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

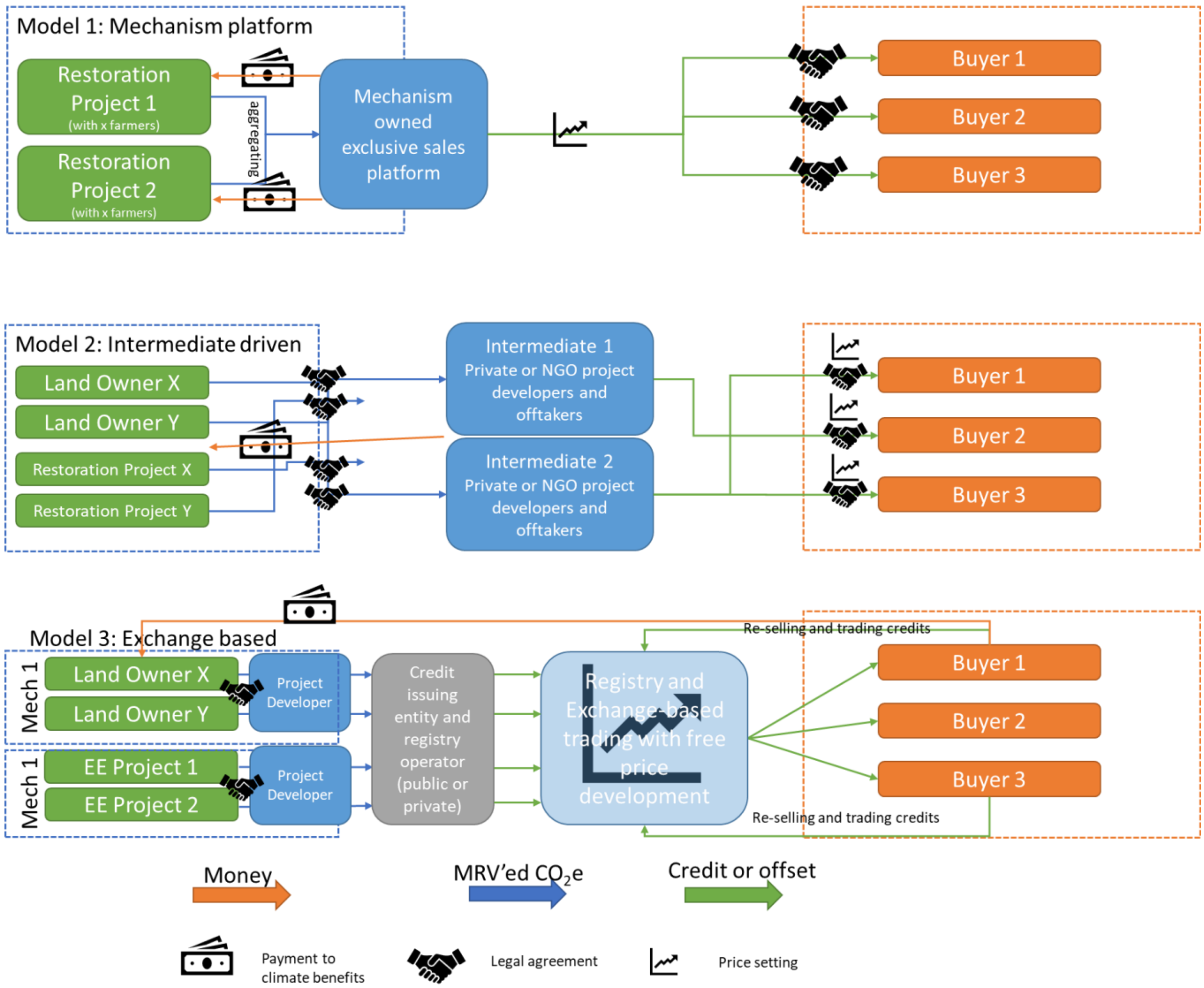
Local benefits that can be communicated by customers or other stakeholders are often a decisive non-carbon benefit that is of high value to CSR-motivated buyers. For these, **carbon market price setting serves as a benchmark for price setting before price premiums,** and project specific prices can easily 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.

[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

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.

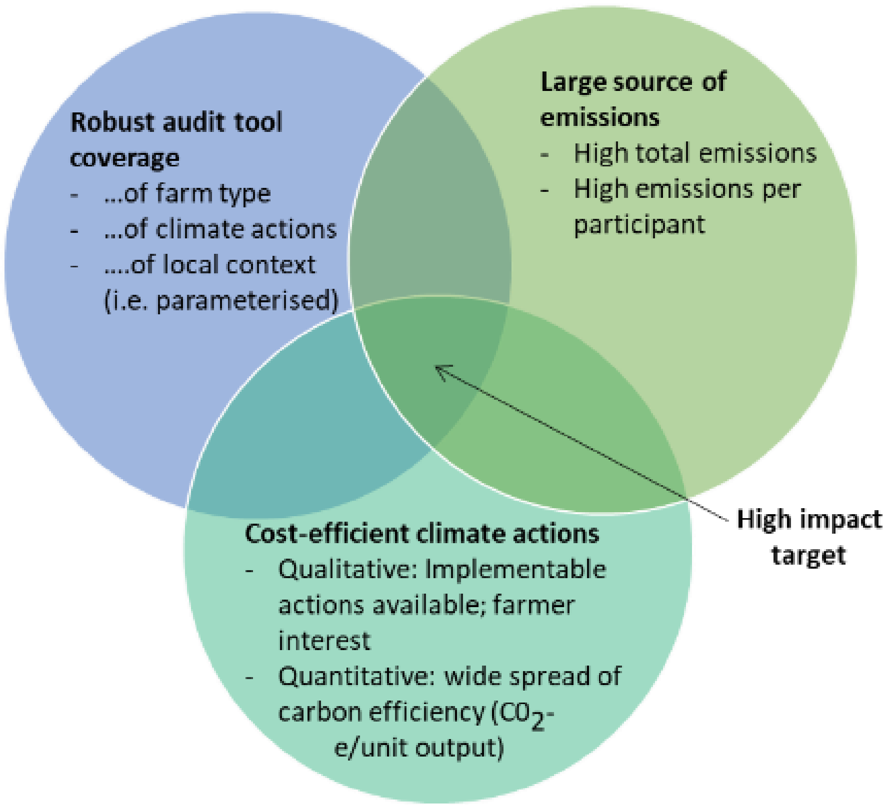
b. Transparency

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

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.

[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.

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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

[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

- 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.

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.

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

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.

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.

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

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