, fungible offset credits may be so expensive that it is therefore not worthwhile. GoldStandard offers an example: they paused development of a methodology to create offset credits based on Cool Farm Tool, as they were unable

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[45] As discussed in earlier chapters, increasing MRV stringency increases MRV complexity and cost, for scheme operators but also for farmers. For example, if using external funding, scheme operators will have registry costs, and higher ongoing validation and audit costs due to the more complex MRV. Farmers would also face greater cost, as increased MRV may require external verification and increased input data requirements, which increase farmer time commitments; these farmer transaction costs will decrease uptake. MRV costs undermine the overall benefits of the scheme.

to estimate the uncertainties; in addition, the large discounts that GoldStandard applies to high-uncertainty credits could make a scheme based on this method uneconomic[46].

Nevertheless, **offset credit markets are attractive to scheme designers as a way to crowd-in private financing for emission reductions**. There are already twelve voluntary offset credit markets in Europe, with five schemes launched since 2015 (Cevallos, Grimault, and Bellassen 2019). Cevallos, Grimault, and Bellassen (2019) find that average prices in European schemes are 13 €/tCO2e, with prices ranging from 6-110€/tCO2e. We found comparable prices in the result-based schemes we have analysed, i.e. 30-40€/tCO2e in CARBON AGRI, €15-18€/tCO2e in GoldStandard, 35-67€/tCO2e in MoorFutures. Offset credits also offer a way to cover administrative costs. This can be achieved by charging a set rate per offset tonne (e.g. GoldStandard charges $0.30USD per credit sold, in addition to verification and registry costs). This is especially true for "first mover" schemes – offset credits can fund the development of innovative approaches and pilot studies.

Scheme designers can get external funding without fungible offset credits. An option with more flexible MRV would be to create scheme-associated **emission reduction certificates**, which cannot be traded as a fungible offset credit but would rather be used by the buyer to demonstrate that they financed a quantified level of reductions. The certificate would list a set amount of emission reductions, matched by actual reductions from the scheme (recorded in a registry). The certificates would be sold by the scheme in the form of a one-off sale. The certificate would list the amount of reductions that were financed by the certificate purchaser and would include instructions for how the buyer could report the offsetting, e.g. to customers. The scheme designer would have to decide whether they would sell certificates to any purchaser, or would limit sales to certain buyers (e.g. buyers who provide evidence that they have already decreased emissions within their operation). The value of these certificates would depend on the buyers' trust in the scheme. This trust can be achieved in ways that do not require strict MRV: for example, in the MoorFutures scheme the buyers of emission reduction certificate trust the reductions due MoorFuture's association with local university researchers, whose personal reputation underpins the method and the credits; this enables less stringent (and expensive) MRV. Trust in the CARBON AGRI scheme is facilitated by its approval by the French Environment Ministry's Label bas Carbone, which vouches for its integrity.

Should the scheme designer opt for **external funding, additional elements** must be considered:

- Scheme designers will need to budget time and money for staff training to ensure they develop the necessary additional skills (e.g. sales); scheme designers should look to existing schemes as best practice (e.g. Woodland Carbon Code).
- External funding requires a transparent registry that records all results achieved through the scheme, and all purchases of offsets/certificates. This should be publically available to increase transparency and associated perceptions of environmental integrity, which will support demand.
- Offset credits/emission reduction certificate demand (and prices) can be supported by reporting multiple sustainability indicators (not just emission reductions),

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[46] At higher rates of uncertainty, GoldStandard requires projects to apply steep credit discounts, i.e. 50% for 20-30% uncertainty (i.e. for each tonne of estimated reduction, participants only receive 0.5 credits), and up to 100% for more than 40% uncertainty (Gold Standard 2018).

especially when selling to regional buyers (who are also more likely to value these additional sustainability benefits, which may be locally occurring).

- The price received would be determined by supply and demand for credits, though the scheme designer may decide to set price floors to ensure that their costs are covered.
- Scheme designers must also consider if they will limit who can purchase credits/certificates, to ensure that the objectives of the scheme are met. For example, scheme designers may only want to sell credits to buyers who have already reduced their own emissions internally, rather than simply offsetting others emissions.
- The scheme designer may also have to limit sales to domestic buyers or maintain careful records to ensure that trades are correctly recorded in country-level emission reporting (i.e. to avoid double-counting).

7 Governance, delivery, scaling up adoption and evaluation

This chapter discusses scheme governance, including transparency and evaluation, and opportunities for upscaling the scheme.

a. Governance

There is no one-size-fits all approach to governance. Accordingly, in this chapter we introduce potential governance examples from the existing schemes (CARBON AGRI, GoldStandard, MoorFutures, and Arla Climate Check) as potential options.

A key element of governance is the verification and validation of the methodology or project. If schemes want to develop verified, fungible offset credits or verified emission reduction certificates, they must meet the standards set by external verifying authorities (Box 1 and Box 2 summarise the external verifying processes set by Gold Standard and Label bas Carbone).

Box 1 Examples of governance processes for external approval of methodologies and projects

GoldStandard offset credits

External funding through fungible offset credits has the highest governance requirements, and highest costs. An example is given by GoldStandard, a non-profit foundation that has managed offset standards and credits since 2003. While GoldStandard schemes are not a direct match for the scheme proposed in this report (e.g. Gold Standard deal with projects, rather than individual landowners), this process and costs illustrate one potential approach. To generate GoldStandard credits, scheme developers must have their method and implementing projects approved and verified:

Methodology approval: To sell GoldStandard credits, project developers must first have their methodology approved

1. Concept: Scheme developers develop a concept method that outlines and justifies the method, and submit it to *GoldStandard technical advisory committee* to assess initial eligibility.
2. Full draft: If concept is approved, scheme developers create a full draft, setting out methods, management, and uncertainty, and re-submit it.
3. Review: *GoldStandard reviewers* (two internal reviewers and one external reviewer e.g. scientist) identify issues that the developers must address (up to 3 rounds of review).
4. Final approval: *GoldStandard technical advisory committee* give final approval of the method.

Note: For a new method the cost is €50,000, and the approval takes approximately 5 months. For a method already recognised elsewhere (e.g. CDM) the cost is €7500 and the approval takes approximately 2 months.

Project verification: To generate credits, projects implement the approved methodologies and get certified/verified/registered with an independent verifier (*SustainCert*):

1. Certification: Projects must submit to a preliminary desk review (*SustainCert*), an independent audit (including site visit by *3rd party auditor*) and review of audit. Cost: €5000 for *SustainCert* reviews + €30-40,000 for audit
2. Verification: Projects must be verified by a *3rd party auditor* within the first two years of project, and after then every five years. The cost is €30-40,000 per verification, + €1500 for *SustainCert* review.
3. Registry: To sell credits, project developers must open a *registry* account (€1000) and pay fee of €0.30 per credit sold).

Box 2. Label bas Carbone programme

The French Ministry for the Ecological and Inclusive Transition launched Label bas Carbone in April 2019 as a public certification scheme for voluntary offsets, as well as a public registry. The approval of the methodology is an ad-hoc and collaborative process. So far, methods are arising from existing research projects. The Ministry works with the developer to prepare the method, consulting with experts and stakeholders. The Ministry then convenes an ad-hoc scientific board to help the Ministry review and approve the methodology. The Ministry may make the process more formal in the future to increase integrity, for example by establishing a separate technical group with independent terms and nominations. The credits that are produced using the scheme are not fungible i.e. they are project-specific and cannot be resold. CARBON AGRI is one of four currently approved methodologies.

Schemes can also seek **external funding without having external verification**, e.g. the **MoorFutures** project. The MoorFutures project was established by the regional government and local universities. Two key bodies support the development, implementation, and verification of projects: a scientific advisory board (featuring experts from local universities) and a project working group (headed by the local regional environment agency). The credits produced are project-specific and are not re-sellable, i.e. buyers purchase a one-off offset. Given the lack of external validation or verification, the scheme relies on the personal reputation of the researchers and regulators involved.

Schemes that do not seek external funding can be more flexible in their governance. Arla Foods' Climate Check programme is a scheme that aims to meet the target of reducing emissions by 30% by 2030. The programme is currently activity-based rather than result-based. As the programme does not develop credits or emission reductions, external verification and validation are carried out in line with Science Based Targets[47] and to convince consumers about the credibility of the programme, rather than to increase credit demand. To this end, they have made documentation of the Arla tool publically available and support its assessment by scientific research projects. At the same time, the standards are not as prescriptive as externally funded schemes.

Existing schemes offer key lessons for governance design. Schemes will be more impactful and efficient if their design **involves key stakeholders** in the objective setting and design process. Key stakeholders include farmers, agricultural business representatives, farm consultants, audit tool developers, local community representatives, and policymakers, at least. If the aim is to develop offset credits or emission reductions, then key stakeholders should also include potential buyers. The objective setting process could be a co-development process where stakeholders collaborate to identify shared priorities. At a minimum, the scheme designer should consult with the stakeholders to understand their views. The better the scheme reflects all stakeholders' objectives, the greater the likelihood of success.

Table 3 Key actors in the development of a result-based carbon farming scheme and their responsibilities

Key actors	Description	Responsibilities
Scheme designers/operators	They develop and then implement the scheme. They could be regional/national authorities, associations, downstream companies, or other., e.g. the French CARBON AGRI Association	They design and update the scheme, and carry out training activities, administration, supervision and audit of the MRV, registry management, outreach and communication, funding (including establishing credit scales)
Farmers	Participant	They implement climate actions, collect and report input data.
Consultants	They run the audit tool and act as advisors and auditors at different times	They run the audit tool, set the baseline, recommend climate actions to farmers and carry out random/targeted audits.

b. Transparency

Transparency supports the effective operation of the scheme and its ability to achieve its objectives. Transparency builds trust with all stakeholders, especially farmers, policy-makers, and external funders (e.g. credit buyers). **A public registry**, managed by the scheme operator, should publically record all non-commercially sensitive results of the scheme. This should include non-anonymised farm-level reporting on results indicators (i.e. emission reductions achieved) and other sustainability indicators. The overall impact of the scheme should also be calculated based on this data and publically

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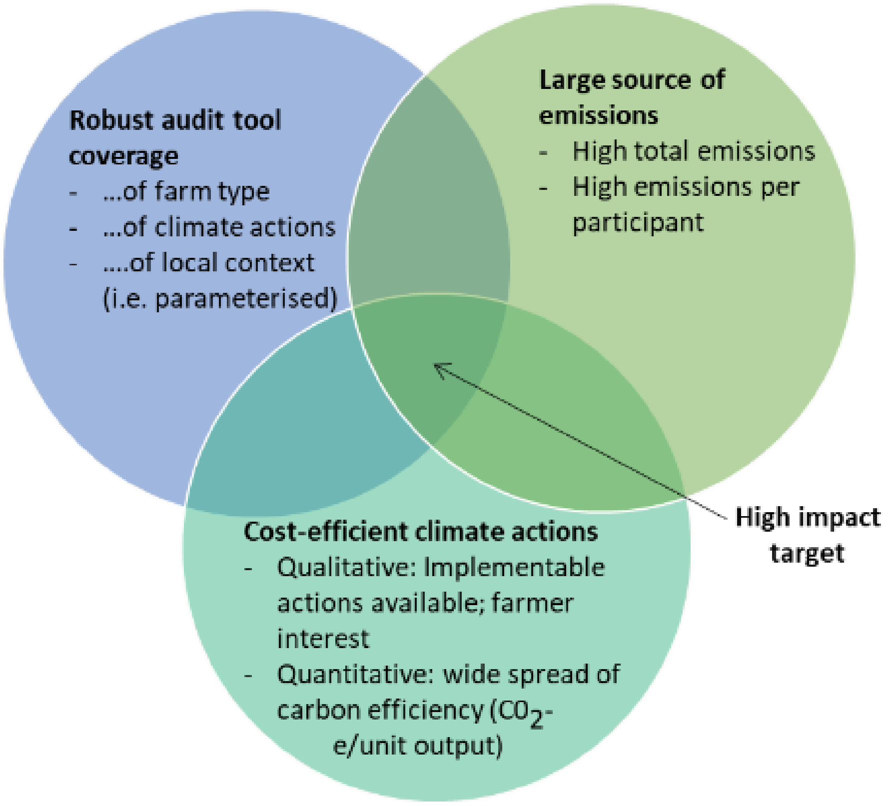
[47] Science Based Targets are a program for corporates to set climate action commitments that are in line with the Paris goals of limiting global warming to at most 2 degrees Celsius, see https://sciencebasedtargets.org/

promoted, for example through website and promotional material. The scheme should also confidentially store the audit tool input and output data as anonymised data to support the development of the scheme. If emission reduction certificates or offset credits are sold, the purchaser and the amount of credits purchased should be publically listed on the registry.

Figure 4 Targeting upscaling



Source: own elaboration

To support learning and promote transparency, the **scheme should publish all methodologies and cooperate** with external stakeholders, for example farmer participants and external scientists. As well as increasing trust in the scheme, this will provide inputs for the scheme to continue to develop and improve. This will also support the extension of the scheme to other areas, thereby supporting climate action elsewhere.

c. Upscaling adoption

As discussed in the feasibility chapter, the upscaling of this scheme is primarily limited by the capability of farm carbon audit tools to robustly measure emissions i.e. the coverage and scope of the scheme is first defined by the type of farms, climate actions, and the (geographic) contexts covered by farm audit tools. Apart from these limitations, upscaling efforts should be targeted to areas/farm types where it can deliver the highest impact, most efficiently. These are summarised in Figure 4. Efficiency refers to the ability to take climate actions that deliver net benefit, i.e. the benefits (including climate and other co-benefits) exceed the costs (including all transaction costs).

Existing schemes demonstrate that **diverse methods of upscaling are possible**. Examples include schemes developed and implemented by the public sector[48], the development of research projects into a non-profit association (with public certification)[49], and similar schemes implemented as part of a private supply chain[50]. Upscaling **success factors** identified by the schemes include:

- **Economic incentives**: economic incentives are a key first attractor for farmers.
- **Farmer interest**: increased media and public interest in climate issues is matched by growing farmer interest in how to farm in a climate friendly manner. Farmers respond to positive stories about how their actions can have significant impact. Farmer "champions" disseminate to other farmers, for example at kitchen table meetings, boosting uptake.
- **Broader sustainability impacts**: stakeholders care about more than climate, so broader impacts should be highlighted using indicators that are salient to the stakeholder. For example, offset credit buyers care about local projects and other environmental and animal welfare impacts. Farmers are also motivated by economic co-benefits (e.g. productivity gains).
- **Consultants**: schemes depend on sufficient number and quality of trained consultants, who also play a key role in farmer uptake.
- **Farmer involvement**: scheme design should include stakeholders, especially farmers, to ensure salience and practicality, and to build up interest.
- **Good science**: MRV and farm audit tool capability remain the biggest barrier to uptake. Existing schemes have built on existing tools or research projects and involve scientists in governance and design, to ensure robustness.
- **Learning-by-doing**: all existing schemes have flexibly developed over time, responding to challenges and opportunities as they arose, rather than up-front developing a perfect plan.

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[48] The Woodland Carbon Code (a result-based scheme for carbon farming that incentivise woodland forest planting in the UK.) was established and is run by a government department (the Forestry Commission). Its advisor board features representatives of scientists, policymakers, carbon market participants, and farming and environmental associations, but the executive board is made up of public servants.

[49] The CARBON AGRI scheme arose from two research projects. To increase uptake of the methodology, involved partners established the France CARBON AGRI Association to link farmers, farm consultants/project developers, the ministry, and buyers. The association employs two full-time staff to support uptake and development. The association includes stakeholders from across the sector (farmer associations, audit tool developers, scientists, regional councils, downstream companies, farm consultants, relevant national ministries, among others). The CARBON AGRI scheme has been publically certified by the French government's Label bas Carbone offset certification programme, but is not a public sector initiative.

[50] Carbon farming schemes can also be implemented by private companies, such as the Arla Foods Climate Check programme, which is running farm audit tool checks and incentivising emission reductions on its 10,000 dairy farms.

Box 3. Role of the CAP and connectivity to the delivery of carbon farming

The **scheme could be implemented through the new CAP's** proposed eco-schemes in Pillar 1, as well as through the well-established agri-environment-climate measures in Pillar 2. These instruments are designed to create incentive-based voluntary schemes for farmers and/or other land managers (where applicable). Member States would be able to target and tailor prospective carbon farming schemes supported under these instruments to their climate and other environmental needs, provided they can demonstrate how they will contribute to EU climate objectives and corresponding targets. This could be accompanied by policy support for training, advice and innovation uptake, including pilot projects. Relevant instruments include knowledge exchange and information (including the Farm Advisory Service – FAS), as well as cooperation, in particular through operational groups under the European Innovation Partnership.

The **scheme must also be designed to align with the CAP**. To ensure environmental integrity of the scheme and to lower costs for the scheme's administrators and farmers, designers need to be aware of related CAP measures. Solutions identified include, where possible, aligning MRV requirements with CAP (e.g. data reporting, timing), and including exclusion criteria or financial additionality requirements to avoid double funding or double counting.

d. Scheme evaluation

The scheme operator should **regularly evaluate** the scheme to assess progress towards objectives and to identify ways to improve the scheme. The evaluation should focus on effectiveness, efficiency, and equity issues. Effectiveness will assess progress towards objectives, using the indicators identified in the objective setting phase, i.e. scheme-wide impact on emissions, number of farmers participating, broader environmental impact, economic impact. This should include specific focus on potential negative externalities. Efficiency will focus on the cost of implementing the scheme, including administrative costs and MRV costs, in absolute and relative terms (i.e. € per tonne of CO_2eq, € per farm). Equity considerations should consider whether costs and benefits are spread fairly across different farm types (e.g. large/small, first-movers, young farmers etc.). The evaluation should draw on aggregated scheme data as well as interviews or focus groups with stakeholders. These evaluations should be completed annually to identify trends over time. The feedback and evaluation results should be used to improve the scheme in an ongoing way e.g. to improve the audit tool's usability, changing eligibility rules to limit negative externalities, or to adapt communication to target new farmer groups.

Generally, the experience of existing result-based carbon farming schemes shows that all schemes develop through **ongoing evaluation and adaptation**. This process begins with the adapting of the scheme proposed above to the local context, priorities, challenges, and opportunities. This continues as scheme operators and participants gather new data and experience, learn from research and practical applications elsewhere, and as they trial new approaches. Applying a versioning approach to the methodology and audit tool can enable the scheme designer to implement and start learning early, while development continues, then transitioning to improved versions of the tool and methodology as they become available, without affecting the participants who have already acted.

9. References

Cevallos, G., J. Grimault, and V. Bellassen (2019) *Domestic Carbon Standards in Europe: Overview and Perspectives*. Institute for Climate Economics, Paris.

Eory V., S. Pellerin, G. Carmona Garcia, H. Lehtonen, I. Licite, H. Mattila, T. Lund-Sørensen *et al.* (2018) Marginal Abatement Cost Curves for Agricultural Climate Policy: State-of-the Art, Lessons Learnt and Future Potential. *Journal of Cleaner Production*, vol. 182, pp. 705–16.

Gugele B., B. Strobel, P. Taylor (2019) *Total Greenhouse Gas Emission Trends and Projections in Europe (Indicator Assessment)*. European Environment Agency.

European Environment Agency (2020) *EEA Greenhouse Gas - Data Viewer*. European Environment Agency webpage. https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer. Accessed 14.10.2020

Frelih-Larsen, A, M. MacLeod, B. Osterburg, A.V. Eory, E. Dooley, S. Kätsch, S. Naumann, *et al.* (2014) *Mainstreaming Climate Change into Rural Development Policy Post 2013*. Final Report. Ecologic Institute, Berlin.

Gold Standard (2018) *Gold Standard for the Global Goals. Land Use & Forests Activity Requirements. Version 1.1*. Accessed at: https://globalgoals.goldstandard.org/standards/203_V1.1_AR_LUF-Activity-Requirements.pdf

IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use. Available: https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

IPCC (2019) *Special Report on Climate Change and Land. An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. Intergovernmental Panel on Climate Change.

Joosten H., K. Brust, J. Couwenberg *et al.* (2015) *MoorFutures®: Integration of Additional Ecosystem Services (Including Biodiversity) into Carbon Credits – Standard, Methodology and Transferability to Other Regions*. Bundesamt für Naturschutz (German Federal Agency for Nature Conservation).

Kuikman, P., E. Anderson, B.S. Elberson, A. Frelih-Larsen, P.J. Jones, S. Naumann, J.J. Onate, and I. Staritsky (2013) *EU Wide Farm-Level Carbon Calculator: Data Availability at Farm Level for Farms across EU-27*, Ecologic Institute.

Lanigan, G. J., T. Donnellan, K. Hanrahan, C. Paul, L. Shalloo, D. Krol, P. Forrestal, N. Farrelly, D. O'Brien, and M. Ryan (2018) *An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030*, Teagasc.

Leinonen, I., V. Eory, M. MacLeod, A. Sykes, K. Glenk, and B. Rees (2019) *Comparative Analysis of Farm-Based Carbon Audits*, ClimateXChange.

Leip, A, G. Billen, J. Garnier, B. Grizzetti, L. Lassaletta, S. Reis, D. Simpson, *et al.* (2015) Impacts of European Livestock Production: Nitrogen, Sulphur, Phosphorus and

Greenhouse Gas Emissions, Land-Use, Water Eutrophication and Biodiversity. *Environmental Research Letters*, vol. 10, no. 11: 115004.

Leip, A., Carmona--Garcia, G., Rossi, S., 2017. Mitigation measures in the Agriculture, Forestry, and Other Land Use (AFOLU) sector. Quantifying mitigation effects at the farm level and in national greenhouse gas inventories. https://doi.org/10.2760/51052

McConkey, B., K. Haugen-Kozyra, J. Alcock, T. Maynes, and C. Vinke (2019) *Global Assessment of Beef Emissions Quantification Standards and Tools*. Viresco Solutions Inc. Global Roundtable for Sustainable Beef.

Mullender, S., L. Smith, and S. Padel (2017) *Sustainability Metrics: The Case for Convergence*. Sustainable Food Trust.

New Zealand Interim Climate Change Committee (2019) *Action on Agricultural Emissions: Technical Appendix 2: Calculating Agricultural Emissions*. Wellington. Accessed at: https://www.iccc.mfe.govt.nz/assets/PDF_Library/ad8206e92b/FINAL-ICCC-Technical-Appendix-2-Calculating-Emissions.pdf

O'Brien, D., J. Herron, J. Andurand, S. Caré, P. Martinez, L. Migliorati, M. Moro, G. Pirlo, and J-B Dollé (2020) Life Beef Carbon: A Common Framework for Quantifying Grass and Corn Based Beef Farms' Carbon Footprints, *Animal*, vol. 1, no. 4: pp. 834–845.

OECD (2019) *Enhancing the Mitigation of Climate Change Though Agriculture: Policies, Economic Consequences, and Trade-Offs*. Organization for European Co-Operation and Development, Paris.

Sykes, A. J., C. F. E. Topp, R. M. Wilson, G. Reid, and R. M. Rees (2017) A Comparison of Farm-Level Greenhouse Gas Calculators in Their Application on Beef Production Systems. *Journal of Cleaner Production*, vol. 164: pp. 398–409.

van Zanten, H.H.E., H. Mollenhorst, C.W. Klootwijk *et al.* (2016) Global food supply: land use efficiency of livestock systems. *The International Journal of Life Cycle Assessment*, vol. 21, no. 5, pp. 747–758.

Zumwald J., T. Nemecek, S. Ineichen, B. Reidy (2019) Indikatoren für die Flächen-und Nahrungsmittelkonkurrenz in der Schweizer Milchproduktion: Entwicklung und Test zweier Methoden. *Agroscope Science*, vol. 85, pp. 1-66.

10 Choosing between farm audit tools

This chapter provides additional information on farm audit tools, including a more detailed discussion of uncertainty. This draws on Leinonen et al (2019) and Sykes et al. (2017), who have reviewed existing farm carbon audit tools in the context of Scottish livestock farms, as well as on a global tools assessment (McConkey et al. 2019), and interviews.

We provide an overview of the three prominent tools that appear appropriate for the livestock case study, building on the Leinonen et al. (2019)'s paper and interviews carried out for this research: Cool Farm Tool and Solagro (JRC) Carbon Calculator , as well as the CAP'2ER tool, which is applied in the Carbon AGRI scheme. Table 4 summarises each tool's coverage (i.e. what types of farms, climate actions, and geographic regions are covered by the tool), level of practicality, broader sustainability aspects, and indicators of likely robustness (transparency and methodology).

Table 4 Coverage of farm carbon audit tools[51]

	Cool Farm Tool[52]	**Solagro (JRC) Carbon Calculator**	**CAP'2ER**
Farm types	Crops: More than 30 different crop species/categories Livestock: Beef cattle, dairy cattle, sheep, pigs, chicken, turkeys and ducks (and also buffalo, goats, camels, horses and rabbits). For dairy cows, it is possible to select from 14 different breeds. For dairy/beef, information on start/end weights can be included.	Crops: all main European crop species Livestock: dairy cattle (different animal categories), beef cattle (different animal categories), goat (milk and meat), dairy and meat sheep (different animal categories), horses, donkeys, pigs (different animal categories, sow and meat animal systems), broilers and laying hens (different production systems), rabbits, geese and game birds.	Livestock: Dairy cattle, beef cattle, meat & dairy sheep, goats, crops. It will be extended to cover other livestock.
Climate actions	Livestock emissions include emissions embedded in feed, emission from enteric fermentation and emissions from manure management. Crop emissions include crop production (CO_2, N_2O, CH_4) include emissions from fertilizer production (embedded), emissions from pesticide production, among others. Carbon storage/sequestration include trees, soil carbon changes due to land management (averaged over a 20-year period).	Crop mitigation activities: reduce total fertiliser use, the change between different types of fertilisers, fuel use in field operations, and improvement of yield. Livestock mitigation activities: the GHG emissions embedded in the feed can be affected through changes in the feed composition and through the total feed consumption. However, it is not possible to assess the reduction of the manure emissions resulting from changing the feed, because of the Tier 1 method used for these emissions.	Livestock and crops mitigation activities include managing the following: Inputs (pasture management, concentrates and fertilizers, legumes, crops rotation), herd management (increasing productivity Reducing number of unproductive animals) Fuel and electricity (No-till cultivation, power and equipment, working organization), feed (feed efficiency, forage quality and yield), crops management & fertilization (legume

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[51] Based on Leinonen et al. (2019), interviews with developers, and tool documentation.

[52] Cool Farm Alliance interview, technical documentation

		Livestock emissions include emissions embedded in the feed, emission from enteric fermentation and emissions from manure management. Carbon storage/sequestration: most detailed of all tools. Based on management factors (e.g. full tillage, reduced tillage, no tillage), specific for land use, soil type, management type, and climatic conditions. Soil carbon stocks can be increased through return of crop residues, using organic amendments and green covers. Trees, hedges, shrubs also included.	fodder crops, optimization of fertilizers uses), manure management (time spent in shed vs pasture, biogas production). In addition, CAP'2ER considers carbon sequestration climate actions including cover crops, avoiding bare soil, agroforestry, and grassland management. Not all aspects are covered by the simpler Level 1 version of the tool (based on 30 inputs); some rely on Level 2 data.
Geographic coverage	The tool has been applied in 118 countries worldwide.	The tool has been developed to be used within the EU-27 area, and it has country specific built in data for most European countries.	Already applied for beef and dairy farming in France (13,000 farms) and Italy and has been tested in Scotland and Spain. It is currently being extended and validated to cover extensive sheep farming (milk and meat) in France, Ireland, Italy, Romania and Spain, and there are ongoing discussions to extend to Poland, Switzerland and Belgium.
Practicality (ease of use, data availability)	Currently, it needs to be run separately for each product, then combined (i.e. not whole farm). Ease of use: well-tested (more than 10000 users). Additionally, the current version of Cool Farm Tool is not appropriate for	It is built in excel visual basic, meaning it is relatively straightforward to use.	2 modes: level 1, with 30 parameters; level 2, with 150 parameters. National data base with all audits done

	regulation, as some elements are based on subjective assessment. Stricter protocols and alterations to tool defaults would need to be developed before use for monetization.		
Broader sustainability	Other sustainability indicators are calculated separately, though based on similar data. It includes biodiversity, water use, economic indicators	It calculates and reports automatically: water consumption, direct primary energy consumption, nitrogen surplus, and ammonia volatilization.	It produces broader sustainability outputs, including energy consumption, ammonia emissions, nutrient runoff, carbon storage, biodiversity area, amount of people fed, economic performance.
Transparency	Medium: Technical documentation available. Source code not available.	High: it runs in Microsoft excel visual basic. a technical description is published.	Medium. A methodology with references for emissions factors etc., is available but the code not publically available.
Methodology	Aligned with IPCC Tier 2 or more detailed. Exception: Feed input for animals other than cattle is simplistic. it has gone through scientific review.	Generally IPCC Tier 2.	IPCC Tier 2 or more detailed i.e. some Tier 3 for methane or specific scientific references for inputs to GHG emissions calculations.

11 Interviews and reviews

The authors are thankful to four external reviewers for their comments: Owen Hewlett (Gold Standard); Jean-Baptiste Dolle, Idele (French Livestock Institute/Carbon Agri); Hanne Bang Bligaard (Arla Foods); Adrian Leip (EU Joint Research Centre).

Table 5 shows the experts that were interviewed for this research.

Table 5 Interviews

Name of Expert	Project they are associated with	Organisation
Giancarlo Raschio		GoldStandard
Hanne Bang Bligaard (leads Climate Check programme), Anna Flysjö - Arla's corporate sustainability team	Arla Climate Check	Arla Foods
Ida ML Drejer Storm	Focus Group Reducing emissions from cattle farming	EIP Agri
Jean-Baptiste Dolle, Catherine Brocas	Carbon Agri	Idele
Owen Hewlett		GoldStandard
Pat Snowden	Woodland Carbon Code	Scottish forestry
Simon Miller, Daniella Malin, Richard Profit	Cool Farm Tool	Cool Farm Alliance
Thorsten Permien	MoorFutures	MoorFutures / authority
Vera Eory	Audit Tools inventory	SRUC
Thomas Blackburn and Tif Potter		SustainCert

Annex V

MANAGING SOIL ORGANIC CARBON ON GRASSLANDS

A CARBON FARMING CASE STUDY

Table of Contents

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Summary and recommendations

The aim of this case study is to provide analytical insights, lessons learned and guidance on how to design and operate a result-based carbon farming scheme on grasslands in an EU carbon farming context. There are only a few (current or past) result-based initiatives rewarding carbon sequestration on grasslands in Europe to learn from, so the study mainly builds on learning from result-based rewarding systems for biodiversity enhancement, such as the Burren Programme in Ireland and the Result-Based Agri-environmental Payment Schemes (RBAPS) in Ireland, the UK and Spain. The Sown Biodiverse Pastures Project on grasslands, financed by the Portuguese Carbon Fund, provides insights on setting up and managing carbon sequestration initiatives on grasslands with result-based reward schemes using indirect measurements.

We only consider four overall categories of land use and management changes that contribute to carbon sequestration on grasslands: 1) the ongoing management of existing grasslands; 2) conversion of 'fallow/set-aside' areas to grasslands; 3) the replacement of annual cropland with grassland, including arable land that is economically marginal, such as sloping land or shallow soils, which are especially suitable for grassland management; and 4) avoided emissions from averted conversion of grasslands to arable land on soils that are suitable for cultivation.

Changes in carbon on managed grasslands can happen in two main pools: soils and biomass. Since we are looking for permanence, the grasslands case study looks at the changes in soil organic carbon (SOC), and not at the changes in biomass, since the latter is subject to high fluctuations.

Some of the key challenges of designing an effective grasslands carbon sequestration reward system include costs and uncertainty of measuring changes in SOC and hence carbon sequestration in soils. Related to this, another challenge relates to establishing cost-effective MRV across different geographies/contexts where spatial variations in the content of SOC are significant. Ensuring permanence is also challenging, because of the reversibility of soil carbon gains plus the long timescales before significant carbon changes can be reliably detected.

The feasibility of the scheme relies on a range of factors, some of them depending on the socio-economic context in which the initiative takes place. The overall feasibility considerations seem to focus around the following set of factors: i) 'relatability' for the involved farmers; ii) opportunity costs and risks related to the likelihood of the initiative resulting in a payment; iii) simplicity and administrative burdens put on the farmer in order to participate in the scheme and comply with the rules of the initiative; iv) transaction costs – and related economic and/or practical/knowledge barriers for uptake; v) coherence and compatibility with other (parallel) initiatives (and/or policies and regulations); vi) uncertainties – with regards to actual potential for carbon sequestration on the farms, and with regards to measurements and robustness of MRV; and vii) fair baseline and target setting.

The likelihood of success of an initiative depends to a large extent on management practices and agro-climatic conditions: success rates will be higher where the potential for SOC sequestration is large (e.g. degraded, overgrazed grasslands, where the change occurs faster and the total amount of C sequestered leads to higher rewards).

Besides, on such lands the reward – transaction cost ratio is more favourable and uptake and permanence more likely.

The level of required certainty on the achieved climate results depends on the objectives of the initiative. If schemes want to develop verified, fungible offset credits or verified emissions reduction certificates, schemes must meet the standards set by external verifying authorities, like Gold Standard and Label Bas-Carbone. schemes that do not seek external funding can be more flexible in their governance structures.

Farmer engagement is crucial for uptake and long-term sustainability/ permanence of any initiative on farmland. Removal of barriers to uptake, and optimization of drivers and engagement factors are therefore important for long-term sustainability and permanence of impact.

Barriers to farmer uptake arise from mainly two areas: 1) (perceived and real) financial concerns and 2) uncertainty and complexity of the initiative and the impact it may have on the overall farm practices.

Multi-stakeholder engagement is a key enabler in establishing effective schemes. Active involvement of farmers is important as well as the dialogue between them, as the practitioners, owners and managers of the land, and the researchers and advisors. This has been key to establishing and operating innovative (grazing or other) result-based biodiversity enhancement strategies on grasslands, and experienced practitioners within these initiatives claim that this would be crucial to any grasslands initiative for result-based carbon sequestration.

Deciding on the result indicators that will be linked to payments in a way that is transparent, relevant and relatable for the farmer is key to acceptance and uptake. Also, the multifunctionality of grasslands in providing multiple ecosystem services besides climate regulation and adaptation, should be recognized and rewarded. Hence, co-benefits like enhanced biodiversity, improved soil water holding capacity and stability, etc. should be considered when deciding on indicators for the initiative. The use of direct and indirect/proxy indicators are not mutually exclusive; existing experiences focussing on managing SOC on grasslands show that the best option is to use both kinds of indicators.

The feasibility, reliability and costs of MRV is by far the most important challenge in relation to result-based initiatives for grasslands. The part of the costs borne by the farmers is of particular importance since it can turn out to be an unsurmountable barrier to uptake, if the administrative and financial costs are too high, and exceed the advantages and net benefits of being part of the initiative.

A hybrid scheme rewarding both actions taken and results achieved – with regard to co-benefits and SOC sequestered – seems at present more enticing to farmers than a result-based scheme where famers are only paid ex-post for actual tons of carbon sequestered.

Recommended grassland scheme - Summary

Objective: incentivise avoided emissions, maintenance and enhancement of SOC on grasslands.

Scale/coverage: there are four main categories of land use/management to consider for result-based carbon sequestration initiatives on grasslands:

1. permanent grasslands;
2. conversion of fallow/'set-aside' areas to grasslands;
3. arable land being converted to grassland;
4. avoided emissions because of the avoided conversion of grasslands to arable land, even though the land is suitable for arable crops.

Climate actions: all actions that maintain and/or increase the SOC content in grasslands and do not have adverse impacts on other ecosystem services, biodiversity and socio-economic factors.

Design principles:

- Action-oriented, farmer-centred design that is based on the local agro-ecological context– actively engaging farmers in the actual design of the initiative(s);
- Local anchorage with a trusted advisory service as the initiative manager;.
- Minimising MRV costs;
- Simplify administrative procedures and shift costs away from farmers (to minimise transaction costs and maximize farmer uptake and permanence and);
- Learning-by-doing – any scheme set-up needs to be evaluated and improved based on experience.

MRV: the selection of MRV approaches – direct and/or indirect SOC measurement with sample verifications, and/or the use of proxy-indicators and determined carbon sequestration factors based on management conditions – and the acceptable level of uncertainty, determine the level, complexity and costs of the MRV set-up. The basic principle, however, remains that the administration and costs to the farmers should be minimized, and usability and transparency optimized.

A robust, yet realistic (i.e. efficient and not overly burdensome) MRV would include:

- Initial farm baseline setting, where initiative advisors in dialogue with farmers establish a baseline level of SOC, agree on relevant indicators (proxy and/or actual changes in SOC) and agree on management actions (carbon sequestration factors) to maintain/enhance SOC levels on the farm's grassland.
- Farmers implement the agreed management actions (carbon sequestration factors); keep records and send in reports according to agreed reporting requirements.
- The farm is visited at least twice a year where status of carbon sequestration factors is 'measured', opportunities discussed, and obstacles addressed.

- C-sequestration levels are assessed (based on the above-indicated indicators and compliance requirements) and paid once a year during the 10 years of the life of the initiative.

Rewards: A hybrid model with a combination of action-based and result-based payment is recommended – so that investments, efforts and management changes towards increased carbon sequestration are and rewarded, while actual carbon sequestration is also rewarded, based on indirect SOC measurements and proxy-indicators. This part of the payment would be based on a set rate of € per t of sequestered carbon, as long as eligibility and compliance criteria are met.

Funding and governance: Grasslands schemes can potentially be financed with public funds, as part of private sector supply chain efforts, or through external sales of credits/certificates. The governance and MRV requirements will vary according to the type of funding and payment scheme.

Conclusions

- Despite the challenges, the size of land under grasslands in Europe and the overall potential to deliver significant and efficient climate impact, makes carbon farming in grassland an interesting option to explore. The following elements are key enablers of successfull result-based initiatives on grasslands:
- **A farmer-centred approach**, building on effective, practical and relatable solutions that fit into what the farmers are already doing, decreases the barriers for uptake and enhances the likelihood of permanence. It furthermore facilitates learning, revisions and adjustments towards a more effective scheme developed over time.
- **Recognizing investment and efforts** made to increase carbon sequestration — as opposed to rewarding only the carbon sequestered at the end of the initiative — increases farmer engagement.
- **Recognizing co-benefits** like biodiversity enhancement, water retention capability and reduced soil erosion - and using these as proxy-indicators for carbon sequestration, enhances farmers' ability to see where they can improve their management practices to increase carbon sequestration.
- **Designing an initiative that optimizes the economic** benefits for the farmer beyond the carbon sequestered and that limits (real or perceived) additional costs associated with participation in the initiative, will also increase uptake.
- **A transparent and relevant payment scheme builds** trust and engagement.
- **A cost-effective, understandable and non-burdensome MRV scheme** removes (at least some) of the transition costs and administrative burdens for the farmer, hence, facilitating uptake and permanence.
- **Providing trusted advisory services** to the farmers during design and implementation of the initiative builds trust and enhances the likelihood of farmers applying the most optimal management procedures.
- **Working with farmers to raise awareness of the benefits of SOC sequestration** for the farming business and as a societal climate action to mitigate climate change enhances farmers' interest and pride in being an active partner in the common fight against climate change.

1. Introduction

The grasslands case study aims to cover all elements necessary to establish result-based carbon sequestration payment initiatives on grassland (schemes, projects or policies) in an EU carbon farming context. The intention is to provide insights and guidance on key design elements, implementation approaches and enabling factors to design and implement result-based carbon farming initiatives on grasslands. It outlines the steps and considerations a scheme manager - a regional authority, national government, or private initiative - will need to take to establish such a scheme, identifying key trade-offs and open questions to be considered and further analysed in order to set up long-term sustainable result-based carbon sequestration schemes on grasslands.

The case study will present the implementation design considerations of result-based payment initiatives for the delivery of climate benefits through grassland management, which can maintain and increase soil organic carbon (SOC) storage, plus avoid emissions from conversion of grasslands to cropland.

Grasslands are diverse in terms of agro-ecology, usage (e.g. grazing, no-grazing), socio-economic value, etc. For simplicity, and in order to be able to provide applicable guidance for setting up grassland initiatives, we consider four overall categories of land use and management changes that we need to take into account when discussing carbon sequestration on grasslands. This includes

1. the ongoing management of existing grasslands;

2. the conversion of 'fallow/set-aside' areas to grasslands;

3. the replacement of annual cropland by grassland, including marginal arable lands such as sloping land or shallow soils, which are especially suitable for grasslands management;

4. the avoided emissions from avoided conversion of grasslands to arable land on soils that are suitable for cultivation.

So overall, there are four major grassland management categories that should be considered when discussing key elements for setting up schemes for result-based climate action on grasslands.

Table 1. The four overall categories of land use and management changes to be considered when discussing carbon actions on grasslands.

Category	Key climate action feature
1) Grasslands remaining grasslands	Maintenance and increase of carbon on existing grasslands, e.g. as improved pasture, via sown biodiverse pastures and/or improved grazing.
2) Conversion of fallow/'set-aside' areas to grasslands	Conversion of fallow/'set-aside' areas to enhance biodiversity and carbon-sequestration in grasslands.
3) Replacement of arable cropland with grasslands	Ceasing arable cropping and converting to grasslands, e.g. for grazing and/or restoration to high nature value areas.
4) Grasslands remaining grasslands – avoiding conversion of grasslands to arable land on land suitable for conversion to crop cultivation	Avoided emission due to avoidance of conversion of grasslands to cropland.

Changes in carbon on managed grasslands can happen in two main pools: soils and biomass. The grasslands case study will be looking at the changes in SOC, and not at the changes in biomass. This is because biomass is subject to high fluctuations, due to natural as well as man-made disturbances, and therefore cannot ensure permanence.

Estimating the carbon sequestered in grassland in a reliable way is complex for a number of reasons. Climate benefits differ depending on the soil type, the climate, previous land use and subsequent management practices (e.g. fertilizer input, soil disturbance and grazing intensity). Furthermore, to ensure permanence, grasslands need to be maintained for a long period of time, typically for decades, with minimum disturbance (cultivation and re-seeding will release some of the carbon that has been sequestered). The fact that there are only a few (current or past) result-based initiatives rewarding carbon sequestration on grasslands in Europe to learn from, adds to the challenge of designing feasible initiatives. Most existing result-based schemes on grasslands focus on biodiversity enhancement.

Therefore, the grassland case study is based on a literature review of these initiatives, combined, with insights gained from interviews with experts, developers, practitioners and the scientific community involved in grasslands management, and in particular in result-based schemes focussing on biodiversity. In addition, the few existing carbon sequestration initiatives on grasslands have been taken into account.

The case study mainly draws on experiences from result-based schemes for biodiversity enhancement, such as the Burren Programme in Ireland and the Results-Based Agri-environmental Payment Scheme (RBAPS) in Ireland and Spain. The Sown Biodiverse Pastures Project on grasslands financed by the Portuguese Carbon Fund provides experience and insights on setting up and managing carbon sequestration initiatives on grasslands with results-focused rewarding schemes using indirect measurements[1]. Private sector supply chain sustainability actions such as Aral Food's sustainable dairy project, as well as the CARBON AGRI and the Finnish Climate Action scheme hold learning elements for some of the key driving schemes and MRV that are relevant for result-based carbon sequestration initiatives.

Result-based payment initiatives for carbon sequestration on grasslands can be designed in various ways, and in principle each initiative should be tailor-made to the specific environmental, social and political context. This case study explores the design elements that the existing (mainly biodiversity enhancement) initiatives have experienced as key drivers and barriers for uptake. In addition, this report discusses how the design elements of result-based schemes focussing on biodiversity could be adapted to develop schemes rewarding *carbon sequestration* in grasslands.

Definition of grasslands

UNESCO defines grassland as "land covered with herbaceous plants with less than 10 percent tree and shrub cover." We follow the slightly broader and widely accepted definition by Peters et al. (2014) which links the definition of agricultural grasslands to grazing. We therefore define agricultural grasslands as: *"land devoted to the production of forage for harvest by grazing/browsing, cutting, or both, or used for other agricultural environmental services such as recreational purposes… The vegetation can include grasses, grass-like plants, legumes and other forbs (herbaceous flowering plants that are not graminoid). Woody species, shrub/tree cover, may also be present, spontaneously or purposefully planted, as long as the predominant vegetation is 'grasses'. Grasslands can be temporary or permanent."* Permanent grasslands are, according to EU definitions, grasslands that are covered by grass for five years or more. Meadows are grasslands that are harvested predominantly by mowing; pastures are grasslands that are harvested predominantly by grazing.

Grassland conditions could include categories such as: native, extensively managed grasslands, grasslands subject to woody encroachment, moderately and severely degrading grasslands, intensively managed and improved pastures.

2. Exploring options – choosing the approach

Putting the case study in context

Role of grasslands in a climate change mitigation context

Grasslands are a significant storage and potential sink of carbon within Europe. Grasslands are also responsible for the protection of important flora and fauna and supply numerous other ecosystem services including flood and fire management, erosion control, and water purification. Modifying or converting grasslands has the potential to emit significant emissions.

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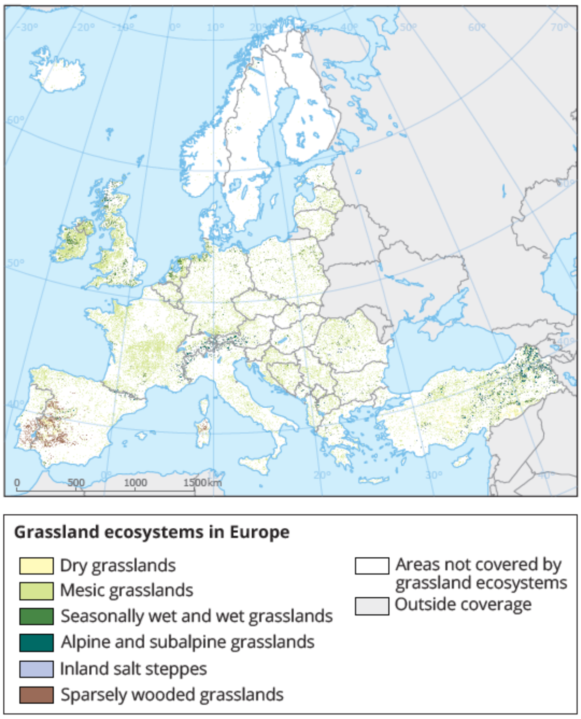
[1] See the introduction to the programme in the following link: https://www.youtube.com/watch?v=WR4tINbSXp4

In Europe, nearly all grasslands have been altered by human activity to varying degrees of intensity. The extent of permanent grasslands is quite small in comparison to the overall grassland area. Permanent grasslands are most likely protected for their characteristics as highly valued habitats for endangered species (Silva, 2008). Grasslands range from semi-natural pastures or meadows, which include high biodiversity and may be used for livestock grazing or mowing, to extensively managed grasslands. Grasslands cover more than a third of the total agricultural area in Europe and play a vital role in feeding the livestock sector within the EU. Roughly 40% of the annual animal feed needed for livestock within the EU comes from dry grass (Velthof et al., 2014). Between 1990 and 2003, the area of grasslands in the EU declined by 12.8% resulting in major losses of biodiversity; grasslands are distinctly species-rich and can have up to 80 plant species per m² (Silva, 2008). Figure 1 shows the distribution of grasslands across Europe within six ecosystem categories.

Figure 1 Grassland ecosystems in Europe



Source: EEA, 2016

The recent IPCC Climate Change and Land report identified that soil carbon sequestration on grasslands and agricultural lands – through improved grazing land management – offers a global potential annual GHG mitigation opportunity of 0.045 GtC per year. The range for the potential increase in SOC for the broader category of land management of soils, which covers the other grassland mitigation pathways, is 0.4-8.6 $GtCO_2eq$ per year (IPCC, 2019).

In terms of emission savings from maintaining current stocks of SOC under grasslands, the 2016 data reported an estimate of 41 $MtCO_2eq$ sequestered on mineral soils under grasslands for the EU. This estimate is mainly associated with sequestration due to land use changes of cropland to grassland (Paquel et al., 2017).

However, depending on how grasslands are managed or impacted by natural and human events, they can also be a net source of emissions, resulting in a decrease of the reservoir. In other words, grasslands may have a net negative or net positive impact on the climate, depending on their characteristics and management. The level of climate benefits differs depending on climate and biophysical conditions, previous land expenses and uncertainty of measuring use and subsequent management practices (e.g. fertilizer input and grazing intensity) as well as the production system involved. The largest potential for grasslands is associated with grazing management, biodiversity enhancement, e.g. through sown biodiverse pastures, agroforestry established on grasslands, prevention of conversion of grasslands to arable land, and conversion from arable to grasslands.

The highest potential is on degraded soils where SOC has been depleted; soils with high SOC content that are close to local saturation may not sequester further significant amounts (FAO & ITPS, 2015. For such soil types focus should be on preventing SOC losses (FAO & ITPS, 2015).

In addition to climate impacts, sustainable grassland management can deliver significant co-benefits, including biodiversity conservation and improved soil productivity and pasture yields.

Some of the key challenges towards designing an effective grassland carbon sequestration rewarding system include costs and uncertainty of measuring changes in soil carbon, which would be the basis of a result-based payment. Related to this, another challenge relates to establishing cost-effective MRV across different geographies/contexts where spatial variations in SOC are significant. Ensuring permanence is also challenging, because of the reversibility of soil carbon gains plus the long timescales before significant carbon changes can be reliably detected. Adding to this are relatively significant knowledge gaps due to few existing initiatives to learn from.

Despite the challenges and concerns about the cost-effectiveness of result-based carbon farming initiatives on grasslands, especially in comparison to more well-established initiatives, there is still significant climate impact potential. The scale of the grassland area in Europe and the overall capacity for grasslands to deliver efficient GHG mitigation means it is worthwhile exploring options for setting up carbon sequestration initiatives for grasslands.

Rewarding – result-based, activity-based or a hybrid approach?

Can the aforementioned barriers and uncertainties be addressed sufficiently and do the advantages of result payments outweigh the disadvantages, or are hybrid payments more likely to be successful for uptake?

Table 2 gives an overview of the main advantages and downsides of setting up result-based initiatives for SOC sequestration on grasslands.

Table 2. Advantages/disadvantages of result-based schemes relative to traditional, activity-based approaches on grasslands.[2]

Advantages	**Disadvantages**
Farmer flexibility: Result-based schemes allow farmers to manage their grasslands without prescriptive rules and set management actions. This increases their flexibility and leaves room for adjustment/ design to fit with the existing farming system. **Monitoring can provide a useful feedback loop** to farmers and increase their knowledge and ability to manage their grasslands for multiple impacts, including SOC levels, but also improved pastures and enhanced biodiversity. **Payments** are clearly linked to impact, which can provide for better efficiency and value for money for the use of public or private funds. The approach can be **applicable to a broad range of activities.**	There is still **uncertainty** in the estimation of the potential for SOC sequestration at the granular scale that is relevant for farm-level initiatives. Quantification of SOC improvements is dependent on data being available for a number of parameters; given this, the design of the scheme is more difficult. Existing methods cannot accurately measure how quickly carbon accumulates on a particular farm. The MRV component in result-based schemes can lead to **increased administrative efforts and skills requirements** compared to action-based schemes, to gather sufficient data and enable monitoring and verification of results. **The costs of MRV** for SOC measurements are currently high and depending on who bears the costs, may involve financial risk for farmers. Result-based schemes are more **knowledge-intensive** and have potential **risks for farmers if the payments do not materialize** due to insufficient (detectable/measurable) amounts of carbon sequestered by the end of the initiative. Since the highest potential is on degraded soils where SOC has been depleted, there is the **risk of making the farmers with good agricultural practices disadvantaged** since they will be closer to the carbon saturation state already at baseline and will, hence, not be able to increase SOC significantly.

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[2] Action-based management refers to when farmers are paid for implementing climate actions, independently of the resulting impact of those actions.

In practice, many schemes have been designed to combine both payments for management actions and payments for results in ***'hybrid' schemes*.'** Typically, in these types of initiatives, part of the payment is based on the successful delivery of results, but some specified management actions are also required, and recognized in the form of payment during the course of the initiative. For grasslands, where the realization of the change in carbon takes an extended period of time (maybe even beyond the lifetime of the project/initiative), this approach could/should be considered – in order to increase the incentives for the farmers to participate.

Policy context

The ways in which the EU protects grasslands is embodied in regulations spanning from agriculture to biodiversity and species management. The standout policies are the EU Common Agricultural Policy (CAP), the Financial Instrument for the Environment (LIFE) and the Environmental Impact Assessment (EIA) Directive.

The 2014-20 CAP constrains to some extent the conversion of grassland to arable, protects permanent grassland in Natura 2000 areas (and elsewhere if Member States choose to do so), and offers a wide range of payments to farmers for the environmental management of grasslands through Pillar 1 greening requirements, agri-environment-climate contracts and related RDP measures. LIFE partially covers grasslands but does not specifically define or mention grasslands within the Directive, (unlike the Renewable Energy Directive which has certain criteria to protect highly biodiverse grasslands) although there have been several LIFE projects linked to result-based schemes for HNV grasslands. The EIA Directive covers a wide range of project types and provides some protection against conversion of semi-natural grasslands to intensive agriculture (King, 2010). The Birds and Habitats Directives provide a higher level of protection for semi-natural grassland habitats and species within Natura 2000 sites with dual benefits for grassland management.

Various Result-Based Agri-Environment Schemes (RBAPS) have been developed across Member States under Pillar 2 of the CAP or using national funds.

The Farm to Fork and the Biodiversity 2030 strategies published in 2020 are part of the European Green Deal which recognize the importance of nature-based carbon sinks and rewarding farmers engaged in carbon farming for climate change mitigation. Several initiatives are therefore expected as a result of these strategies that will shape the policy context in the coming years for carbon sequestration, including funding under CAP for carbon farming.

Annex 10 offers an overview of EU legislation and policies most relevant for the protection, use, and restoration of grasslands within the EU. Most of these are implemented through national legislation. Box 1 links carbon sequestration activities in grasslands to national GHG inventories.

Box 1. Connecting grassland carbon sequestration initiatives to national GHG inventories.

The requirements for reporting of grasslands has shifted over time since the 1996 IPCC Guidelines where only emissions from tropical savannah burning and changes to biomass from converting grassland to another type of land use had to be accounted for.

According to the IPCC Good Practice Guidance (GPG) developed in 2003, grasslands were included within LULUCF reporting guidelines. The 2006 updated IPCC guidelines expand upon the 1996 guidelines to include among others, fires and natural disturbances on managed grasslands as well as methods to analyse C stock changes in two main pools in grasslands: biomass and soils. Emission data must come from 'Grassland remaining Grassland' and 'Land Converted to Grassland'. If data is not readily available, grasslands should be classified as 'Grassland remaining Grassland'.

New LULUCF accounting rules entered into force in July 2013, following the agreement within the UNFCCC at Durban in November 2011 on new accounting standards for soils and forests. The new legislation phases in mandatory accounting for grassland and cropland management at the level of member states. Accounting for the draining and rewetting of wetlands will remain voluntary, as in the international context. It requires member states to report on their actions to increase removals and decrease emissions of GHG from activities related to forestry and agriculture. Importantly, the regulation makes clear that LULUCF targets will only be set once the accounting rules have been validated.

While GHGIs require reporting of grassland encompassed in LULUCF, the reporting remains centred on the changes in biomass due to converted grassland. Soil carbon methodologies are more developed in the 2006 IPCC Guidelines and Tier 1 C stock change is more prominent in the inventories in order to adapt to a more developed understanding of soil carbon and its estimation (IPCC, 2006).

Volume 4 in the updated IPCC Guidelines (IPCC, 2006) is devoted to the reporting of grasslands but it is necessary to consider the project level reporting and if they can align with the GHGIs. In some countries, if there are carbon credits on a scheme level they can also be claimed at a national level, e.g. emissions trading. This can result in the issue of double counting.

3. Feasibility, support and enabling scheme development

This chapter discusses the enabling factors that are necessary to ensure the feasibility of carbon sequestration initiatives on grasslands, including design, set-up, governance, as well as other issues relating to the engagement of farmers and other stakeholders , advisory services and knowledge sharing associated with operating a grasslands carbon sequestration scheme. Again, the observations in this chapter are mainly based on experiences from initiatives focusing on result-based biodiversity enhancement on grasslands.

The feasibility of the scheme relies on a range of factors, some of them depending on the socio-economic context in which the initiative takes place. The following enabling factors are key to the overall feasibility of result-based schemes:

- 'Relatability' for the involved farmers, i.e. the extent to which the initiative makes sense to farmers and the extent to which the initiative is connected to ongoing farm activities;
- Low risk for farmers of not receiving the expected payment (especially if the initiative is strictly result-based and the farmer is only payed based on the amount of carbon sequestered at the end of the initiative);
- Simplicity and limited administrative burdens for farmers in order to participate and comply with the rules of the scheme;
- Low transaction costs and related economic and/or knowledge barriers for uptake;
- Coherence and compatibility with other (parallel) initiatives (and/or policies and regulations);
- Low uncertainties with regards to the actual potential for carbon sequestration on the farms, and with regards to measurements and robustness of MRV;
- Fair baseline and target setting (considering that degraded areas with low carbon content have higher carbon sequestration potential than land that has been managed well and is closer to carbon saturation. Hence, indirectly disadvantaging farmers with good agricultural practices).

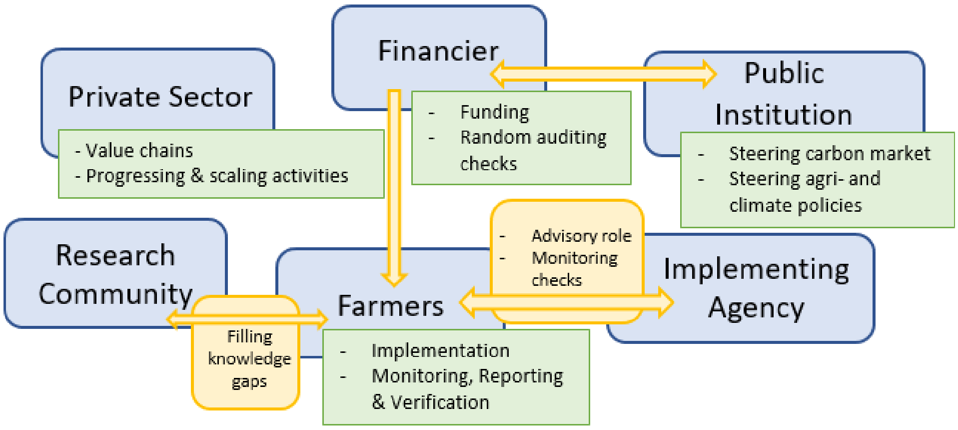
The likelihood of success and overall feasibility of an initiative furthermore depends to a large extent on management practices and agro-climatic conditions. The success rate will be higher where the potential for carbon sequestration is large (e.g. degraded, overgrazed grasslands, where the change occurs faster and the total amount of carbon sequestered leads to higher rewards). Besides, on such land, the reward – transaction cost ratio is more favourable and uptake and permanence more likely. Linked to this, the availability of nutrients, and the impact of water on the carbon sequestration capacity will influence the rate of success. All other factors being equal, the potential will be lower in areas with lower precipitation and limited biomass growth due to water scarcity. However, even smaller increases in carbon sequestration in such areas can have significant climate impacts due to their large geographic coverage, and from a public policy perspective are desirable from an overall climate perspective. Such considerations will need to come into play when designing the rewarding schemes.

The more specific the knowledge on the potential for sequestration is at a regional (or even better, farm-level), the more straightforward the design of the initiative is. This provides for a more transparent determination of targets and a transparent (and fair) reward scheme.

Governance and institutional capacity

Good governance starts with a stakeholder analysis to ensure that the full landscape of stakeholders and their needs are assessed and addressed. Figure 2 shows the key stakeholders and the roles they could play in a result-based carbon farming scheme.

Figure 2. Landscape of stakeholders and agents.



The key stakeholder categories are the following:

- ***Private sector/public institution/financier*** - government (national, regional, local), civil society organizations, private entities and international bodies involved in funding, implementing and/or overseeing the intervention. These actors are also steering the agri- and climate relevant policies and the carbon market schemes;
- ***Farmers/beneficiaries*** – they could be individual farmers or a collaboration of farmers (groups or organizations) jointly implementing the initiative;
- ***Advisory/implementing agency*** – it could be a local organization managing and supporting the implementation of the scheme, for instance by providing advisory services and facilitating or conducting the monitoring of the implementation progress;
- ***The research community*** – it is important for filling the knowledge gaps together with the farmers and the implementing agency.

Initiatives are more likely to succeed and will be more efficient and impactful in the long term if farmers have been actively engaged in the design of the initiative. Preferably, the design is an action-oriented process where designers and farmers work together to e.g. set the most optimal objectives, targets and means of verification. As a minimum, the scheme designer should consult with the key stakeholders (farmers and others) to understand their views.

The level of required certainty on the actual level of carbon sequestration depends on the objectives of the initiative. If schemes want to develop verified, fungible offset credits or verified emissions reduction certificates, schemes must meet the standards set by external verifying authorities, like Gold Standard and Label Bas-Carbone.

Schemes that do not seek external funding can be more flexible in their governance structures. Arla Foods’ Climate Check Programme, for instance, is a scheme that aims to reduce its emissions by 30% by 2030. The programme is currently action-based rather than result-based. As it does not develop credits or emission reductions, external verification and validation are carried out internally. In order to be credible and transparent in the eyes of consumers, Arla has made documentation of the Foods’ Climate Check Programme publicly available and supports its assessment by scientific research projects. At the same time, the standards are not as prescriptive as in externally funded schemes.

Table 3. Illustrating governance throughout scheme development and operation – who does what to secure a robust scheme?

Key actors	**Description**	**Responsibilities**
Policy/regulatory entity/governing bodies	Could be a public institution.	Steering agricultural climate policies, carbon credits and related policies.
Financiers	Could be a public or a private body (e.g. for value chain driven initiatives).	Financing/rewarding scheme.
Advisory/initiative manager	Develops and oversees the implementation of the initiative. Could be a regional/national authority, association, downstream company, or other.	Design and revision of the scheme, including setting the baseline and targets together with farmers, supervising and advising farmers, training, carrying out administration tasks, random/targeted auditing, managing the registry and the payment, carrying out outreach and communication activities, administration of financing (including credit scales).
Farmers/beneficiaries	Carry out climate actions and receive the related payment.	Carrying out climate actions. Collecting data, self-monitoring and reporting on agreed targets.
Research community	Engaging with farmers to fill knowledge gaps and initiate pilot initiatives	Filling knowledge gaps
Other stakeholders	Credit buyers, external verifiers, …	

Advice, knowledge transfer

With result-based schemes, farmers are asked to take risks and develop new knowledge. Therefore, they should receive advice. Initiatives like the Burren Programme and grassland carbon sequestration projects under the Portuguese Carbon Fund showed the crucial importance that capacity development and advisory support have played for their success. Another important source of information and learning is collaboration between farmers, which could be fostered e.g. by organising meetings and creating occasions for networking and peer-to-peer learning.

Farmer engagement

Farmer engagement is crucial for uptake and long-term sustainability/ permanence of any initiative on farmland. Removal of barriers to uptake, and optimization of drivers and engagement factors are therefore important for long-term sustainability and permanence of impact.

Barriers to uptake

Barriers to farmer uptake arise from mainly two areas: 1) (perceived and real) financial concerns and 2) uncertainty and complexity of the initiative and the impact it may have on the overall farm practices.

Depending on the complexity of the initiative, farmers may face significantly increased transaction costs, particularly in the initial phase of the scheme. Such increases are caused by changes in farming practices and additional MRV requirements which may require more training, complex whole-farm changes in farming techniques, the need of further advisory services and additional administrative efforts. If real or perceived costs exceed real or perceived advantages or income streams, farmers may be unwilling or unable to participate in carbon farming initiatives.

Secondly, **uncertainty and complexity** of carbon farming schemes and their integration into existing legislations and farming practices may act as a further deterrent to uptake. Uncertainty within the context of result-based initiatives primarily stems from the difficulty to measure the link between climate actions and outcomes (see Chapter 5). This can lead to risk for farmers, as changes in their management practices may not lead to the expected climate impacts and related payments. This can be a major barrier for farmers' engagement. In addition, external factors may reverse climate actions. For example, wildfires may revert carbon sinks. Uncertainties may also be caused by the design of the reward scheme. For instance, market-based schemes come with price fluctuations, while non-market-based schemes depend on funding situations and political will.

The design therefore needs to identify solutions that can lower, cover, or alter farmer's costs, including both initial investments and operational costs. Costs can be lowered through various schemes, especially concerning administration and MRV as well as by offering flexibility. Administrative efforts can be decreased by aligning the scheme with other policies or by allowing farms to group together and act as a single project, reducing collective administrative costs. Similarly, compliance testing can be designed in cost-effective, smart ways, for example by randomized compliance testing of only a few participants (potentially hand in hand with higher fees for non-compliance to incentivise action). Flexibility schemes can also play an important role to lower costs. For instance, initiatives can offer several tiers of ambition or require different actions and MRV for farms of different sizes. Alternatively, **administrators/ regulators can bear investment costs** for farmers as a way of encouraging uptake.

Finally, apart from lowering and covering costs, initiatives can aim at **raising awareness** around carbon farming so that additional costs appear in a different light. This can take the form of awareness raising on the importance of climate actions or providing information on co-benefits of carbon farming practices, thereby shifting farmers' perceptions.

Upscaling engagement

The Burren Programme in Ireland – an example of a successful result-based initiative for biodiversity enhancement – started as a result of a PhD research, looking at the local farming sector and state of the environment, and in particular at the ongoing land abandonment process and environmental degradation. The initiator, Dr. Brendan Dunford, started to talk with farmers and explore their needs. This process led him to conclude that a **farmer-centred approach** would be the only feasible way of establishing a long-term sustainable initiative with engaged farmers. The initiative started by addressing immediate needs like re-establishing stone fences around fields, and then step-by-step integrating biodiversity and sustainable farming practices. It developed over many years, designed around the farmers, into a result-based scheme co-funded by the current Ireland RDP.

One important aspect for actively engaging farmers, is the **recognition of efforts**. It takes a long time before results can be verified, so it is important to recognise, and reward, the efforts made by the farmers. In addition, it is important to not only pay for concrete results, but also to account for the decision to shift the farming system towards enhanced environmental management practices, as well as for the specific actions and management to achieve the verified result. Another key to active involvement and the maintenance of long-term engagement of farmers, is the **flexibility** that result-based payments offer them to choose the most appropriate management and necessary changes of practices to deliver results.

Plans should be visual and simple, relevant and relatable; reporting should not be an administrative burden to the farmers.

As an example of support, farmers have free access to advisory services from the Burren Programme staff who have been available as dialogue and guidance partners.

Cooperation and stakeholder engagement

Literature review and advice from interviews with stakeholders from existing result-based initiatives all pointed to one key factor as the main enabler in establishing effective schemes: multi-stakeholder engagement. Active involvement of farmers is important as well as the dialogue between them, researchers, and advisors. This has been key to establishing and operating innovative result-based biodiversity enhancement strategies on grasslands. The same would apply to result-based schemes for carbon sequestration in grasslands.

The farmers engaged in the Burren Programme because they felt that their voices were heard, and their needs understood. The engagement of the Public Service Ministry has been more challenging, and it took time to convince them that the initiative (and the financing involved) was a risk worth taking. The Ministry ended up financing the programme with funds from the EU (DG Agriculture). The strong evidence base for the programme, along with strong farmer support, was enough to convince the Ministry to invest, and the verifiable success in subsequent years ensured that the funding continued and, in 2016, expanded (using National and EU funding). The usual 'distrust' that many farmers felt toward the Ministry was mitigated by the establishment of a local office to deal with administrative and technical issues. This has through time even increased the trust between farmers and the public authorities because farmers during the programme have witnessed and benefitted from the engagement of the public sector.

Likewise, interviewees from the Sown Biodiverse Pastures projects under the Portuguese Carbon Fund pointed to the importance of collaboration and a supporting advisory service as a central theme to uptake and long-term engagement by farmers.

Key engagement factors:

- Informed farmers;
- Advisory service with a good relationship with the farmers - preferably a team with a local base and which is trusted by the farmers;
- A supporting Ministry/agency; and
- Building trust and systems that reinforce trust and reliability.

4. Setting scheme objective and demonstrating additionality

Objective setting

Designing holistic and implementable climate actions that take account of farm economics, environmental, social, cultural considerations and legislative requirements, puts high demands on the initiative designers. Understanding the potential and the most relevant practices in a specific context is the basis for setting the objectives and designing an initiative that takes account of the spatial and temporal complexity, reflecting soil types, climate, and management conditions. Beyond that, the following basic principles could guide the design of feasible, acceptable and implementable carbon credit rewarding initiatives on farmland:

- Project developers need to actively engage farmers in the design of the initiatives;
- The initiative should be voluntary;
- The objectives must be formulated in a way that is comprehensible to the farmer and can be measured and examined by both the advisor and the farmer;
- The objectives need to be as targeted as possible. For example "Zero soil disturbance" is more understandable and measurable than "Improvement of soil quality".

Additionality

Additionality, in the context of a carbon crediting scheme, requires that a project must generate environmental benefits above what would already be occurring without the implementation of the policy scheme. The Clean Development Mechanism (CDM), developed under the Kyoto Protocol and one of the first international carbon offsetting schemes to involve land use, outlined that additionality is determined by: *"(a) voluntary participation approved by each party involved; (b) real, measurable, and long-term mitigation benefits; and (c) reductions in emissions that are additional to any that would occur in the absence of the certified project activity"* (Fenhann & Hinostroza, 2011). The additionality requirement acts as a safeguard so that landowners are rewarded only for genuine credits that go above and beyond the business-as-usual (BAU) scenario.

For grasslands, additionality covers the emissions avoided if grasslands are not converted to cropland. Additionality also covers the additional carbon sequestered as a result of increased maintenance of grasslands as well as the carbon sequestered as a result of conversion of annual cropland to grassland. Methodologies to calculate SOC are currently being improved, and future developments will improve accuracy and reduce costs (see the case study on maintenance and enhancemeng of SOC in mineral soil – Annex III). In general, there further research is needed to analyse how improved grassland management, especially with regards to grazing land, affects soil carbon stocks (Conant et al., 2017).

The Climate Action Reserve (CAR)[3], and American carbon offset registry, calculates SOC using the DayCent method, which is a model of medium complexity used to simulate carbon flows in grasslands (Del Grosso et al., 2011). The baseline calculation through CAR is divided into emissions from fossil fuels from cropland management or conversion and loss of SOC due to conversion to cropland. Carbon sequestration as a result of management is not factored into the baseline. This is an important consideration for future schemes. The determination of a method to consider increases in SOC due to improved management and grassland conversion is necessary in designing a scheme that fully embodies sequestration options for grasslands. The key will be to have a scheme in place that quantifies emissions/true sequestration, but also does not discourage participation of farmers.

In the California Carbon Crediting Mechanism, for example, baseline and additionality setting is conducted using a top-down approach; external verifiers are responsible for conducting emission calculations at the site, instead of the farmers. This again follows the principle of reducing the costs at the farmer level in order to encourage uptake.

Eligibility

Due to the aforementioned risks of fast reversal of the sequestered carbon in grasslands, a willingness to commit to permanence should be part of the eligibility criteria and included in the contracts with the participating farmers. This 'permanence criteria' would be applicable to grasslands initiatives on all the afore-mentioned grasslands categories.

For category 4 – avoided emission due to avoidance of conversion of grasslands to cropland on land suitable for cultivation – there are special additional considerations to take into account with regard to eligibility.

One of these eligibility considerations is that the project area must be grassland, and it must be suitable for conversion to crop cultivation. The area must have been under continuous grassland cover for at least 10 years prior to the start of the initiative. The baseline scenario would be conversion to crop cultivation.

Beyond that, it is debatable whether there should be an obligation to carry out specific management practices in order to be eligible to participate in the initiative, or whether each farmer should be free to choose the type of management to meet the objectives and the targets set for the initiative. In the above-mentioned Burren Programme, the farmers were free to choose what they found the most suitable management practices to reach the set of biodiversity enhancement objectives. The main argument being that this allowed for the highest flexibility, transparency and ownership on farmers' side – leaving it up to them how much, and in which way to influence the result of their engagement. In the Sown Biodiverse Pastures under the Portuguese Carbon Fund, the farmers were obliged to follow agreed management practices which during

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[3] http://www.climateactionreserve.org

piloting had demonstrated efficiency in changing/enhancing carbon stocks on pilot farms.

Box 2. The Sown Biodiverse Pastures Project under the Portuguese Carbon Fund

One example of a widespread, large-scale incentive for carbon sequestration in pastures took place in Portugal. Between 2009 and 2014 the Portuguese Carbon Fund (PCF), a financial instrument created by the Portuguese Government to help the country comply with Kyoto targets, financed projects for carbon sequestration in pastures.

In two of these projects, the PCF supported the installation and maintenance of sown biodiverse permanent pastures rich in legumes through a system of payments for carbon sequestration.

50,000 new hectares of Sown Biodiverse Pastures were sown under the project between 2009 and 2012, contributing to the sequestration of 1 million tons of carbon. 1000 farmers participated in the scheme.

The primary eligibility criteria to participate in the project was that farmers would meet compulsory Good Agricultural and Environmental Conditions (GAECs) resulting from the CAP reform. Other eligibility and participation criteria included ensuring high biodiversity grassland and a high share of legumes. In addition, farmers had to demonstrate the required persistence in following the project up to the term of the contract, accepting responsibility for all the operations and methods used.

5. Choosing result indicators and MRV

Table 4 illustrates the specific objectives and possible result indicators for different kinds of carbon farming schemes for grasslands.

Table 4. Objectives and indicators for different categories of grassland management options

Grasslands category	Specific objective	Possible result indicators
Category 1 Grasslands remaining grasslands	To maintain and increase carbon on existing grasslands, e.g. as improved pasture, via sown biodiverse pastures and/or improved grazing.	Direct measurement is not an option for farmer assessment but for scheme evaluation. Pilot testing of indirect indicators can be used to adapt indicators or check if indicators are delivering the quality of grassland needed to achieve the desired sequestration. Proxy-indicators could include: ▪ Registered farm activities for which the potential of increasing carbon storage is known ▪ Enhanced biodiversity ▪ Increased water holding capacity ▪ Permanent ground cover ▪ Non-disturbance of soil and ground cover
Category 2 Conversion of fallow/'set-aside' areas to grasslands	Conversion of fallow/'set-aside' areas to enhanced biodiverse and carbon-sequestration grasslands.	Satellite imagery (vegetative images) of land before and after conversion. As above.
Category 3 Replacement of arable cropland by grasslands	To cease arable cropping and convert to grasslands, e.g. for grazing and/or restoration to high nature value areas	Satellite imagery (vegetative images) of land cover and utility before and after conversion. As above.

Category 4 "Grasslands remaining grasslands" – avoiding conversion of grasslands to arable land on land suitable for conversion to crop cultivation	To avoid emission due to avoidance of conversion of grasslands to cropland.	Avoided loss of soil carbon and the avoided emissions from fertilizer and fossil fuel usage related to crop production.

There are complex challenges associated with reliable and cost-efficient measurement of additional carbon in grasslands. One issue is the lack of a direct, quantifiable and verifiable link between management practices and carbon sequestration since changes occur over a long timeframe, are heterogenous and the amount of carbon sequestered depends on the baseline level of carbon saturation in the soil.

Selecting result indicators

Choosing transparent, relevant and relatable indicators is key to ensure farmers' acceptance and uptake. Indicators need to be site-specific, because carbon sequestration in grassland soil is highly dependent on the context.

In grasslands where management practices are static, biomass carbon stocks will be in an approximate steady-state, i.e. carbon accumulation through plant growth is roughly balanced by losses through decomposition and fire (IPCC, 2019).

In grasslands where management changes are occurring over time -e.g. through savannah thickening, tree/brush removal for grazing management, improved pasture management or other practices, the stock changes can be significant. However, information is not available to develop broadly applicable default rates of change in living biomass carbon stocks in grassland for these different management regimes.

With regards to category 4 – avoided conversion of grasslands to cropland – measuring the exact climate impacts of hypothetical conversion activities on the grassland area is not possible. In other words, it cannot be measured how much carbon would have been released if a particular area of grassland were converted to cropland. As a result of that, the use of proxy indicators is needed.

The Burren Programme faced similar challenges when deciding result indicators. Even though the program involved result-based payments for biodiversity enhancement, the counting of species was not used to establish the payment. Farmers were uncomfortable with counting species and found it difficult to relate to such indicators. Therefore, indicators like level of grazing, water source conditions, level of bare soil, etc. were used as proxy indicators that would release payment. The added advantage of using this type of indicators was also that these have more direct links to management and different ways in which the farmers could improve their scores.

Considering the correlation between enhanced grassland biodiversity (e.g. through sown biodiverse pastures with higher numbers of plant species, including legumes) and the capacity to sequester carbon (e.g. Kirwan et al., 2007; Fornara & Tilman, 2008; Teixeira et al., 2018)), similar, or even the same, indicators could be considered as proxy indicators for carbon sequestration on grasslands.

A monitoring scheme can be based on a combination of i) sampling through direct measurements, ii) use of proxy indicators and iii) registration of farm activities or indirect indicators of farm activities that have potential to increase carbon storage. The latter are more appropriate than (solely) measuring soil carbon as an indicator for assessing the contribution of specific practices to maintain or enhance soil carbon levels. There needs to be a balance between the costs involved and the robustness and reliability of the monitoring system. In addition, the benefits for different stakeholders need to be taken into account.

It has been argued that enhanced biodiversity could be used as a proxy indicator for carbon sequestration, because of the interlinkages between biodiversity, different grazing management schemes and carbon sequestration. However, the link between agricultural activities and changes in carbon storage is still uncertain due to scarcity of scientific evidence on the link between biodiversity protection, grazing and carbon-sequestration. All in all, both direct carbon measurement options and proxy indicators needs to be further researched.

In the meantime, a combination of indicators need to be agreed with the farmers during the design of carbon farming schemes. Such indicators need to be tested in pilots or early schemes.

Providing evidence for the link between biodiversity enhancement and increased carbon sequestration is challenging, because they are both dependent on a suite of interacting factors, including turnover rate, magnitude and long-term permanence of carbon stocks. The species present in a given ecosystem determine the carbon storage level due to, e.g. root structure, depth, chemical outputs and symbiotic associations (Díaz et al., 2009). For this reason, biodiversity is an important indicator and can be used as a stand-in for measuring carbon stocks.

Considering the importance of biodiversity and since reliable and measurable carbon sequestration indicators are still not available, we suggest to use biodiversity indicators as proxies for carbon sequestration.

The use of direct and indirect/proxy indicators are not mutually exclusive; assessment of existing (though not result-based) experiences with carbon sequestration on grasslands points to the most feasible being a mixture of the two.

Testing result indicators

In general, the impact of management on carbon sequestration in grasslands is still relatively unknown (Teixeira et al., n.d.). Specific management practices have different effects on carbon sequestration and need to be tested before their impact or an indicator can be established.

For example, the carbon sequestration projects under the Portuguese Carbon Fund adopted the following approach: firstly, it measured directly the impact of certain management practices on soil carbon on a set of pilot farms; then it used the results to develop a simulation model to establish the carbon sequestration resulting from the analysed practices. Those management practices were then used as indirect indicators for carbon sequestration. Based on that, only the compliance with those practices were monitored and used to establish the payment to the participating farmers.

Monitoring successes: the M in MRV

Effective monitoring of changes in soil carbon is required to document the provision of carbon sequestration services by farmers. The feasibility, reliability and cost of MRV is by far the most important challenge in relation to result-based sequestration initiatives for grasslands.

Despites all the challenges mentioned above, methodologies are being created to develop quick, low-cost, reliable and easy-to-apply techniques that help farmers and advisors monitor the effects of their management decisions on carbon sequestration and other ecosystem services. The best monitoring system must respond to the needs of the stakeholders involved.

The part of the costs borne by the farmers is of particular importance since it can turn out to be an unsurmountable barrier to uptake, if they are higher than the advantages and net benefits of being part of the initiative. A large uptake is important in order to create significant overall climate impact. The transaction cost considerations are therefore crucial, so that they do not constitute a barrier to farmers' decision to participate. To overcome this (potential) barrier, a less rigorous monitoring system, e.g. designed as a group exercise where results and progress towards results are discussed with farmers and an adviser, could be an option. This would allow farmers to provide feedback and to learn from the initiative and could contribute to the revision and adjustment of the initiatives.

Direct measurements using soil sampling and analysis, or indirect measurements using remote sensing, must be made over long periods of time if the change in carbon sequestered is to be described accurately. However, relying on long-term measurements alone for informing land management is impractical for farmers and policymakers. Following the logic and experiences of the Burren Programme mentioned above, a combination of direct and indirect measurements, plus the use of proxy indicators seems most feasible.

EU remote sensing and survey data - like the Copernicus Sentinel-derived data and the Land Parcel Identification System (LPIS) using high precision satellite imagery- can potentially be used for monitoring above ground carbon stocks. There are, however, currently several limitations in the available technology and capacities to monitor farm-level changes with respect to SOC.

Sentinel data cannot distinguish farm management practices related to livestock, e.g. manure application, or detect the level of detail to distinguish a multi-species grassland from single species grassland. Finally, although the satellite imagery used in LPIS can detect changes in land cover and land use (e.g. a change from cropland to grassland, to forest) remote sensing cannot detect SOC levels in a reliable way. Ground-truthing and combinations with on-the-ground surveys would therefore be needed. At present, the most feasible option to gather the input necessary to calculate changes in emission sequestration and avoided GHG emissions at farm level, is reliance on farmer-recorded and reported data on these management activities. The farm carbon audit tools play a key role here.

A large number of carbon audit tools are available at present, although there is variation in the coverage and robustness of these tools. There are a number of tools that are deemed technically suitable for farm-level carbon audits, enabling sufficient robustness, comprehensiveness and clarity of documentation. The case study Livestock Farm Carbon Audit (Annex IV) examines these farm carbon audit tools in detail, e.g. the Cool Farm Tool, JRC Carbon Calculator, Carbon Agri CAP2’er and other auditing tools and practices.

What can be said here is that farm level monitoring and bookkeeping can provide important learning experiences and a baseline for monitoring trends and effects of carbon farming. This data can be pooled and used as evidence / input for Member States to set up targets at regional and national level. If carbon audit data is collected on a carefully selected sample of farms, it could also provide a good learning ground for accounting purposes. And result-based carbon farming initiatives could in this way produce useful bottom-up data on what is feasible to achieve at farm level, across geographic zones, farming systems, and management approaches. Consequently, the understanding of the link between management options and measured SOC levels and, hence, associate climate benefits can be improved.

Reporting, verification and auditing: RV

It is good practice to implement quality control checks and external expert reviews of inventory estimates and data.

The key guiding principle for reporting should be that it is **administratively light** for farmers so as not to constitute a barrier for uptake.

Under the Emissions Reduction Fund in Australia (a voluntary scheme that provides incentives for farmers to adopt new practices and technologies to reduce Australia’s greenhouse gas emissions), farmers have to prove via collected soil samples, taken by qualified technicians and analysed by an accredited laboratory, that soil carbon sequestration is actually achieved through a new management action (e.g. rejuvenating pastures, changing grazing pattern, changing stocking rates, applying organic or synthetic fertilizer to pastures, changing pasture irrigation). Soil carbon stored must be maintained until the end of the permanence period (25 or 100 years) (Emissions Reduction Fund, 2017).

At the other end of the scale, e.g. under the Burren Programme, advisors visit farmers and monitor --via proxy indicators like level of bare soil, level of grazing-- implementation progress and contribution towards the program's overall biodiversity enhancement goals. The monitoring results (based on which the payments are granted) are validated by advisors from the public extension service.

The monitoring-cum-advisory meetings between the farmer(s) and the advisors from the implementing agency serve also as learning events where the farmer(s) build up their capacity to achieve an impact, and hence, rewards.

6. Paying for results

Due to the challenges mentioned before, a full result-based scheme for carbon farming does not seem feasible at this point in time. A hybrid scheme rewarding both actions taken and results achieved – with regards to co-benefits and actual carbon sequestered - would be more enticing to farmers.

Multifunctionality and 'beyond climate' co-benefits should be recognized in all grassland initiatives. Grazing grasslands contribute significantly to the rural economies of many countries in the EU and they are part of the cultural heritage. They also provide a range of valuable ecosystem services, for example providing fodder for herbivores, combatting soil erosion, regulating water regimes, improving long-term soil fertility, mitigating the effects of weather variability (e.g. floods and droughts) and thereby contributing to climate adaptation. In addition, they contribute to biodiversity conservation.

These co-benefits are valued by farmers and should be rewarded. As mentioned above, the scheme initiative designers should include such 'beyond climate' indicators in the rewarding systems, to make the scheme more attractive to farmers. Private sector actors may also want to enhance the branding of the products in their value chain, and as part of that, decide to directly reward farmers for the provision of both carbon sequestration and other co-benefits.

Reward calculation

Farmers may be reluctant to adopt practices that promote carbon sequestration in grasslands, due to real or perceived short-term losses in productivity, increased costs of operations, or other reservations. Some level of incentive - monetary or otherwise - may therefore be necessary to compensate (real or perceived) short-term losses in productivity or costs in the initial phases of the scheme, before results starts to materialize.

Incentives can be policy driven (e.g. EU, national or regional policies), market driven (e.g. direct and indirect valorisation by consumers and industries, e.g. through labelling and market positioning) or farmer driven (e.g. influencing social norms and the mind-set of farmers).

Setting up the payment scheme in a way that is transparent, relevant and relatable for the farmer is of crucial importance.

In some cases, using proxy indicators is to be preferred over measuring the desired outcome. For instance, even if the Burren Programme was a result-based scheme for biodiversity enhancement, it did not link payments to the number of species in the grassland. The reason is that farmers feel uncomfortable about counting species. Therefore, indicators like level of grazing, water source conditions, level of bare soil, etc. were used as proxy indicators to calculate the payment. The added advantage of using this type of indicators was also that these have more direct links to management activities and it made clearer for farmers how to increase their payment.

In areas with limited carbon sequestration potential, the payment levels per ton of carbon sequestered may need to be higher than in areas with higher potential. Likewise, in order to not disadvantage and disincentivize farmers that are close to carbon saturation levels (due to the application of good agricultural practices before entering the initiative), an increase in payment levels should be considered for those farmers.

The **timing of payments** involves trade-offs between farmer uptake and uncertainty. Ex-ante payments, based on expected climate impacts (i.e. paid after baseline is set), facilitates uptake but entail a degree of uncertainty for the schemes (the expected levels of carbon storage may not materialise), as well as a permanence risk. Ex-post payments i.e. paid after the end of the initiative, and based on the results achieved, increase the risks and uncertainty on the side of the farmer and may become a key challenge for uptake. A compromised approach may be the best solution, where farmers can receive up to a share of the expected reward after baselining and/or during the course of the initiative. The percentage should be set well below the expected reward (e.g. below 50%), to reduce the risk of non-achievement. This could be voluntary, as not all farmers will want to sign up to this, because of slightly increased complexity and legal obligations. The existence of additional economic benefits (in the form of efficiency gains) will somewhat decrease the need for an ex-post payment.

In the Terraprima-administered sown biodiversity pastures project under the Portuguese Carbon Fund, the additional benefits of enhanced pastures are significant and for many farmers adequate to continue the initiative beyond the three-year project period. The benefits they obtain are enhanced pasture productivity and livestock production, increased biodiversity, soil fertility and water holding capacity.

Mitigating the risk of impermanence: Since improvements in grazing management and associated increases in carbon sequestration are a long-term exercise, which can easily be reversed, it is important that carbon farming schemes take a long-term view that creates security and stability for farmers and ensure permanence/maintenance of the increased carbon stocks alongside carbon accumulation. Thorough understanding of farmers' perspectives and perceptions is essential to eliminate or at least reduce disincentives.

The review of existing incentive/rewarding schemes in result-based initiatives has shown that the most effective schemes combine monetary and non-monetary compensation, and include both short- and long-term incentives. For example, the Burren Programme uses a mix of acknowledging efforts and paying for results. In the projects under the Portuguese Carbon Fund, farmers who undertake the creation and maintenance of improved pastures are remunerated for carbon sequestration for plots above 2 hectares. The first two hectares are not paid in order to cover fixed costs for technical support and monitoring done by Terraprima, the company managing the project. The greater the total area sown each year, the greater the payment per hectare for each participating farmer will be. The payment can be cumulative with other support, e.g. for agri-environmental measures that promote biodiversity, among others. The Fund remunerates farmers through Terraprima after obtaining evidence of carbon sequestration.

Initiatives can also build on the methodology used by the Australian Emissions Reduction Fund, based on the measurement of carbon in the soil. The payments can be made either as a fixed price payment per additional ton of sequestered carbon or as carbon credits to be sold.

If the intention is to sell offset credits, the level of acceptable uncertainty is limited, since credit buyers need to trust that the credits that they purchase are matched by real, additional emission reductions or permanent carbon storage. This again increases the MRV costs, possibly to levels that jeopardize the feasibility of credit offsetting for grassland initiatives. Box 3 provides information on the potential role of market-based credit schemes to support carbon farming in grassland ecosystems. While there is little uptake with regards to grassland schemes, they still have major potential within market-based crediting schemes in the coming years due to the continued pressure on forest ecosystems. Not to mention, the EU is continuously ramping up its financial support to farmers and landowners that are implementing 'green' practices. Rangelands and grasslands make up a significant portion of the EU and preserving them involves low input costs.

Box 3. Role of market-based credit schemes

Market-based credit schemes create carbon credits that can be sold to private actors who aim to offset their own emissions. The demand for credits as well as an established market are vital in maintaining a market-based credit scheme, and they both represent barriers to implementation.

An advantage in developing a carbon offset market is that it encourages the development of protocols for the MRV of soil carbon changes.

In some cases, offsets from carbon crediting schemes can be traded in an emission trading scheme, such as in the California Compliance Offset Program (CCOP) which is tied to the California Cap, and Trade Program and the Chinese Clean Development Mechanism. In general, market-based schemes rely heavily on the price of credits and have to set price floors (minimum prices) or obtain additional support from the government. The New Zealand Emissions Trading Scheme has set both a price floor as well as a price ceiling in order to tackle price uncertainty.

The Clean Development Mechanism (CDM) and Joint Implementation (JI) developed under the Kyoto Protocol are the longest flexible market-based schemes and have set the stage for smaller schemes and voluntary schemes such as the Verified Carbon Standard (now Verra). Both CDM and JI have saleable credits that can be used by industrialized countries to meet a part of their emission reduction targets. CDM has developed methodologies that might implicitly include grassland projects but are primarily rewarding renewable energy projects.

Verra, which uses CDM methodologies has also developed four methodologies related to grasslands which can be used for future schemes. These methodologies comprehend the Methodology for Avoided Ecosystem Conversion, Soil Carbon Quantification Methodology, Methodology for Sustainable Grass Management, and Methodology for the Adoption of Sustainable Grassland through Adjustment of Fire and Grazing. The methodologies in market-based schemes are often focused on projects that will obtain the highest number of credits. For any of the large-scale voluntary crediting schemes, grassland management is typically focused on grazing management as it has the highest potential for uptake.

Critical issues remain though in designing carbon offset contracts on grasslands, such as addressing permanence, saturation and leakage as well as ensuring additionality.

7. Delivery, scaling up adoption and evaluation

Delivery, scaling up adoption

Existing research projects and initiatives offer evidence that grassland initiatives can be upscaled. Initiatives mentioned in this report, like the initiatives focused on biodiversity outcomes, e.g. the Burren Programme in Ireland and the Medinet initiatives, offer useful lessons to be learned for the development of result-based agri-environmental initiatives. The Finnish Climate Action scheme and the Portuguese Carbon Fund offer examples of enabling factors for developing initiatives, and how to link grasslands into broader policy approaches to incentivize different types of carbon farming, including on grasslands.

The analysis of ongoing and past initiatives allowed us to define the most important **drivers for the upscaling** of carbon farming initiatives on grassland:

- **A farmer-centred action-oriented approach**, building on effective, practical and relatable solutions that fit into what the farmers are already doing, decreases the barriers for uptake and enhances the likelihood of permanence. It furthermore facilitates learning, revisions and adjustments towards a more effective scheme developed over time.
- **Recognizing investment and efforts** made to increase carbon sequestration — as opposed to rewarding only the carbon sequestered at the end of the initiative — increases farmer engagement.
- **Recognizing co-benefits** like biodiversity enhancement, water retention capability and reduced soil erosion, and using these as proxy-indicators for carbon sequestration, enhances farmers' ability to see where they can improve their management practices to increase carbon sequestration.
- **Designing an initiative that optimizes the economic benefits** for the farmer beyond the carbon sequestered and that limits (real or perceived) additional costs associated with participation in the initiative, will also increase uptake.
- **A transparent and relevant payment scheme** builds trust and engagement.
- **A cost-effective, understandable and non-burdensome MRV scheme** removes (at least some) of the transition costs and administrative burdens for the farmer, hence facilitating uptake and permanence.
- **Providing trusted advisory services** to the farmers during design and implementation of the initiative builds trust and enhances the likelihood of farmers applying the most optimal management procedures. Additionally, it helps remove obstacles that can become barriers for permanence.
- Work with farmers and other stakeholders to **raise awareness on the benefits of soil carbon sequestration** for the farming business and as a societal climate action to mitigate climate change enhances farmers' interest and proudness of being an active partner in the common fight against climate change.

Such actions would be important steppingstones for progressing and upscaling adoption.

However, the complexity of the challenges and the gaps in knowledge and experience with regards to designing and setting up effective result-based schemes for carbon sequestration on grasslands are still large. Further research and piloting of schemes is needed to shed light on how to improve the role of the success factors grasslands as carbon sinks through the maintenance of carbon in the soil, carbon sequestration and avoided emissions.

Judging from the literature review and interviews with stakeholders of existing result-based schemes, the following areas need special attention in order to design effective and efficient result-based carbon sequestration schemes on grasslands:

- Considering variability issues (climate, soils and socio-economic contexts), exploring grassland-based business models for grazing and other agricultural uses that increase the carbon content;
- Comparing different management practices and their potential to impact on changes in soil carbon content, again under variable European contexts;
- Analysing drivers and barriers (including economic and management factors) that increase or limit the potential of grasslands as carbon sinks;
- Identification/development of tools for reliable, cost-effective and simple measurement of sequestered carbon;
- The large and overlapping interests of public and private actors call for an exploration of potential schemes for co-investment by public and private agencies;
- Analysis of the links, trade-offs and synergies between carbon sequestration, other ecosystem services and biodiversity conservation – including further assessment of the feasibility of using these as proxy indicators for carbon sequestration;
- A team of farmers, experts and practitioners designing the research and piloting to mutually benefit from multiple sources of knowledge and awareness of the benefits of C sequestration and of the effects of grassland management on C sequestration;
- A 'Grasslands Carbon Code' similar to the Peatlands Code and the Woodlands Carbon Code, where project developers are required to be able to demonstrate that the environmental impacts of an initiative will be positive, including consideration of habitats, species, soil and water environments, as well as landscapes – would also be useful in order to be able to develop robust result-based carbon sequestration initiatives on grasslands.

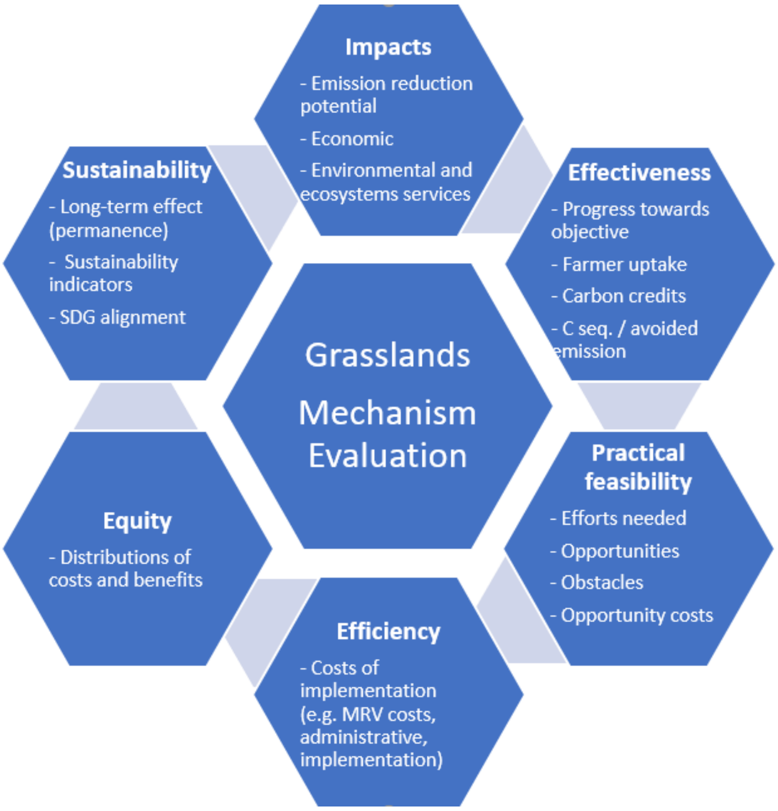
Scheme evaluation

The limited experiences on carbon sequestration on grasslands means that there are limited lessons to be shared with regards to evaluation. Thus, the following are considerations that should be guiding the evaluation of carbon farming schemes in grasslands, and the use of the evaluation results to support the upscaling of result-based carbon sequestration initiatives on grasslands.

Considering the wide recognition and applicability of the OECD DAC evaluation methodology (OECD, 2020), we suggest using this in a revised form with greater emphasis on the learning aspects, feasibility, design and up-scaling.

The key evaluation criteria to be used and their relations to carbon sequestration initiatives are provided in Figure 3.

Figure 3. Grasslands scheme evaluation. COWI illustration, 2020.



Source: own elaboration

The questions following each evaluation criteria need to be contextualized to fit the specific grasslands carbon sequestration initiative. Data availability (actual carbon sequestered) may be a limitation, as mentioned before.

Each criterion provides a different perspective through which the intervention can be assessed. Together, the criteria and the evaluation questions provide a comprehensive picture of the initiative, the process of implementation, and the results achieved.

In this way, the evaluation will help assess whether the initiative is relevant to the context, coherent with other initiatives; whether it is progressing as expected towards the objectives; whether it will deliver the expected results, in an efficient way, and whether it will have positive impacts that last (permanence).

But above all, the criteria can be used beyond evaluation – for monitoring and as a management tool for farmers and advisers to decide on strategic management choices to enhance the effectiveness of the intervention. The evaluation process as such can furthermore function as an overall learning tool for stakeholders involved in the initiative, to facilitate learning and upscaling.

Connectivity for the delivery of carbon farming on grasslands

One way in which to further establish grasslands in carbon farming is through its connection to the CAP (see Box 4) and other broad policies and initiatives. The EU can play a key role in financing grasslands initiatives. Connecting regional initiatives to international and national policies helps facilitate communication and flow of available funding across initiatives.

The economic gains partnered with the long-term land benefits of sustainable management should garner support for policies that encourage carbon sequestration on e.g. grasslands and rangelands. Tackling producer reluctance to participate in grassland management due to cost can be offset by payments such as those offered by the CAP. The EU's recent Farm to Fork Strategy also has a specific agenda to encourage EU landowners to participate more readily in sustainable management. Annex 10 provides a more detailed view of EU policies that could have an impact on grasslands. In general linkages between local, regional, national and international strategies for promoting carbon farming on grasslands should not be understated.

Box 4. Role of the CAP and connectivity to the delivery of carbon farming on grasslands

The trend in recent reforms of the EU Common Agriculture Policy (CAP) has been to increase the focus on climate action by farmers and this is reflected in the proposed legislation for the CAP 2021-27. The 2013 reform introduced Pillar 1 direct payments for farmers that apply environmentally-friendly management practices, the so-called “greening requirements”, which together with the designation of Environmentally Sensitive Permanent Grasslands and Pillar 2, achieved indirect positive effects on carbon sequestration via the preservation of permanent grasslands.

CAP 2014-2020: Grassland protection, management and restoration is already an integral part of the CAP. The Pillar 1 direct payment greening requirements include a requirement for Member States to restrict the conversion of permanent grassland to arable land, designed as a basic requirement to maintain carbon stocks and reduce losses. Member States are also required to designate and protect Environmentally Sensitive Permanent Grassland (ESPG) in Natura 2000 sites, and have the option of designating ESPG elsewhere, focusing on grasslands carbon-rich soils contributing to carbon sequestration, biodiversity and soil protection. In addition, voluntary agri-environment-climate measures (AECM) also have a strong focus on grassland protection, management and restoration. While these measures are largely designed to address biodiversity issues, they may offer lessons in terms of upscaling also for carbon sequestration.

CAP Post-2020: Under the current legislative proposals the existing requirements for Member States to maintain the ratio of permanent grassland to the agricultural area and to protect of wetland and peatland soils become part of two new GAEC standards under enhanced conditionality. In addition to the existing AECM (Pillar 2), a new eco-scheme under Pillar 1 offers potential to support upscaling of carbon farming schemes. EIP-AGRI Operational Groups could have a significant role in innovative approaches including result-based carbon farming, for example through piloting result-based payment schemes and supporting farm advice, knowledge transfer and cooperation (especially where knowledge gaps and/or uncertainties exist) prior to upscaling.

References

Climate Action Reserve (2020) *The Grassland Protocol*. Version 2.1. http://www.climateactionreserve.org.

Conant, R. T., C. Cerri *et al.* (2017) Grassland management impacts on soil carbon stocks: a new synthesis. *Ecological applications*, vol. 27, no. 2, pp. 662–668.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal L, 22.07.1992.

Del Grosso, S. J., W. J. Parton, C. Keough, M. Reyes-Fox (2011) Special features of the DayCent modelling package and additional procedures for parameterization, calibration, validation, and applications. *Methods of introducing system models into agricultural research*, 2, pp. 155-176.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Díaz, S., Hector, A., & Wardle, D. A. (2009). Biodiversity in forest carbon sequestration initiatives: not just a side benefit. Current Opinion in Environmental Sustainability, 1(1), 55-60.

FAO & ITPS (2015) *CAN CARBON (SOC) offset the Climate Change*. Food and Agriculture Organization of the United Nations (FAO), Intergovernmental Technical Panel on Soils. Global Soil Partnership (GSP).

Fenhann, J. V., & Hinostroza, M. L. (2011). CDM information and guidebook. Danmarks Tekniske Universitet, Risø Nationallaboratoriet for Bæredygtig Energi.

Fornara, D. A., D. Tilman (2008) Plant functional composition influences rates of soil carbon and nitrogen accumulation. *Journal of Ecology*, vol. 96, no. 2, pp. 314-322.

IPCC (2006) *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4: Agriculture, Forestry and Other Land Use*. Intergovernmental Panel on Climate Change.

IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* Intergovernmental Panel on Climate Change.

King, M. (2010) *An Investigation into Policies Affecting Europe's Semi-Natural Grasslands*. Report to the European Forum on Nature Conservation and Pastoralism and to the European Commission, DG Environment, The Grasslands Trust.

Kirwan, L., A. Lüscher, M. T. Sebastià, *et al.* (2007) Evenness drives consistent diversity effects in intensive grassland systems across 28 European sites. *Journal of Ecology*, vol. 95, no. 3, pp. 530-539.

OECD (2020) *Evaluation Criteria*. OECD webpage. Organization for Economic Co-operation and Development, Paris. https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm. Accessed 13.04.2020.

Paquel, K., C. Bowyer, B. Allen, M. Nesbit, H. Martineau, J.-P. Lesschen, E. Arets (2017) *Analysis of LULUCF actions in EU Member States as reported under Art. 10 of the LULUCF Decision*. Final report to the European Commission, DG Climate. Institute for European Environmental Policy, Ricardo Energy & Environment, Wageningen University.

Regulation (EU) No 1293/2013 of the European Parliament and of the Council of 11 December 2013 on the establishment of a Programme for the Environment and Climate Action (LIFE) and repealing Regulation (EC) No 614/2007 Text with EEA relevance

Regulation 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) Nom73/2009. Official Journal L, 20.12.2013.

Silva, J. P. *et al.* (2008) *LIFE and Europe's grasslands: Restoring a forgotten habitat*. Office for Official Publications of the European Communities.

Teixeira et al. (2018) *Grazing for* carbon. Final report, EIP-AGRI Focus Group. European Commission. Accessed at https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_grazing_for_carbon_final_report_2018_en.pdf

Teixeira R. M. F. *et al.* (n.d.) *Grazing for carbon. Mini-paper: Monitoring.* EIP-AGRI Focus Group. European Commission. Accessed at https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/fg25_05_minipaper_monitoring.pdf.

Velthof, G.L, J.P. Lesschen, A. Schils *et al.* (2014) Grassland areas, production, and use. Lot 2. Methodological studies in the field of Agro-Environmental Indicators. Wageningen University. Report to the European Commission, EUROSTAT on Contract 40701.2012.002- 2012.316)

8. Interviews

Name	**Organisation / position**	**Date Interview conducted**
Hanne Bang Bligaard Anna Flysjö	Leads Arla's Climate Check programme Arla's corporate sustainability team	17 April 2020
Dr. Brendan Dunford	The Burren Programme, Manager www.burrenprogramme.com	21 May 2020
Dr. Annemette Dahl Jensen	Grasslands Expert.	22 May 2020
Mr. Tiago Domingos	CEO Terraprima, www.terraprima.pt	4 June 2020
Dr. Ricardo Teixeira		8 June 2020
Kim Rasmussen	Farmer	15 June 2020

9. EU legislation and policies relevant for grassland

Table 5 provides an overview of the EU legislation and policies most relevant for the protection, use, and restoration of grasslands in the EU. Most of these are implemented through the national legislation.

Table 5. Overview of EU legislations and policies relevant to the management of grasslands.

Policies and legislations	Impact on grasslands
CAP Direct Payments: (Regulation (EU) No 1307/2013)	Arable farmers can meet the 'greening requirements' attached to their Pillar 1 direct payments by selecting from a list of management practices that include permanent grass buffer strips and landscape features, which offer some protection for grasslands but are not focused on SOC. Typically, grassland protection that is regulated or incentivised through the CAP is aimed at 'permanent grassland' which includes both semi-natural pastoral grasslands and more intensively managed grasslands, and is only partially aimed at SOC sequestration. The ratio of permanent grassland to agricultural land is determined by the individual Member States and can be regional or country specific. It is permitted under this requirement to plough and reseed permanent grasslands If the ratio drops by 5% from the pre-established thresholds in 2015, the obligation of the MS is to ensure that the land is reconverted back to grassland. Member States are also required to designate and protect Environmentally Sensitive Permanent Grasslands in Natura 2000 sites, and have the option of designating ESPG elsewhere, focusing on grasslands carbon-rich soils The objective of these two instruments is explained in recital (42) of the Regulation '*For the sake of the environmental benefits of permanent grassland and in particular carbon sequestration, provision should be made for the maintenance of permanent grassland. This protection should consist of a ban on ploughing and conversion on the environmentally most sensitive areas in "Natura 2000" areas covered by Directives 92/43/EEC and*

	2009/147/EC, and of a more general safeguard, based on a ratio of permanent grassland, against conversion to other uses.'
CAP Rural Development (EAFRD) (Regulation (EU) No 1303/2013):	The funding is spread across a wide array of sectors including in environmental management and restoration of degraded areas. At least 30% of the funding for rural development programmes must be allocated towards climate change and the environment. This can be done through grants or yearly payments awarded to farmers that are dedicated toward adopting environmentally friendly practices on their land.
Birds and Habitats Directives (Directive 92/43/EEC and Directive 2009/147/EC	The EU Habitats Directive specifically protects habitats and species of European importance that are listed in the Directives including around 15 types of grassland ecosystems that are protected.
Natura 2000	Natura 2000 is a network of protected areas covering Europe's most valuable and threatened species and habitats. It is the largest coordinated network of protected areas in the world, extending across all 28 EU countries, both on land and at sea. The sites within Natura 2000 are designated under the Birds and the Habitats Directives, and many of them are in agricultural management. The European Commission and the European Environment Agency (EEA) are responsible for reviewing the sites proposed by the MS themselves.
LIFE (Regulation (EU) No 1293/2013):	The LIFE programme has over 370 projects that cover grassland management explicitly, or indirectly. The LIFE programme is managed by DG Environment and DG Climate Action and the current iteration for the 2014-2020 period involves sub-programmes associated with climate action with a budget of €3.4 billion. From this budget, €1,243.81 million is devoted to environmental protection and nature conservation and €413.25 million for climate action.

Renewable Energy Directive (Directive 2009/28/EC):	The Renewable Energy Directive protects semi-natural 'highly diverse grasslands.' from being converted to biofuel production, Recital (69) *'Having regard, furthermore, to the highly biodiverse nature of certain grasslands, both temperate and tropical, including highly biodiverse savannahs, steppes, scrublands and prairies, biofuels made from raw materials originating in such lands should not qualify for the incentives provided for by this Directive. The Commission should establish appropriate criteria and geographical ranges to define such highly biodiverse grasslands in accordance with the best available scientific evidence and relevant international standards*.' Article 17, 3.(c)' *highly biodiverse grassland that is: (i) natural, namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or (ii) non-natural, namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.*

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