CARBON FARMING SCHEME

LIFE Preparatory Project

Key considerations for the future carbon farming incentive scheme based on stakeholder perspectives

Report of Activity 4 / LIFE CarbonFarmingScheme project

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The Life Carbon Farming project has received funding from the LIFE Programme of the European Union

The LIFE Preparatory Project

The LIFE Preparatory Project aims at identifying and accelerating the development and adoption of novel incentives for carbon sequestration and the increase and maintenance of the organic carbon stock in soil and biomass in Europe. With the aim of promoting a well-functioning carbon market, the project will uncover the key factors in supply and demand measures to invite the private sector to accelerate climate action. The project is co-funded by the LIFE Program of the European Union.

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Summary:
Main findings and conclusions

This report covers the outcome of the three main components in Activity A4 of the EU LIFE CarbonFarmingScheme project: online surveys, farmer interviews and test trading with credits. With respect to the aim of incentivising carbon farming and the expectations and preferences regarding the future European carbon market, based on stakeholder input, the report puts forward the following conclusions.

The two sides of the voluntary carbon market – supply by farmers and forest owners and demand from non-mandated sectors – seem to be far apart when it comes to their expectations. The difference is great in terms of price and permanence of carbon credits. However, both sides are closer when it comes to their expectations concerning co-benefits, which both sides consider very important. As for permanence, farmers have difficulty in making commitments that extend longer than five years, whereas buyers find the 20-year durability of the credits in the trading pilot confusingly short. The same contradiction applies to price. Buyers find the 50 €/tonne CO2 price high for 20-year credits, but farmers expect to be paid four times that price for the same amount.

This significant difference of expectations between the market participants can be seen in two ways. On the basis of this evidence, there is no foundation for a market-based solution when supply and demand requirements are so far apart. However, the preference for co-benefits when factored in as additional criteria can offer a win-win plateau. A successful scheme would be based on the local supply of measures which carry broader environmental benefits for, among other things, soil health and biodiversity. Reliable data and information accessible to all actors are key prerequisites for mutual trust and the consequent viability of the carbon market. Once there is a common information basis, and if the contract price and terms can be negotiated to the satisfaction of both parties, the market can pick up voluntarily. Despite this mismatch in expectations between supply and demand, there is an opportunity for win-wins.

When it comes to incentivising sustainable carbon farming measures in general among farmers and foresters, the clear message from primary producers is that the incentives must align with the overall productivity and viability of the business, growing food, feed and timber. In parallel, a positive impact on the environment and the local community in general should be ensured. Public policy and support programmes, such as the EU Common Agriculture Policy (CAP), play an important role economically but also in building knowledge and providing advisory support. Reliable and accurate data and MRV are regarded as the basis also by land managers. The carbon market connects to many fundamental issues also in property rights,

capital investment and socio-economic dynamics, which makes farmers and foresters call for broad societal dialogue and multi-level strategies to ensure that development follows a fair and sustainable path.

Preface

The LIFE CarbonFarmingScheme Preparatory Project (2020–2022) seeks to identify market and policy mechanisms and associated regulatory adaptations to incentivise farmers and foresters to implement measures that sequester carbon in soil. The project considers both the prerequisites and governance of the potential European carbon market as well as public policy support schemes (notably CAP) and the interlinkages.

This report summarises the main outcomes from Activity Work Package A4, which focuses on testing elements of carbon farming incentives and the potential of the carbon market with primary producers. The aspects in the design of the carbon credit or public policy incentive schemes are covered in Activity Work Package A2 and are introduced in a dedicated report (NEOT 2021). The socio-economic assessment is provided separately.

The primary aim regarding the study results and conclusions in this report is to process them in the project partnership for the development of the final conclusions and recommendations concerning incentive mechanisms for carbon farming. In addition, they also serve independently as a snapshot that provides a sample of insights into the perspectives on carbon farming and the future carbon market of agricultural practitioners.

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Authors

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1. Introduction

The EU's climate policy partly relies on increasing the carbon sink in agricultural soils and forests in its Fit for 55 package in order to meet the overall climate neutrality target by 2050. The proposal for the revised LULUCF sector (AFOLU) targets carbon neutrality in the whole land use sector[1]. The strong impetus for carbon sequestration also comes from the emerging and growing voluntary carbon market based on the recent surge of companies and programmes offering carbon removal, carbon compensation and investments also in nature-based carbon sinks (e.g. Nori, IndigoAg, Climate Farmers, Puuni). The food industry, for its part, is also resorting to nature-based carbon sequestration in its own value chain as part of its climate, CSR and ESG strategies (e.g. Nestlé, Danone, Valio). From the point of view of governance as well as the individual land manager, it is necessary to understand how these targets and the envisioned measures play out on the farm or forestry plot level. Furthermore, the complexity of different mechanisms in the climate policy framework, including the envisioned EU carbon market (to be operational from 2030) entails a thorough and detailed review and development of the governance framework relevant to the production (supply), accounting and trading of carbon credits. In addition, the Common Agriculture Policy, which also introduces environmental and other sector policy objectives for farms, affects the economy, market position and adaptive capacity in farm management of primary producers, which is discussed further in this report.

The global landscape of carbon farming and carbon credit trading is rapidly evolving with an influx of new players and initiatives. This adds to the urgency of regulation and governance schemes, but also dialogue and the definition of concepts and practical measures. One of the new concepts currently being defined is 'regenerative farming' or 'regenerative agriculture' (Newton et al. 2020), which places carbon farming under a more holistic concept and aims to prescribe a path for farming that secures the delivery of maximum potential in terms of economic, environmental and social benefits.

The approach adopted by the LIFE CarbonFarmingScheme with regard to carbon sequestration and increasing carbon sinks in agricultural soils embraces the integration of carbon sequestration with productive arable farming. Through this approach, we emphasise the dual goal of utilising nature's potential in expanding natural carbon sinks and supporting the transition in our agricultural and food systems towards models which are more resilient to climate change, weather extremes and market disturbances, and which support the delivery and maintenance of environmental services and values.

[1] https://ec.europa.eu/clima/eu-action/european-green-deal/delivering-european-green-deal/land-use-forestry-and-agriculture_en

In order to develop tested and practically applicable recommendations for the incentive schemes and governance measures to enable a carbon market, this report summarises the stakeholder interactions and dialogue conducted in the project to date concerning the field and farm level dimension of mechanisms incentivising carbon farming. On the basis of the results and lessons learned, the report identifies key considerations for further work in developing the carbon market and associated governance framework.

The report follows a straightforward structure. Chapter 2 reviews the background policy context for the study. Chapter 3 describes the methodology, steps and scope of stakeholder interactions. The results are summarised in Chapter 4, and the conclusions, in the form of the key considerations, are presented in Chapter 5.

2. Background and policy context

The aim of the LIFE Preparatory project 2019 call was to support a project to explore and suggest mechanisms to incentivise carbon farming and carbon forestry by considering both public and private mechanisms. The LIFE CarbonFarmingScheme project approached this task by further defining its focus to target elements of the carbon market, from both the supply and demand side and how the carbon market could be implemented for the dual aim of increasing nature-based carbon sinks and providing additional economic incentive and income for farmers and foresters in a sustainable way. On the policy side, the EU Common Agriculture Policy (CAP) operates as a strong public steering and incentive programme as the baseline. The strong effect of the CAP was clearly expressed by the farmers interviewed (see below), as anticipated, and the opinions of the farmers reported here should be understood as reflecting their experiences of the CAP and their expectations concerning its content in the new period 2023–2027. In particular, moving to result-based compensation in the CAP for environmental and climate delivery was a topic for explorations, as it parallels the logic of the carbon market. This issue is further discussed below. In addition, this chapter outlines the relevance of other policies considered for this interactive study.

During this LIFE project, the European Commission has made two major changes to its carbon markets policy. First, in July 2021, the Commission set a stop for the use of international carbon offset credits for EU ETS compliance after 2020[2]. Second, in December 2021, the Commission released a communication on the development of voluntary carbon markets for sustainable carbon cycles[3]. The project was aligned with these initiatives, then in preparation, and can, thus, provide lessons for the future carbon market and carbon farming incentives from a broad perspective. This report focuses on the context of productive agriculture.

2.1. A debated aim: result-based agrienvironment support

The new CAP (2023–2027) has increased performance-based management on the programme level. This means that the Member State (MS) strategic plans must have performance targets and indicators and that they are closely monitored (EU 2021/2115, preamble 101). In this respect, the new programme aims to address gaps that were criticised in the previous CAP (e.g. Pe'er et al. 2020). However, adding the result-based element to farm compensations through the agri-environment-climate schemes, which has been discussed for over a decade[4], has

[2] https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/use-international-credits_en
[3] https://ec.europa.eu/clima/eu-action/forests-and-agriculture/sustainable-carbon-cycles_en
[4] Result-based agri-environment payments have been referred to by different terms such as outcome-based or outcome-oriented measures or payments for ecosystem services (e.g. ECA 2011, Burton and Schwarz 2013, Schwarz and Morkvenas 2013, Jordbruksverket 2013, Keenleyside et al. 2014, https://www.rbpnetwork.eu/)

proven to be a highly complex challenge, despite some Member States' schemes portraying the nature of result-based payments, such as Germany, The Netherlands and Austria. A new dimension in this development is found the eco-schemes of the new CAP, as they, in theory, would allow an incentive or reward form of payment as additional to basic income connected to the delivery of environmental attributes (EU 2021/2115). While the CAP regulation allows result-based payments in the management commitments (EU 2021/2115, preamble 71[5]), it remains to be seen if the Member States choose and find ways to institute a result-based element in the payments for agri-environment commitments[6].

Although there are some encouraging examples of the benefits, also in terms of cost-efficiency of result-based payments, it seems the evidence is still inadequate (e.g. Sidemo-Holm et al. 2018, Waterdrive). In addition to transaction costs (or the models of implementation, such as through auctions or other alternative schemes), questions related to baseline, measuring the results and the attributability of the result to a single farm or contract are just some of the practical challenges that stand in the way of result-based environmental compensation schemes. The main hurdle, however, has been the interpretation of the WTO rules regarding the eligibility of state support in the green box (e.g. Burton and Schwarz 2013, Sidemo-Holm et al. 2018).

The pros and cons of result-based schemes overall are also well summarised in the Commission's communication on Sustainable Carbon Cycles (EC 2021, 2021a), and they serve to define the implicit assessment framework used to mirror the results of this stakeholder mapping process. As there are still many open questions regarding result- (or outcome-/ impact-) based schemes in CAP, this question is studied from the perspective of farmer preferences. Many of the pending questions are the same as those that need to be solves with respect to the carbon market, so they align with the target of the project overall and will gain further insights via the interactions reported here.

[5] "Support under payments for management commitments may also be granted in the form of locally led, integrated or cooperative approaches and result-based interventions" (EU 2021/2115, preamble 71).
[6] Estonia has plans for result-based schemes for grasslands and landscape features (Helm 2020).

2.2. Other relevant policies and regulation considered

The long-term orientation of the task to develop governance enabling an EU carbon market in 2030 also provides a setting to approach farms with a more open and future-oriented agenda. New EU initiatives, such as the Green Deal, Farm to Fork and the Biodiversity Strategy and the Forest Strategy, contain objectives and elements which have to be taken into account on the farm level. These, along with the climate package, frame and define the future operating environment for farmers, forest owners and the agricultural and forestry value chains. Therefore, aspects such as the reduction in fertiliser and pesticide use (as key objectives in the Farm to Fork strategy[7]) are questions which farmers need to give, and are giving, increased consideration. Adding to that, the Nitrate Directive is being more meticulously enforced (evidenced by the ongoing debate on the extent of the designated Nitrate Vulnerable Zone in Poland; Ptak et al. 2020) and the Water Framework Directive is introduced in the CAP conditionality (new CAP conditionality). Furthermore, the full implications of the Weser ruling concerning the WFD targets as legally binding are still unfolding (e.g. Söderasp and Petterson 2019). On the global level, we adhere to the SDG's as common guiding objectives and embrace the concept of sustainability, thus integrating also socio-economic considerations. This establishes a foundation for the ex-ante socioeconomic assessment of the future carbon market provided as a separate report (upcoming). Also, the very timely communication of the European Commission, Sustainable Carbon Cycles (COM (2021) 800), was published on 15 December 2021 and the Member States and other stakeholders will begin to formulate their positions on this initiative. Therefore, the key stakeholders have an additional impetus to consider aspects of carbon farming and carbon market governance. For this process, the project can offer its contribution in the form of reports, engage in dialogue and report on the issues and questions raised.

[7] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

3. Overview of the stakeholder input methodology and process

The stakeholder mapping study conducted as part of the LIFE CarbonFarmingScheme consisted of three main elements. Input was sought through surveys, interviews and test trading with credits. The results and conclusions are based on these triangulated data sources. Initially, an online survey on the supply of carbon credits by agriculture and forestry was conducted. The outcome of this survey is summarised below at the beginning of Chapter 4, and the survey form and results overview are provided in Attachments 2 and 3.

Further, in order to dive deeper into the practical operating environment on the farm level, interviews with farmers were conducted. The farmers to be interviewed were selected from among survey respondents or based on the contacts established during the project. The interviews also served to fill in any gaps in territorial coverage of the case farms in order to cover a sufficiently wide range of different pedo-climatic areas in Europe.

Third, test trading with carbon farming credits was organised. A methodology named Soil Amendment was developed for carbon sequestration with recycled soil improvement fibres. Projects were identified, verified and the resulting credits were issued for sale at the Puro.earth marketplace. The report on the methodology and outcome of the test trading is provided in Chapters 3.3 and 4.3.

Building on the experience of working closely with farmers for a long time (see e.g. https://www.bsag.fi/en/action/jarki-projects/) and seeking to establish a mutually beneficial exchange and future synergies in terms of achieving an impact between the Carbon Action Platform (https://carbonaction.org/en/front-page/) and the LIFE CarbonFarmingScheme, this stakeholder study aims to ensure sufficient attention is paid to the practical context on the field and farm level in different types of climatic environments and agricultural production systems. The element of the Carbon Action Platform which ensures the involvement of practical farmers in the design of pilot and training activities was noted in, for example, the Technical Guidance Handbook for carbon farming mechanisms (COWI, Ecologic Institute and IEEP, 2021). A virtue increasingly understood and emphasised across related initiatives concerning agri-environment and carbon farming scheme design (e.g. Allen Jones 2021, Taylor 2019).

Through initial dialogue mapping the field of carbon farming, the project partnership developed a sense of importance of incorporating the perspectives of stakeholders, particularly farmers, as a key element in understanding the potential of different incentive

mechanisms. The case farm modelling calculations (from Activity A1) offered additional information and communication material for the process. Designing a purely market-based incentive was not seen as possible without understanding the role and influence of the CAP on the farm level. With the future carbon market design as the end-beneficiary of the study, the project set out to assess and investigate stakeholder preferences regarding the main criteria of the carbon market. This refers to that carbon credits are based on additionality and permanence and that there is a transparent registry that enables traceability and prevents double counting. Also, as the project adopted an integrated and holistic approach, it was seen as relevant that other environmental and socio-economic effects of the carbon farming incentives were included in the study.

3.1. Online survey

An online mapping survey on the preferences regarding the carbon credit market was conducted in spring 2021. The survey focused on the supply of nature-based carbon credits and was aimed primarily at farmers/primary producers as a focused group survey. It also included a general part for other stakeholders who were invited to respond to the survey. The survey group was a selected sample of farmers, associations, advisors and companies involved in the carbon farming discussion or programmes around Europe. In addition, the survey was distributed to associated mailing lists. The survey was made available in eight languages: English, Finnish, French, German, Latvian, Polish, Spanish and Swedish. Of the 70 respondents, more than half were farmers or other actors in primary production. The respondent group was fairly well aware of the carbon farming measures referred to (see Attachment 3), even though they had not applied them in practice. The survey form and summary of results, are provided in Attachments 2 and 3 to this report.

It became evident already in the drafting and testing phase of the survey that the topic was not easily approached or one on which the stakeholders had formed definite opinions. Another challenge was to find the correct terms for all the specific attributes of the nature-based carbon credit market in eight languages and ensure that the respondents would interpret and understand them in the same way. In an attempt to minimise the risk of misunderstandings, the project group decided to stick to the planned approach of targeting the survey to persons and networks with above-average awareness of the carbon market discussion. It was assumed that surveying general and common farming-related questions among the mass of farmers would offer less value for further work with the specific elements of the carbon market. The results of the survey are incorporated in chapter 4 of this report.

3.2. Interviews with farmers

Partly on the basis of existing contacts, survey responses and expressions of interest and partly on the basis of model calculations, interviews with farmers were conducted. Some of the respondents requested to remain anonymous; however, the publishable data of the interviewed farmers is provided in Attachment 1. The interviews with farmers were mainly conducted from August 2021 to January 2022, which was somewhat delayed from the original schedule. However, the timing was considered as optimal for the farmers as they had to set aside time (approximately four hours for the interview, including preparation and follow-up comments), for the project to define the specific questions and issues to study as well as still being able to deliver the results for the preparation of the final report.

The main objective of the interviews was twofold: 1) to understand the drivers and context of the farmers' decision-making relevant to environmental management on the farm and the adoption of carbon farming practices, and 2) to test and investigate the acceptance, possibilities and limitations with respect to the foreseeable conditions of carbon credit contracts. In addition, market-related and socio-economic issues were explored. The study questions for the interviews are provided in Attachment 4.

The interviews were semi-structured open interviews with selected individual respondents. One objective in the selection of interviewees was to cover at least five pedo-climatic areas around Europe, as with the case farm calculations. The recorded results (8 interviews) represent case studies in Northern, Southern, Atlantic and Central European regions. These regions vary in terms of pedo-climatic conditions, but also with regard to the socio-economic context in which farmers operate (see ***Figure 3.1.*** below). In addition to the full interviews conducted with eight farmers, additional farmers were interviewed with a narrower scope. The farmers who agreed to be named are listed under Attachment 1.

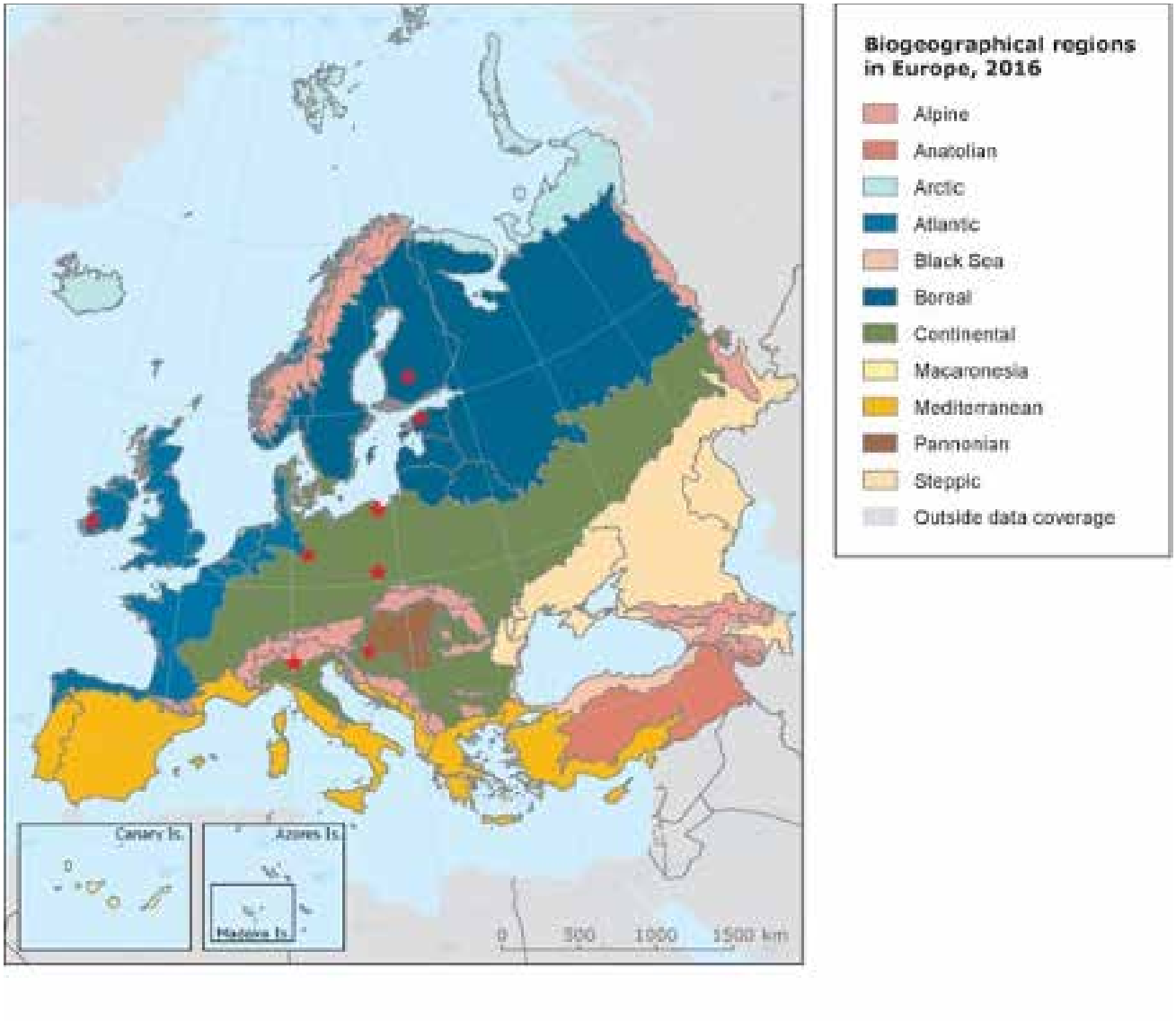

Figure 3.1 .Locations of the farms for complete interviews for this report (8).
Of the interviewed farms, 4 were also included in the calculation cases (Estonia, Ireland, Germany, Italy). Original map: EEA, https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2, last accessed 1 June 2022.

3.3. Test trading with carbon credits

The concrete aspects and implications of carbon farming and future carbon markets are challenging to explore and assess in a single study, due, in part, to the multitude of practical management options and possible policy approaches. In order to increase understanding of the design of carbon credit methodologies and valuations of the respective market actors, the project implemented test trading of carbon credits based on a methodology developed specifically for this purpose.

Test trading requires a product to be sold, a contract between the parties and a market that matches supply and demand for the trade transactions to take place. In this A4 work package, these required steps were taken in real life with real carbon flows and real farmers. The product was defined in this project as a carbon removal credit resulting from Soil Amendment materials being stored in soil and not combusted. Cooperation with the Finnish circular economy company Soilfood was established for product value chain management and to guarantee the basis for the carbon credits according to the methodology. The methodology of carbon credit formation is described in Attachment 5. The contract was drafted and executed on the Puro.earth platform as a change of ownership of a CORC20 credit representing 20 years of carbon storage in soil. The farmers were represented in the contract by the intermediary responsible for the processing of the Soil Amendment material and its delivery to farms. Market awareness of global exposure was boosted by Puro.earth through online channels and one-to-one meetings, as well as the projects directly reaching out to potential buyers. The trade transactions and payments were completed in Puro.earth's online shop or bilateral contracts.

The pilot was carried out over a period of approximately one year, from the design of the methodology to this stage of trading. The results of test trading, as of February 2022, and also including the steps in the verification of the methodology are described in Chapter 4.3 (more information on the test trading is available on the websites of the companies involved as well as in the media[8,9,10,11]).

3.4. Scope and limitations

The scope of agricultural systems and measures under study in the LIFE CarbonFarmingScheme project focused on increasing carbon sequestration in arable farming of mineral soils. In addition, forestry measures were also studied as means of creating additional permanent carbon sinks. These measures integrate carbon farming in existing cultures and offer variable carbon sequestration potential, of a different nature than complete changes in cultures, for instance, from arable to permanent pasture (see e.g. Sayer 2019). By adopting this approach, we hope to provide insights for the overall sustainability of agriculture and offer opportunities through carbon farming and carbon markets to all farmers.

The stakeholder study up to this point (in Activity 4 of the project work plan) focuses on farmers. The purpose and idea of the stakeholder study was to deepen understanding of the underlying drivers and practical contexts of adopting carbon farming practices and entering into carbon credit contracts. Due to the resources allocated to the project overall, and this

[8] https://puro.earth/CORC-co2-removal-certificate/carbon-removals-from-finnish-agriculture-100044
[9] https://soilfood.fi/hiilinielut/
[10] https://nordicoffset.fi/en/soilfood-carbon/
[11] https://yle.fi/uutiset/3-11901860

individual task, in particular, an extended scientific stakeholder study was not possible. Instead, the project opted to target the study at actors and persons who were anticipated to have sufficient awareness of the topic and the ability to add value to the project and the project consortium. The required scope to cover at least five pedo-climatic areas means that the results are, in principle, relevant for the whole of Europe. This limited the study's attention to the diversity within the regions. Also, the focus on certain types of production sectors is limited to the case level. In terms of farm size, both small and medium-sized/large farms were addressed and included. Overall, the study offers case-based insights on the topic through the perspectives of those who could potentially be among the early adopters of carbon farming practices.

Significant effort was made to remove the language barrier. The online survey was made available in eight European languages and the interviews were conducted in three languages (English, Polish, Finnish). This ensures that the effect of the language barrier in the data is negligible. However, it must be acknowledged that the terminology and vocabulary related to the carbon market, carbon credits and soil carbon sequestration is not uniform and by no means general knowledge even in this group of study subjects.

In summary, the context in which the carbon farming measures are implemented is real and can be more reliably assessed, whereas the market, at the moment, is emerging and fragmented with a variety of options in its governance frameworks and standards.

4. Results

This chapter is devoted to the results of the three inputs surveys, interviews and test trading. The online survey, which engaged a variety of stakeholders, the majority of them representing primary production and farmers, provided a benchmark and a reference point for the interviews. It helped to understand the respondents' awareness of carbon farming and the different aspects of the carbon credit market, as well as their preferences concerning payments and conditions associated with the carbon credit contracts. The results of the interviews are summarised with respect to selected aspects of farm management. Due to the methodology and scope of the study, the results are not generalised to apply to a certain type of production or specific geographic area. However, when a certain aspect or emphasis can be distinctly attributed to a given type of farm or context, this connection is maintained. When it serves further understanding, results from the case farm modelling calculations (Rimhanen et al. 2021) are referred to. Finally, the results of the test trading exercise are reported. The aggregated results concerning carbon market features from all inputs are summarised in ***Table 4.1***.

4.1. Results of the online survey

The survey on carbon credit supply revealed that there is interest in the agriculture sector, among farmers and agricultural advisory and support organisations, to influence the future carbon market rules. However, many issues are still at an abstract level and farmers need to understand better the connections and implications to practical farm management and farm economy.

The survey was carried out as a focused group survey directed at experts in the carbon farming space, so they were better informed about the topic than an average farmer. More than half of the respondents were farmers or other actors in primary production. Among this group, many carbon farming practices are known, although not yet in use.

Of the practical on-farm measures, catch crops, under crops and continuous green cover were the most favoured, and already in use by 75 per cent of the respondents representing primary production. This measure, together with the second most popular measure, solid manure application, was also among the measures farmers would require the smallest compensation payment to implement. Nearly 40 per cent of the respondents would settle for 30 €/ha compensation for catch crops etc., solid manure application and also slurry/liquid manure application[12]. Biogas digestate application was among the measures with the most potential, considering that it is not so readily available. However, those who have access to

[12] As a curiosity, the compensation level for catch crops in the proposed CAP Strategic Plan 2023–2027 for Finland is 97 €/ha (MMM 2021).

it would apply it with a modest compensation of 30 €/ha. The forestry measures proposed (afforestation and forest fertilisation) were generally seen by the respondents as difficult to adopt.

The question about carbon credit schemes and market rules was seemingly more difficult to grasp. Yet, the responses fairly uniformly indicated that the carbon credit scheme should be robust and solid from all aspects. What is worth pointing out is that the environmental benefit criterion, that is, "Carbon sequestration activities contribute to other environmental benefits and do not compromise equal/greater environmental benefits through trade-off of measures", was considered the most important, relative to the other aspects surveyed. It was also the only criterion which none of the respondents ranked as negligible. This calls for the reinstatement of the holistic aspect and respect for the precautionary principle in designing the governance and incentive scheme for the carbon market. Integration of the carbon farming measures in overall farm management and attention to other environmental aspects along with carbon sequestration will be among the main focus areas in the farm interviews. The farmers, farmers' associations and advisors – more so than all the respondent groups combined – emphasised that carbon credit schemes must be sensitive to individual farm conditions.

In terms of the other aspects of the carbon market, the respondents agreed to a transparent registry for carbon credits and supported the idea of open information regarding carbon sequestration in different conditions. The respondents would partially agree to cross-reporting of carbon credits with CAP conditionality. As for contract length, the respondents favoured contracts of five to ten years, with farmers slightly inclined towards shorter rather than longer contracts. The full aggregated results of the survey are provided in Attachment 3 (all respondents) and 3b (farmers).

4.2. Results of interviews with farmers

4.2.1. Farm environmental management – motivation, objectives and means

The interviews revealed that farmers encounter various environmental challenges on their farms. These are especially viewed as related to the changing climate and overall farming practices in neighbouring farm plots or in the region. Visibly, farmers possess considerable knowledge about environmental management, acquired through their daily practices and from other sources (such as formal and informal training or exchanges with fellow farmers).

Most of the interviewed farmers have a strong interest in maintaining good environmental management practices on their farms. However, this is often compromised with the desire to secure financial stability, which is strongly connected with farm productivity. The

farmers noted that the transformation of plant cultivation practices towards being more environmentally friendly often comes with costs to productivity in the short term but yields more benefits in the long term.

Participation in labelling schemes (such as EU Organic, GlobalG.A.P. or Demeter, which were mentioned in the interviews) is encouraging when it comes to applying specific environmental practices and helping to connect better with the markets. Environmentally conscious consumers who recognise the labels are often willing to pay more for the benefit of the environment. The farmers are thus adapting various principles in their practices, such as those oriented towards improving water management, soil fertilisers and reducing the use of chemical fertilisers and pesticides. The environmental awareness and purchasing capacity of consumers is crucial to supporting this model of farming. This demand for ecological products does not, however, benefit feed producing farms. For forestry, environmental practices seemed to be better integrated in forest management by the respondents.

Sustainable water management was considered as the key challenge. Due to the climate variability observed in recent years, the farmers noted difficulties in managing water-related disasters, such as floods and droughts, which can even alternate in successive years in the same region. Water challenges are present practically all over Europe. However, there is a clear distinction between Northern Europe (Nordic and Baltic countries) and the rest of Europe. In the north, water management is inherently associated with drainage and flood management, whereas in Central and Southern Europe it principally covers irrigation and drought mitigation. In Northern and Northern Central Europe, farmers also need to consider the effect of low temperatures and frost. To help manage water on farms, some farmers invested in technological solutions such as drip irrigation and remote sensing (drones, geospatial monitoring). However, these efforts were also considered insufficient as the farmers underscored the challenge of managing water on a larger scale (watershed, drainage area) rather than on an individual farm. In most countries where the interviewees were located, adequate management plans were either missing or not implemented in a visible way.

In addition to water availability and quantity, water quality considerations are becoming common and are factored into operative farm management and future strategies. In particular, groundwater pollution was understood both as a local environmental concern as well as possibly leading to more stringent protective measures and legislation to, among other things, limit the use of pesticides and fertilisers. In turn, this will mean that farmers would need to find alternative methods to mitigate the risk of pests and increase productivity. Similarly, soil management was considered a crucial aspect of water management and important for good environmental performance overall. Most of the farmers believed that investing in soil health pays off in the long term. If eroded, soils need a long time to recover and the loss for farms can be significant.

There is, thus, potential and carbon farming and agroecological approaches could provide solutions for these challenges, but the farmers need information and advisory and economic support to adopt such practices.

4.2.2. Farm economy

The EU farming landscape is highly diverse in economic terms. This is also visible from the characteristics of the farms that are the subject of this study. The interviewees represented micro (less than 2 ha), medium size (e.g. 40 ha) and large farms (over 700 ha). The different sizes of farms distinctly correspond with the degree of market participation and dependency on income from agricultural activity. For instance, the smaller farms in the survey were not able to sustain their owners without additional income from an off-farm activity (e.g. employment in the city). Increasing land prices, observed almost everywhere, pose a serious constraint to enlarging the size of farms and hence to their economic capacities. Most of the farmers were also concerned with market competition and supported the idea that EU subsidies are a good solution to help them survive in the business. The economic importance of the CAP was acknowledged by nearly all of the interviewees. Land consolidation by large agribusinesses and imports from non-EU countries were considered as disrupting small and medium farming, and the interviewees had little optimism about the future in this respect. In turn, they emphasised that EU subsidies often proved to be helpful in overcoming similar challenges in the past and expected them to be an important form of assistance in transitioning towards more climate-conscious farming. Overall, they were somewhat in favour of the subsidies to adopt a more result-oriented emphasis.

Moreover, as discussed above, the farmers were concerned with the vulnerability of their farms to environmental and climatic phenomena also from the economic perspective. All of the interviewees pointed to different phenomena observed in the climatic regions and on farms directly. In particular, disasters such as droughts, floods and frosts, were mentioned. Significant issues were also noted in terms of water management, which was considered to be an issue beyond the scope of influence of a single farm. For instance, one of the farmers noted that uncoordinated water management practices on neighbouring farms endangered positive outcomes of a farm managed in an organic way. The environmental factors, thus, have a visible influence on farm economy as the productivity of the farms is often adversely affected, in addition to the possible hampering effect on the public image of the farm.

Few farmers had concretely experienced positive synergies between environmental management and economic profitability, instead, trade-offs were more common. Often short term economic limitations (lower productivity) stood in the way of environmental management or practises. Also from the economic viewpoint, they stressed the need for a more coordinated effort, such as the development and implementation of water management strategies at the watershed level rather than a single farm.

Some promising approaches to farm economy were noted within the promotion of various certifications. The farmers participating in this survey applied standards and acquired labelling (or are currently in the process) associated with the EU Organic Farming, Demeter and GlobalG.A.P. Some of the practices under those standards are also closely linked with carbon farming and other popular approaches, such as agroecology, conservation agriculture or biodynamic farming. Most of the farmers were positive about their impact, both from the perspective of farm economy and actual agro-environmental practice. However, they also complained that the system involves too much paperwork and controls from the certifying authorities. Compliance with these is often time-consuming and burdensome, and it reduces capacities to engage in farm work. Two farmers mentioned that for them organic certification was less cost-efficient than conventional farming, and they moved away from it or continued with the mixed model (partly organic, partly conventional farming). Notably, organic farming labelling proved to be successful when it targeted the ecologically conscious customers and when the farm was well connected to the value chain. However, it appeared to be more difficult in the case of animal feed-oriented production.

With a view on the transition towards the carbon farming schemes and related credits system, most farmers lacked clarity about the potential risks, especially those associated with their incomes. At present, the experience of farmers with participation in the organised carbon farming schemes is very limited, and so is their awareness of the potential benefits of the system. Even though some of their practices currently comply with those promoted under carbon farming, most of the farmers did not see clear differences between organic farming, agroecology and similar conceptual framings for the practices. The majority of the farmers were interested in expanding their carbon-friendly practices. However, some safety nets were sought, especially to compensate the perceived risk of decreased productivity (even if temporarily). In this context, they expressed diverging opinions on whether these should be ensured by the public or private sectors[13]. Clearly, there are still fundamental differences on how different farmers across Europe assess the economic benefit of environmental management. For some, environmental management still means compromises with yields and economic returns, while there are also positive examples on the positive synergies with environmental measures and the productivity of the business.

[13] Farmers were aware that decreasing short term economic productivity from carbon farming measures could be justified 'income forgone' and thus form a qualified basis for public compensation through the CAP.

4.2.3. Applicability of carbon farming practices

The results from the case farm modelling calculations (Rimhanen et al. 2022) present the obvious potential of organic soil amendment as a carbon sequestration measure. There is also an observable distinction between smaller and larger farms, where measures such as diversifying crop rotations and manure application seem to work better on smaller farms while larger farms would need a variety of sources for organic matter addition. Finely tuned measures, such as reduced cut on grasslands (leaving grass longer between harvests for increased photosynthesis), can yield a significant impact on carbon storage and increase in soil organic matter. There was also an encouraging example from a farm in Northern Italy, which succeeded in increasing soil organic carbon content from 1 per cent to 2 per cent (two-fold) in five years with crop rotation, reduced use of chemical fertilisers and organic fertilisers.

For the farmers included in the study, a common priority is the productivity of their business and their ability to control the production and land use on their farm according to the market situation. Carbon sequestration is an issue that most of the farmers do not actively consider or pursue; the choice of crops and farming practices is made on grounds other than carbon sequestration potential.

4.2.4. Historical, cultural, structural and market considerations

The interviews considered the different historical and structural contexts of the farmers. The results reflected observations in the historical context of Germany, Italy, Ireland, Poland, Croatia, Estonia and Finland. Historical, structural and market factors affected countries and regions in different ways. In the last two decades, especially following the accession of former socialist states to the EU, visible and often radical transitions have occurred.

Among these, the decline in smallholder farming and rising average age of the farming population has turned out to be one of the most critical issues. These developments were strongly emphasised by the interviewed farmers. With aging farmer basis, the future of the farm, at least in its existing form, is at risk.

The number of active farmers is decreasing in the EU and this poses strategic risks to maintaining the vitality of the agricultural sector and ensuring food security for the EU. In many regions, semi-subsistence, low-intensity and smallholder farm types have been overtaken or replaced by the emergence of large agricultural holdings or urban expansion. Land consolidation and the further professionalisation of the farming businesses allows farmers to increase their production capacities and strengthen their position in the market. However, small and medium size farmers often lacked such capacities (financial or other).

Another challenge identified was the lack of or low willingness of farmers to collaborate with each other when it comes to solving climate challenges. This was especially stressed in the countries with the legacy of post-Soviet farming. In those countries and regions, farmers have a

deep-rooted fear of engaging in collaborative models and seek more individual management practices. There is also limited support available for the relevant public authorities in this respect. Farmers were convinced that cooperation is needed but doubted this would be possible, given that there is a lack of clarity regarding the added value or misconceptions about the collective farming models (often rooted in the past trauma of collective farming).

4.2.5. Social considerations

One of the key challenges in all socio-cultural contexts currently is farm employment. The interviews revealed the importance of farm labour. While on smaller farms the work has been performed mostly by the farm owners and their families, larger farms rely greatly on hired workers. These workers are either recruited as permanent staff (e.g. farm technicians, engineers) or as seasonal workers (especially for harvest time). Seasonal workers were especially sought among immigrants or temporary labourers. Most of the farms viewed challenges associated with recruiting and retaining workers as considerable and crucial for the overall farm performance. Even for large farms, where manual workforce has been replaced with technology and digitalisation to a great extent, the issues were still persistent.

Most of the farms complied with the standard legal requirements for the social security and safety of workers. In some cases, more investments were made (or planned) to provide more contract stability for farm workers, such as permanent employment contracts. Investments in farm facilities have also been made, including improved lodging conditions and a safer working environment (e.g. through the reduction of pesticides and other substances adversely impacting human health). Maintaining regular connections between workers and their families, often living in other countries, has also been supported.

Enhancements of employment conditions were especially stipulated with participation of the farms in the GlobalG.A.P. scheme and through the employment of vulnerable groups in collaboration with local authorities or civil society organisations, oriented towards the improvement of the working and living conditions of immigrants. Furthermore, investments were made (or planned) in employee development, including training on more environmentally friendly practices. The findings indicate that good working conditions and developed personnel strategies are emphasised more in agricultural systems which are more knowledge and skills-intensive than more straightforward industrial monoculture systems.

4.2.6. Carbon contracts

Carbon contracts were a novelty for the interviewed farmers and revealed that the farmers lack the relevant practical experience in this respect. Therefore, the rating and ranking of different potential carbon contract models was not realistic in this study. Most of the farmers, however, welcomed the idea and elaborated on possible conditions under which it

could be implemented. Above all, the interviewed farmers uniformly preferred shorter-term contracts, in line with the farm planning horizon of a maximum of five years. However, those who were also forest owners, admitted that more time is needed to observe visible results. The preference for short-term solutions was related to a number of factors, such as the poor predictability of future incidents in the farming systems subject to natural phenomena, the flexibility consequently needed in farm management decisions as well as the seniority of the farmer. All of these factors hinder planning for the very long term. These factors are in obvious conflict with the objective of guaranteeing the permanence of carbon credits (additional sinks) in the market. For many, five years could be the optimal length of a carbon contract in the prevailing and perceivable situation. There is a clear difference in the preferences of the interviewed farmers and the respondents to the survey (representing a broader group of stakeholders in the agri-food value chain) who were more inclined to accept longer contracts of 10 years or more.

Mixed opinions were expressed in terms of individual and shared contractual obligations. Some respondents believed that farmers would have difficulty collaborating on this matter, while others were more optimistic. However, carbon pooling at the regional level is seen as more beneficial in meeting the overall climatic objectives at large as, in the opinion of farmers, an individual farm usually has limited environmental impact. To better understand the management and governance options, the farmers suggested that a strategy development process, bringing together farmers and decision-makers, could raise awareness of the issue, promote consensus, and tailor solutions to the specific farms and regions.

For the interviewed farmers, the carbon market and carbon contracts do not yet represent a tangible mechanism on which they could form an educated opinion. This is largely because farmers have not yet had an opportunity to participate in a real-life carbon credit scheme. The survey results offer some indication of the stakeholders' preferences regarding specific criteria and contract conditions; however, on average, the survey respondents had more awareness of carbon payments than the interviewed farmers.

As a reference model for carbon contracts, the interviews used the model following the Carbon Contracts for Difference concept used in incentivising low-carbon energy solutions (see i.a. NEOT 2021, Sartor & Bataille 2019). The key element of the contract model, a guaranteed price for carbon, was something the farmers, in this prevailing uncertain and speculative situation, could be willing to consider. Therefore, the interviews provide encouragement to further exploration of this model as a basis for a carbon farming incentive scheme in agriculture as there are many aspects which could be aligned with both farmer and societal preferences. Farmers also expressed interest in real-life pilots if there was a risk-free way of participating in these and the opportunity of getting more data on their farms and increasing their knowledge in general.

4.2.7. The baseline dilemma

The challenge in establishing the baseline against which additional permanent sequestered carbon is measured and accounted for permeates most of the discussions on carbon farming incentives and result-based environmental compensations in CAP. As noted also in the context of carbon modelling in the case farms,

"the potential for C sequestration is higher on farms which have homogenous cereal production compared with more diverse farms, having already put carbon farming practices into operation. For all carbon farming practices, C sequestration is the fastest during the first five years after introduction. The rapid decomposition of C in the soil requires the maintenance of carbon farming practices on the farm to keep the C in the soil and prevent C losses." (Rimhanen et al. 2022).

The interviewed farmers were more or less aware of this and have become alert to fairness and equality with respect to carbon farming rewards, whether from the market or from CAP. Once carbon sequestration becomes a commodity, and more urgently when it becomes a tradable commodity, the carbon accumulated in the soil due to the farmers' management actions in the preceding years or decades should be equally accounted for. Consequently, at a certain point, it requires incremental effort just to maintain the new (higher) soil carbon stock level. Therefore, contracts should also take into account and reward also those farmers who are making an extra effort to maintain soil carbon stocks.

This represents a major challenge for the policy framework to incentivise carbon farming by public and private funds. It is not straightforward to align the objective of increasing natural carbon sinks in agriculture and supporting and rewarding farmers in transition to sustainable production in the holistic perspective with measures which are also accepted as fair and just by all farmers.

4.3. Results from the test trading

The test trading was performed with credits based on the Soil Amendment Carbon Removal Methodology[14] on the puro.earth platform. During this EU LIFE project, three separate carbon credit projects were identified and selected to be verified according to the methodology. In Finland, the project was operationalized, but in France and the UK, the operationalization of the projects remains pending.

Verification of the projects required input data from the proponent and third-party verification of conformity to the requirements of the Soil Amendment methodology. The project in Finland passed the verification, the two others passed the sampling and laboratory test as well as decay modelling (Yasso 07[15]) but did not yet have third party verification finalised as of March 2022.

[14] https://puro.earth/CORC-co2-removal-certificate/carbon-removals-from-finnish-agriculture-100044, https://puro.earth/articles/introducing-corc20-and-the-soil-amendment-methodology-647
[15] Finnish Meteorological Institute, https://en.ilmatieteenlaitos.fi/yasso-description#Yasso07

The project from Finland listed their Soil Amendments credits for sales in August 2021. The price is set by the seller on the Puro.earth platform. The price was set at 52 euros per tonne CO_2 stored for 20 years. Marketing was done in social media, newsletters and in one-to-one meetings. Soil Amendment credits were also offered in corporate RFQs when meeting the criteria set by the buyer.

Interest was high and resulted in many views but yielded only a few trade transactions. After the first seven months of the test trading running in one project (Soil Amendment, Finland), five trades were completed for 58 credits with some negotiations remaining open. In the next two months (March-April) seven more trades were completed with a total 1553 credits, giving a total of 1611 credits sold at 52 € each (***Figure 4.2***). Negotiations for the trades that were completed later (between February-May) were, however, started when the credits were put for sale. The biggest trades were completed at the end of the period, so the larger buyers underwent a more meticulous process to weigh different options and to assess the quality of the credits for their needs.

Once a trade is completed, ownership of the Soil Amendment credits is transferred in the Puro Registry. The buyer decides when and how to claim the carbon credits. The process is called retirement and retired credits can no longer be traded or change ownership. Retirements are available in the Puro.earth Registry[16].

Date	Even type	Retired corcs	Credit type	Methodology	Beneficiary	Retirement purpose	Country of consumption
2021-08-18	Retirement	1	CORC 20+	Soil Amendment	Not available	Not available	Finland
2021-10-21	Retirement	12	CORC 20+	Soil Amendment	Lehmus Roastery Oy	To compensate our emissions from roasting coffee. 100044-001	Finland
2021-12-23	Retirement	40	CORC 20+	Soil Amendment	Not available	Not available	Finland
2022-01-27	Retirement	5	CORC 20+	Soil Amendment	Not available	Not available	Germany
2022-03-16	Retirement	77	CORC 20+	Soil Amendment	Ilmasto-rahasto Oy	The Finnish Climate Funds 2021 own activities carbon footprint cancellation. 100044-001	Finland
2022-03-21	Retirement	20	CORC 20+	Soil Amendment	Gomo AB	To immediately cancel our travel emissions. 100044-001	Sweden
2022-05-12	Retirement	50	CORC 20+	Soil Amendment	Tampereen kaupunki	Retired by Nordic Offset Oy on behalf of the beneficiary	Finland
2022-05-18	Retirement	10	CORC 20+	Soil Amendment	Boliden Harjavalta Oy	Retired by Nordic Offset Oy on behalf of the beneficiary	Finland
2022-05-18	Retirement	470	CORC 20+	Soil Amendment	Boliden Harjavalta Oy	Retired by Nordic Offset Oy on behalf of the beneficiary	Finland

Figure 4.2 Extract from the carbon removal credit (CORC) registry of Puro.earth showing retired soil amendment credits as of May 2022. Note that not all the reported sales are yet recorded as 'retired' and thus may not show here.

[16] https://registry.puro.earth/carbon-sequestration

The main concerns and confusion on the demand side were related to the claim and retirements. Buyers were unclear about the 20-year durability of the carbon storage and the kind of claim it justifies. Also, already well below the price level of 52 euros per tonne CO2, the voluntary carbon markets offer multiple options from emission reductions with better cooking stoves[17] to forest management credits. Those traditional credit types are perhaps easier to communicate to buyers' customers than Soil Amendment credits.

The consent of farmers to participate was received digitally by the project proponent, the party that centrally managed the logistics and processing of the Soil Amendment materials. Over 80 per cent of the farmers wanted to participate and be represented jointly by the central party. The 20-year permanence was not a difficulty in this case. The 20-year durability requires one spreading of the Soil Amendment, and the Yasso modelling result and lab result indicate how much of that remains in the soil after 20 years. Only the share (roughly 20 per cent) that remains is contracted to the buyer as CORC20 credits. The lifetime emissions according the LCA assessment are deducted from the stored carbon to get the net sequestered tonnes of carbon dioxide represented by the CORC20.

The three projects all executed the sustainable carbon cycles of re-purposing carboneous material to better use as soil enrichment in place of combusting or composting the biomass. The material was derived from the paper industry, biogas industry or food and agri sectors. The summarised results and conclusions from the test trading are presented together with other data sources in Chapter 6.

[17] For a critical look at the offset project by Impact Carbon, see https://yle.fi/uutiset/3-12445402 (Finnish broadcasting company YLE, article in Finnish).

5. Ten key considerations for the future carbon farming framework

As our study revealed, EU farming systems will be increasingly confronted with the challenges associated with the expansion of carbon markets. The coming changes in land use and farm production capacity are coupled with many other issues, such as the ageing farming population or the limited availability of workforce on farms. Moreover, we examined the existing mechanisms at the EU, national and regional levels, where actions could possibly take place.

On the basis of the interviews with farmers and the lessons learned from the test trading, we propose ten key considerations for the development of incentives for farmers. These will possibly accelerate the adoption of carbon farming practices, increase carbon sequestration and other environmental benefits and provide opportunities to produce tradable carbon credits for the voluntary market. We identified several areas in which action is needed in order to ensure that the transition to carbon farming is smooth. Increased collaboration between the different stakeholders and authorities will be also necessary to prevent and mitigate the adverse effects of this transition process.

5.1. Public subsidies are needed to pave the way and enhance collaboration

Public subsidies, notably through CAP, are important for promoting carbon farming practices and overall profitability in the farming sector. CAP payments are generally vital for maintaining the viability of farming, balancing income and, of increasing importance, helping to adapt to external shocks related to the changing climate and associated market implications. In terms of agri-environment-climate payments, further steps should be taken to explore and increase the result-orientation of the payments.

Public subsidies could also play a role in supporting collaboration between farmers or other stakeholder groups dealing with carbon farming. Collaboration is necessary to address climate impacts in agriculture, but there are big differences in the resources, means and traditions for collaboration across countries and cultural contexts. Collaboration platforms connected to the Agricultural Knowledge and Innovation Systems (AKIS) should be supported. The CAP could also more strongly support regional cooperation and collective approaches which could improve the accessibility of individual land managers to the carbon market. Collaborative schemes can be more efficient also from the perspective of transaction costs and monitoring performance towards the climate targets.

5.2. Knowledge and advice must be extended to accelerate adoption

There is a big disparity in the availability, thematic scope and quality of agricultural advisory service (Farm Advisory Service, FAS) for farmers around Europe. The lack of advice, support and knowledge are the key barriers to the adoption of new practices. This is one of the fundamental aspects in the transition to more sustainable agricultural systems. The need for information, advice and peer support is greatest in the transition, when one is learning something new and testing the viability of alternative crop rotations or cultivation systems. Furthermore, overall, sustainable production systems, which, by definition, are less dependent on external imported and fossil-based inputs (fertilisers, pesticides, energy), are, in exchange, more knowledge-intensive, requiring more human and intellectual input. This calls for more attention on the whole of AKIS (agricultural knowledge and innovation systems) involving research, extension agents, advisors and peer-groups, supported by data, intelligence, shared platforms and awareness raising. Farm Advisory Services could actively contribute to the knowledge capacity building of farmers, by providing opportunities for knowledge sharing among farmers (peer-to-peer learning) and disseminating knowledge on practices related to carbon farming. An idea about a community of practice focused on carbon farming is worth exploring, for instance as an EIP Operational Group. There are existing local and regional initiatives to learn from and build on (e.g. European Carbon Farmers, Carbon Action, the SCARF network of EIT Climate-KIC and the 4-per-1000 community). The EU research infrastructures through bodies such as the SCAR-AKIS and the emerging Living Labs of carbon farming can facilitate exchange and learning, also involving national authorities.

5.3. Carbon farming practices and how they are implemented needs more precision

A clear definition and common understanding of carbon farming is missing. However, farmers do recognise the individual practices associated with carbon farming.

Partially, the carbon farming practices can be seen as linking closely to other conceptual approaches, such as agroecology, conservation agriculture, biodynamic and organic farming. Certain certification and labelling requirements include measures which could have positive impacts on carbon sequestration. Overall, there is still a visible knowledge gap and a need for more knowledge development and sharing on the topic of carbon farming with farmers and other interests.

With the lack of definition there is a risk that farmers may reject the whole idea of carbon farming as nothing new. When carbon farming is just presented as a list of good practices, such as minimum tillage or green cover, it can easily lead to its neglection or dismissal. As a result, we may go wrong and achieve nothing if carbon farming is promoted just through good practices.

The definition of carbon farming must acknowledge the fundamental role of carbon as a key component that maintains life above and underground. Carbon plays a critical role for soil structure and nutrient cycling between soil and plants. Carbon is also biodiversity underground and carbon farming is expected to benefit biodiversity above the ground. However, failing to understand the link between soil carbon and productivity compromises the ground for making the win-win case for biodiversity and carbon. Awareness raising on this fundamental point (e.g. through advisory and public campaigns) should follow the definition.

Farmers also need practically useful information in their own farming context of the measures and their effect. Therefore, it could be helpful to identify and catalogue the practices, applicability and effects in different climate and soil conditions and thereby support exchange, learning and advice.

5.4. Carbon farming needs to be defined relative to existing labels

Market-driven certification standards can positively encourage farmers to implement carbon farming measures. Farmers who produce with an orientation towards reaching ecologically and climate-aware consumers currently benefit from increased sales through certifications (e.g. GlobalG.A.P, EU Organic Label), which are, however, not specifically oriented towards carbon farming. Acquisition of the certification (label) normally requires compliance with the standards, which to some limited extent may overlap with carbon farming practices. In the carbon markets, some voluntary standards have already been applied in various sectors, such as, for instance, the Gold Standard[18], promoted by WWF and other NGOs for benchmarking. These standards increasingly often do not solely focus on the climate or environmental effects but also on social safeguards.

The lack of clarity in the definitions for carbon farming and practices associated with, for example, organic farming, agroecology, nature-based solutions, climate-smart agriculture, etc., is confusing for farmers. In this context, there are two options: (1) reconsider the existing certification/labelling schemes with a view to supporting carbon farming practices, or (2) develop a new dedicated certification/labelling scheme to focus on carbon farming. Participation in the schemes could be encouraged but remain voluntary. Definitions need to be aligned also with CAP, for instance, and the foreseen role of the policy to support transition and different parallel environmental emphases. For instance, one should note also that following the regulation concerning the CAP Strategic Plans (EC 2021/2115), no further requirements should be imposed on organic farming concerning crop rotation, which is a measure associated with carbon farming. The view that organic farming exceeds the baseline with respect to crop rotation does not, however, mean that it automatically meets the baseline from the carbon farming perspective.

[18] https://www.goldstandard.org/articles/gold-standard-emission-reductions

The evidence also shows, however, that certification (e.g. organic) does not always systematically advance the interests and objectives of the label or translate into increased income for the farmer. Factors affecting this come from the purchasing parties and contracts, costs associated with the label or lack of valuation of the label in connection with, for example, animal feed. Therefore, this kind of incentive will probably work better for certain sectors, where consumers' awareness and purchasing capacity are higher or can be increased, with a realistic timeline in view. Targeted awareness-raising campaigns for different actors in the value chain, especially focusing on consumers and their conscious decisions, are needed in general and to accompany the labels.

5.5. Data and information are fundamental

Data is fundamental in modern governance systems. The extent, quality and reliability of data often determine the feasibility of management measures. The need for better and more accurate data is emphasised on the EU level (e.g. Commission FaST initiative[19]) by the food industry in its value chain management strategies as well as farmers who need it to optimise farm management and also for exploiting the options in the emerging carbon markets and opportunities for various sustainability or responsibility premia. Farmers increasingly manage their farms on the basis of exact data and need data and information to support decision-making. What is not measured is not factored in.

The carbon farming business models discussed here require specific metrics and monitoring to work. Information and data are therefore key prerequisites to informed decision-making in the carbon markets. In particular, broader applicability and scalability—to provide carbon market access to as large a group of small and big farmers as possible—put more demands on data and digital intelligence.

Digitalisation offers the possibility to differentiate management mechanisms and their impact and verify carbon contracts (e.g. through blockchain technology) based on farm-specific data combined with local environmental and meteorological data. This could also help the aim of increasing the adaptive capacity of the MRV system to accommodate small producers. It should be investigated how the information collected through farm support payments and the FaST tool could be shared with carbon market actors, including MRV and registry purposes.

Data and information are already in high demand by the food industry for supply chain management and climate strategies. Greater use could also be made of the existing open data platforms and farmers need to be encouraged to contribute to these. Moreover, the sharing of data and standardisation need to be promoted. The use of existing EU instruments can be valuable, such as the INSPIRE geospatial infrastructure that allows for improving coherence and interoperability of data across the different regions and countries.

[19] https://fastplatform.eu/

Besides the food chain and the carbon market MRV, financing and capital markets are entering the field with differentiated asset and risk valuations based on environmental and climate parameters. The added potential of the financial market to boost transition needs reliable and credible data to be utilised.

Furthermore, advanced use of data should take into account the human capacities needed. While the measurements on-site are rather expensive and time-consuming, geospatial methods and modelling could be more cost-efficient solutions. In either case, there are specific needs in terms of knowledge and skills which may not be met by farmers directly. A well-educated personnel and infrastructure would be necessary to work with data collected, for instance, via remote sensing.

Despite the advancements in the private market, overall, creating the scientific basis and data protocols is clearly within the role of the public sphere to adopt. This is the only way to maintain and also regulate the evident issues in guaranteeing sufficient openness and access to data while enforcing due privacy with personal and sensitive information. It is critical that research funding and steering are aimed systematically and comprehensively, not forgetting the required changes in policy and regulation to incentivise more precise and place-based management. As the management of the carbon farming market is complex, this may also require more investments in the development of comprehensive decision support systems, which are based on careful consideration of the indicators that can best detect the interlinked effects in this complex natural environment of arable farming and forestry. For this purpose, the mobilisation of the expertise in various areas (including climate, economics and social aspects) may be necessary to help with informed decision-making. In this area, the EU can provide particular support though investments in dedicated R&I programmes and projects.

As a benchmark and point of departure for deeper EU cooperation on data and the MRV system, a concept for a carbon sequestration verification system has been developed in the Finnish Carbon Action platform through the coordination of the Finnish Meteorological Institute (Fer et al. 2021, FMI 2021). The scheme of the system, which is scalable and could integrate a variety of ecosystem parameters and utilise an array of ecosystem models, is depicted in Figure 5.1 below. It is geared towards serving the voluntary carbon market, GHG inventory as well as primary production value chain management needs.

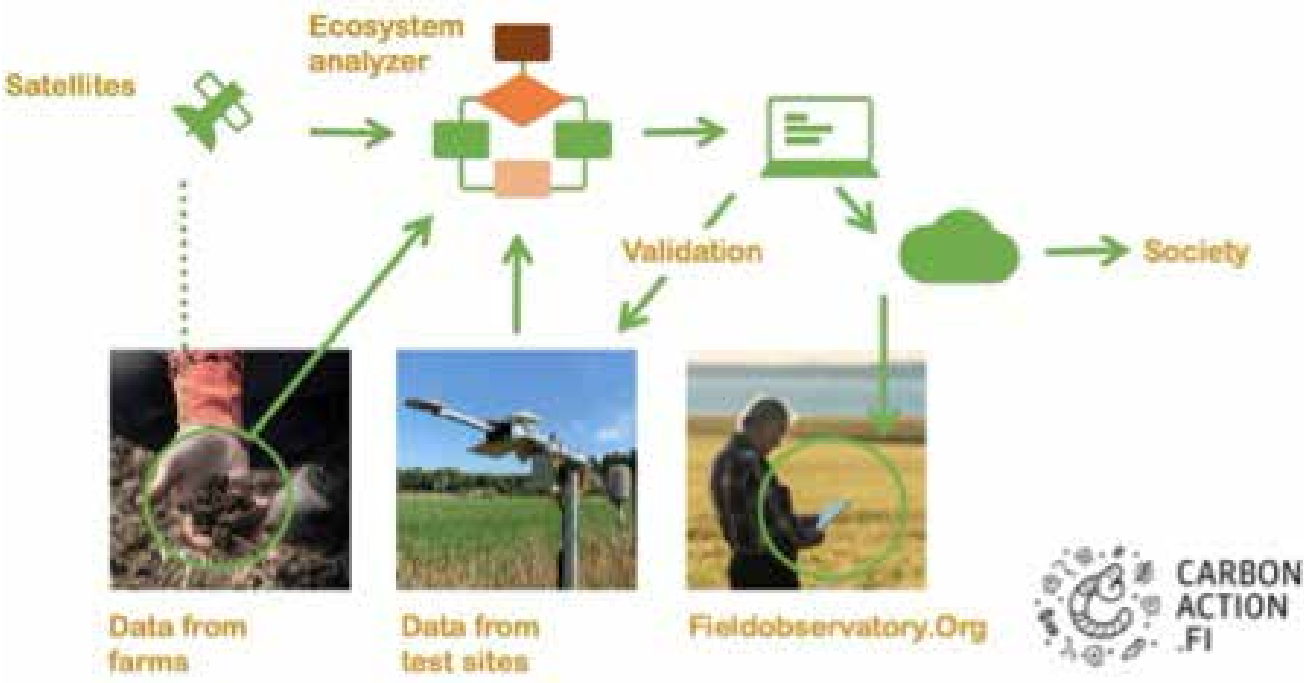

Figure 5.1 FMI verification methodology for the land ecosystem's carbon sequestration (FMI 2021).

5.6. Pilots with different methodologies help design carbon contract models

The average farmer, however environmentally aware, has barely heard of the carbon market and considered the possibility of getting paid to sequester atmospheric CO2. This means that farmers in general are still oblivious to the complexities of the carbon market and the potentially fundamental changes it may bring to their position as land managers and food producers.

Nature-based carbon sequestration and agricultural and forestry carbon sinks cannot be vacuumed out of the natural system or local communities. It is imperative that large-scale nature-based carbon sequestration happens within the boundaries of sustainability of each local context, each production system and value chain and does not risk negative or uncontrollable consequences globally. The farm level is an appropriate context to verify that carbon sequestering activities are sustainable and bring about other private and public benefits as well.

Admittedly, in some cases, this scale is too small or negligible, but that makes only stronger the case that the individual carbon projects, methodologies or incentive schemes need to meet equally high criteria. The difficulty, however, is exactly in the fact that agriculture is

local, biodiversity is local and the socio-economic context is local. No management measure has exactly the same effect across different locations or regions. For agriculture, this means that each farm, each region, must find, implement and adapt its own unique form of carbon farming. Which further stresses the need to develop the structures for information, knowledge and learning.

Due to the apparent mismatch in expectations in contract length and guaranteed permanence across the supply and demand sides (see Chapters 4 and 6), there is a need to assess the related trade-offs and manage the imbalance. The contracts should not be too sophisticated, to avoid unnecessary complexity of the applications and administrative burdens, including controls.

As has been shown by the interest of stakeholders across Europe in the results and methodology of the test trading carried out in this project, such pilots can support the discussion and understanding of the practical implications of carbon market scheme attributes. Based on our experience, trading pilots can help identify differences in applicability and effect of action-based or result-based credits or enable defining the boundary between these in hybrid models or schemes combining public and private funds.

5.7. Risk of land consolidation at the expense of decentralised agriculture

There is a risk that the carbon credit system and market could accelerate the current centralisation, industrialisation and consolidation of agriculture and agricultural land use. There are visible imbalances between the different types of entities operating the farming systems. Business-to-business transactions will most likely be the dominant driver in the carbon market. In contrast, the regular smallholder and family farmers are often insufficiently equipped and lack experience in and even access to the markets. The risk and mitigation measures to prevent land consolidation for carbon sequestration at the expense of diversified agriculture need to be considered.

In particular, the immediate treats that small farmers face should be recognised and mitigated. This could be, for instance, enabled with improved access to finance. Specific financial instruments could be created, which would help facilitate a smooth transition towards carbon farming systems. These could include financial support in mitigating the adverse effects of innovative practices on decreasing farm productivity and incomes associated with more conventional approaches. Both public and private funds could be considered to fill this gap.

Another important sphere in which changes could be sought is regulatory provisions. Decision-makers at the EU and national levels could work towards creating the minimum safeguards for farmers and use impact assessments at the regional level in anticipation of any larger investments. The scale of potential investments could be analysed and assessed against the

criteria set up by the relevant framework, in a similar way to what is currently practised in many countries using social and environmental impact assessment standards. To this end, it is also important that the communities affected are actively involved in decision-making and able to express their consent concerning the direction of investments. Additionally, land tenure and land purchase legislation, which is highly diverse in the EU, could be examined.

5.8. Open dialogue and coordination at the national level

Due to the uncertainties and risks identified, farmers and other stakeholders, including the broader society, need to engage in open dialogue about what precisely is the desired path and state what we are aiming for. Authorities on the national level could support this by, for instance, enhanced coordination between the different institutions responsible for climate and agriculture policies, at the inter-ministerial or even higher level (e.g. the Prime Minister's office). Generally, a more strategic approach is needed to understand the role of the carbon market in tackling the challenge of climate change. Farmers could be involved in the joint development of the strategy to address climate challenges in agriculture and embedding carbon farming measures. The AKIS, peer-learning and awareness-raising campaigns discussed above can serve both as convening platforms and for joint capacity building.

For the farmer, it is never about just carbon or nitrogen or no-till or catch crops. It is about their farm and their livelihood. New sources of extra income can help but, in the end, it is a question of the sustainability of their core business that matters. When designing incentive systems that are intended to work in agriculture or forestry at scale, one must have a context-specific understanding of the key components of the sustainability of productivity and the farm business and build smart incentive and market systems which respond to a multitude of objectives and which do not compromise the viability of productive agriculture or cause unintended structural disruption in the production systems in any country or region. This understanding should be embedded at the national and international strategic levels in carbon market governance design.

5.9. More practical awareness and coordination needed at strategic levels

Farmers pointed to the gaps in knowledge about carbon farming, which is widespread among the EU's farming community. On the ground, most farmers still possess a limited understanding of how they can contribute to carbon sequestration. Most of them are able to clearly identify the climate effects on their farms and certain risks associated with the activity. In this context, they raised a point that more capacity building efforts are needed, not only among farmers but also other relevant stakeholder groups dealing with farming systems.

There is a need for awareness-raising campaigns and improved collaboration between the different entities of the European Commission. Similarly, this is required at the national level to ensure that the support lines are coordinated and that the agricultural, environmental and economic aspects of the system are well understood and aligned. The coordination effort is limited and often the support for environmental management is lacking the understanding of the economic impacts which are associated with certain practices. Eventually, a new institution or a task force could be set up.

Farmers are also confused about the rapid rate at which the private market is entering their space with an interest in soil carbon sequestration and carbon trading. This calls for strategic level coordination also to follow and steer the private market. In contrast to the public sector, the private sector has already progressed by setting up a dedicated network and some farmers have organised themselves. Some steps have been already taken by the WBCSD to recognise relevant Farming Carbon Practices, and promote awareness and voluntary standards in the business sector. The carbon credits market is currently strong in dynamics and increasingly affecting agriculture around the globe. Private sector entities and financial sector players are highly involved in shaping this dynamic. Many farmers and public authorities, however, are not yet sufficiently informed about the potential benefits and risks associated with these practices. The monitoring mechanisms for tracing the impacts of carbon markets on agriculture are still nascent.

At present, the efforts oriented on regulating carbon markets in the EU are still little visible at the national and local level. In this context, farmers would welcome more coordinated action at the EU, national and regional levels. A strategic approach should be promoted, which will involve the joint setting of objectives and targets to be met. This needs to have sufficient focus on the practice and details of the technical, legal and moral aspects. Specific targeted action plans for agriculture climate commitments could be developed by farmers and other stakeholders. In this context, farmers need to understand the climate goals for agriculture and be involved in setting them and defining actions. Subsequently, mechanisms can be put in place (either public or market-driven) that will provide instruments that enable the implementation of those action plans in practice.

5.10. The carbon market calls for careful attention to the role of the capital market

Land managers also direct attention to the legal context of the carbon market. It is critical to create the conditions which will, on the one hand, create favourable market conditions for the investors while, on the other, protect the most vulnerable players, such as small farmers. The legislation should take into account not only the European context and set up of the business, but also consider that the carbon market is global and diverse. It is also characterised by visible competition and varied land prices. In this context, the Common

Market Organisation and especially the competition rules should be reconsidered, enabling fair access to the carbon markets and, at the same time, providing safety nets to those who could be adversely affected by the developments in this business.

Following the EU's internal capital market rules, a registry of investors would be helpful to monitor the developments on the carbon markets. One could also consider whether the carbon market investments would simply involve a credit system or should they be part of a major transition towards more sustainable and climate-friendly agriculture in the EU. In this context, several EU policies and programmes could play a major role by providing targeted financial incentives, i.e. direct subsidies or loans to farmers and other stakeholders in the carbon market that would help facilitate the transition process.

The sustainable financing taxonomy and ecolabel for financing could be the mechanisms to ensure the necessary safeguards for farmers from global risk capital. The EU introduced the Taxonomy Regulation (Regulation (EU) 2020/852) establishing six environmental objectives and four conditions to be met in order to be considered as sustainable. These could be considered as starting points for further specification in the context of the carbon market. Especially the technical screening criteria, which detail the climate change adaptation and mitigation activities, could be used and coupled with the EU funding priorities. Some forms of blended finance could also be promoted to reinforce the capacities of farmers and other players to participate in the carbon markets. With the help of these, participating companies could gain monetary and other incentives to reduce their carbon emissions and sequestrate carbon via farming activities.

At the global level, various funds operate that allow for incentivising climate transition projects at the national level, especially in developing countries. The EU countries greatly contribute to these as donors. Examples of the funds include the Green Climate Fund, Adaptation Fund and Global Environment Facility, among others. They foster large-scale projects at the national and sometimes international levels that enable climate-friendly transitions in agriculture and other sectors. They are also increasingly integrated with the financial sector, interested in collaboration and improving their contribution to mitigation and adaptation to adverse climate impacts. The carbon farming markets could learn from those collaborative approaches and projects. For instance, several projects financed by those funds promoted climate smart agriculture, which also provide insightful approaches to promoting and accounting carbon sequestration.

6. Conclusion

This report covers the outcome of the three main components in Activity A4 of the EU LIFE CarbonFarmingScheme project: online surveys, interviews with farmers and test trading with credits. With respect to the aim of incentivising carbon farming and the expectations and preferences regarding the future European carbon market, based on stakeholder input, the report concludes the following.

The two sides of the voluntary carbon market–supply by farmers and foresters and demand from the non-mandated sectors–seem to be far apart in their expectations. The contrast is big in terms of price and the permanence of carbon credits. However, the two sides are closer together when it comes to their expectations concerning co-benefits, which both sides consider to be very important. As for permanence, farmers have difficulty in making commitments that last longer than five years, whereas buyers find the 20-year durability of the credits in the trading pilot confusingly short. The same contradiction applies to price. Buyers find 50 €/tCO2 price high for 20-year credits, whereas farmers expect to be paid four times that price for the same measure.

This big contrast between the market participants can be seen in two ways. With this evidence, there is no basis for a market-based solution when supply and demand requirements are so far apart. The preference for co-benefits when factored in as additional criteria can offer a win-win plateau. A successful scheme would be based on local supply of measures which carry broader environmental benefits for, among other things, soil health and biodiversity. Reliable data and information accessible to all actors is a key prerequisite for mutual trust and the consequent viability of the carbon market. Once there is a common information basis, if the contract price and terms can be negotiated to satisfy both parties, the market can pick up voluntarily. Carbon farming contracts must mitigate the risks and concerns for both buyers and sellers/farmers. For buyers, the biggest risks are the accusations of green washing. For sellers/farmers, the rigidity and liabilities that limit their farming decisions are the biggest threats. Despite this mismatch in expectations between supply and demand, there is an opportunity for win-wins. However, when and where there are large gaps between the market parties–as we can see in the table below for price, durability and other terms–the carbon credit markets will take time to mature as a voluntary mechanism, unless it is enforced through a mandatory policy. ***Table 6.1*** below presents the key findings with respect to the carbon market from the different data inputs in this study.

With respect to incentivising sustainable carbon farming measures in general among farmers and foresters, the clear message from the primary producers is that the incentives have to align with overall productivity and the viability of the business, growing food, feed and timber. In parallel, a positive impact on the environment and local community in general

should be ensured. Public policy and support programmes (e.g. CAP) play an important role economically, but also in building knowledge and providing advisory support. Reliable and accurate data and MRV are considered fundamental also by land managers. The carbon market connects to many fundamental issues also in property rights, capital investments and socio-economic dynamics, which make farmers and foresters call for broad societal dialogue and multi-level strategies to ensure that the development takes a fair and sustainable path.

Aspects of voluntary CS contracts	Supply survey	Farm interviews	Test trading	Aggregated findings in this study (project activity A4)
Price / expected income to farm	30–100 €/ha/a per activity	At minimum, expect risk-free cost coverage and annual payment.	16 €/ha/a (Price set by seller was 50 €/tCO2 net stored for 20 years and it is shared 33% farm, 33% fibre, 33% Process)	**Price demand by seller is higher than expected and higher than current nature-based carbon market**
Permanence and durability of the carbon storage	5–10 years preferred contract length max. 10 years	Preference for 1–5 year contracts	20 years (based on the methodology for soil improvers)	**Supply and demand are far apart**
Willingness to participate (both supply and demand)	high interest	Moderately interested	Buyers waiting and confused, fear of green washing label	**Participants are hesitant, not strongly "incentivised"**
Must-have-terms in contract	Integrity and co-benefits	Flexibility, low bureaucracy	Liability of re-emissions should be on the seller, in this case the farmers	**High contrast between supply and demand on contract terms rigidity**
Preferred Additional criteria or co-benefits (environment, social, socio-economic)	Co-benefits are important: Agronomical (farmers) and biodiversity (buyers)	Farm productivity, synergies with resilience to weather and climate	Prefer credits from their own country	**There is potential for win-win-win incentives**

Table 6.1 Aggregated findings with respect to the key carbon market parameters.

7. Literature

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Attachment 1

Basic data of interviewed farms

Country	Croatia	Estonia	Finland	Germany	Ireland	Italy	Poland	Poland
Bio-geographical region[20]	Continental	Boreal	Boreal	Continental	Atlantic	Alpine	Continental	Continental
Type of farm	Family farm	Family farm	Family farm	Family farm (formerly state farm in Eastern DE)	Family farm	Family farm	Co-owned by the state	Family farm
Type of production	Mixed crops, trees, small animals	Forest, wetlands, meadows, cereal production, fruit trees, berries	Organic, mixed farming (oats, rye, ley crops and live-stock)	Mixed crops (arable farming), cereals, canola, sugar beets, potatoes, biogas production from animal manure	Forest	Vegetables	Cereals and animal breeding	Permanent grassland
Size	1.7 ha	1600 ha (some 1000 ha forest)	135 ha	700 ha (30% own, 70% from lease)	15 ha	40 ha	>2600 ha	730 ha
Conventional, organic	Organic	Mixed	Organic	Conventional	Conventional	Organic	Conventional	Conventional
Certification	EU Organic, Demeter (application pending)	EU Organic label	Organic	No	No	Global GAP, EU Organic	No	No (had earlier organic)
CAP support	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
New entrants	Yes	No	No	No	Yes	No	No	No
Dependency on agricultural market	Medium	High	High	High	Marginal	High	High	High

In addition, the following persons were consulted:
Farmers Jari Eerola (Finland), Alfred Grand (Austria), Juuso Joona (Finland), Eliisa and Mika Malin (Finland) and Virpi Kling, Development Manager, Valio Ltd (Finland).

[20] https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2

Attachment 2

LIFE Carbon Supply Survey

Survey:
Nature-based carbon credit supply

> Mandatory fields are marked with an asterisk (*) and must be filled in to complete the form.

The LIFE CarbonFarmingScheme project (www.st1.com/st1-life) aims to develop and test concepts for carbon farming incentives for farmers and foresters. This survey aims to increase common knowledgeon stakeholder priorities concerning various aspects of nature-based carbon sequestration and how to incentivize actions by policy and market mechanisms. The project is carried out in close coordinationwith the European Commission DG Clima (ec.europa.eu/clima/index_en) and there will be further opportunities for stakeholders to provide insights and information on various aspects related to carbon farming and how to build a functional carbon credit market in the EU as part of the EU climate policy.

This survey contains 22 questions. Some of the questions concern fairly specific elements and aspects of the carbon credit market. We appreciate the effort to proceed to the end of the survey even if some of the questions may be irrelevant or abstract from your perspective. The survey as a whole addresses primary production and thereby is most relevant for farmers and foresters. For others, there is an option to jump directly to the questions about carbon credits.

Please reserve 15-20 minutes to respond to the survey. You can fill in the survey in parts, there is a possibility to save your answers and resume later. Mandatory fields are marked with an asterisk *. This survey is open until 31 May 2021.

If you have any questions, you are welcome to contact us.

Thank you very much for your cooperation!

Kaj Granholm
Baltic Sea Action Group
kaj.granholm@bsag.fi

1. Respondent's sector *

Choose your primary business sector

- ☐ Primary producer (farmer etc.)
- ☐ Producers' association
- ☐ Agricultural advisory/ extension service
- ☐ Food industry
- ☐ Forest owner, timber producer etc
- ☐ Other, what

_____

_____

2. Location: geographic region

e.g. according to Barão & Basch (2017)

- ☐ Boreal to Sub-Boreal (Northern Eur.)
- ☐ Northern Sub-Continental (e.g. Southern & Eastern Baltic Sea region)
- ☐ Atlantic (coastal Western Europe)
- ☐ Sub-Oceanic (e.g. Central Europe)
- ☐ Southern Sub-Continental (e.g. Southeast Europe)
- ☐ Temperate Mountaneous
- ☐ Mediterranean Temperate
- ☐ Mediterranean Semi-Arid
- ☐ I don't know

3. Specification of geographic region

An option to specify if climatic region is difficult to establish.

_____

_____

4. Country

The respondent's country of residence.

- [ ] Albania
- [ ] Andorra
- [ ] Belarus
- [ ] Belgium
- [ ] Bosnia & Herzegovina
- [ ] Bulgaria
- [ ] Croatia
- [ ] Cyprus
- [ ] Czech Republic
- [ ] Denmark
- [ ] Estonia
- [ ] Finland
- [ ] France
- [ ] Georgia
- [ ] Germany
- [ ] Greece
- [ ] Hungary
- [ ] Iceland
- [ ] Ireland
- [ ] Italy
- [ ] Kosovo
- [ ] Latvia
- [ ] Liechtenstein
- [ ] Lithuania
- [ ] Luxembourg
- [ ] Malta
- [ ] Moldova
- [ ] Montenegro
- [ ] Netherlands
- [ ] North Macedonia
- [ ] Norway
- [ ] Poland
- [ ] Portugal
- [ ] Romania
- [ ] Russia
- [ ] San Marino
- [ ] Serbia
- [ ] Slovakia
- [ ] Slovenia
- [ ] Spain
- [ ] Sweden
- [ ] Switzerland
- [ ] Turkey
- [ ] Ukraine
- [ ] United Kingdom
- [ ] Other

5. Country

(if other)

_____

6. Production sector

If engaged in primary production, indicate sector(s).

- ☐ cereals
- ☐ dairy/livestock
- ☐ pig/poultry
- ☐ orchards/viticulture
- ☐ forestry
- ☐ other, specify

_____

_____

- ☐ I am not engaged in primary production and wish to proceed to questions aboutcarbon credits ➔

7. Farmiland / forest area, ha

- ☐ <2 ha
- ☐ 2-19 ha
- ☐ 20-49 ha
- ☐ 50-99 ha
- ☐ 100-200 ha
- ☐ >200 ha

8. Agricultural land use, ha

☐	Cropland	_____	hectares
☐	Annual crop rotation with ley/legumes	_____	hectares
☐	Permanent/perennial grasses	_____	hectares
☐	Agricultural land outside crop rotation (buffer zones, hedges, natural habitats)	_____	hectares
☐	Other	_____	hectares

9. Forest land use, ha

☐	Timber or other commercial raw material	_____	hectares
☐	Protected (for landscape, biodiversity, heritage)	_____	hectares
☐	Fertilized area	_____	hectares
☐	Other	_____	hectares

10. Percentage of company income from agricultural activity?

Please reply according to your best knowledge

☐ I don't know/I'd rather don't know / I'd rather not tell

11. Percentage of company income from forestry activity?

Please reply according to your best knowledge

☐ I don't know/I'd rather don't know / I'd rather not tell

12. What measures you think or have discovered to increase carbon sequestration in agricultural soil or in forests?

13. In your opinion, what other measures in primary production are relevant from the climate perspective?

Those can be direct emission reduction measures (carbon dioxide, methane, nitrous oxide, ammonia) or climate change adaptation measures that have environmental benefits.

14. How suitable/readily adoptable are the following potential carbon farming measures on your farm?

Please answer on a scale 1-4.

	1 Already in use	2 Suitable to adopt	3 Difficult to adopt	4 Not applicable
Solid manure application	☐	☐	☐	☐
Slurry/liquid manure application	☐	☐	☐	☐
Compost application	☐	☐	☐	☐
Biochar application	☐	☐	☐	☐
Organic soil amendments	☐	☐	☐	☐
Biogas digestate application	☐	☐	☐	☐
Catch crops, undersown crops; continuous green cover	☐	☐	☐	☐
Agroforestry	☐	☐	☐	☐
Paludiculture	☐	☐	☐	☐
Forest fertilization	☐	☐	☐	☐
Afforestation	☐	☐	☐	☐

15. At what minimum compensation level would you implement thefollowing measures? (EUR/ha)?

You can also estimate the area in hectares for each measure in the text field.

	10 €/ha	30 €/ha	70 €/ha	100 €/ha	>200 €/ha
Solid manure application	☐	☐	☐	☐	☐
Slurry/liquid manure application	☐	☐	☐	☐	☐
Compost application	☐	☐	☐	☐	☐
Biochar application	☐	☐	☐	☐	☐
Organic soil amendments	☐	☐	☐	☐	☐
Biogas digestate application	☐	☐	☐	☐	☐
Catch crops, undersown crops; continuous green cover	☐	☐	☐	☐	☐
Paludiculture	☐	☐	☐	☐	☐
Forest fertilization	☐	☐	☐	☐	☐
Afforestation	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

16. How familiar are you generally with the literature, terminology and discussion concerning carbon credit markets, in particular, related to nature-based carbon sequestration? *

- ☐ Well familiar
- ☐ Somewhat aware
- ☐ Not at all familiar

17. Do you participate or have you participated in a programme aiming to increase carbon sequestration in soil/biomass? *

If yes, you can name the project(s) or programme(s) in the text field.

- ☐ Yes _____
- ☐ No

18. Do you currently implement measures to produce carbon credits? *

If yes, you can name the programme(s) in the text field.

- ☐ Yes _____
- ☐ No

19. How important are the following criteria in a carbon credit scheme from your viewpoint?

Leave empty if unsure or no opinion on the particular issue.	1 Critical ('dealbraker')	2 Important	3 Desirable	4 Negligible
Amount of soil carbon/SOC content	☐	☐	☐	☐
Additionality The carbon stored is additional to thelegal baseline and business-as-usualpractise and that the carbon payment triggers the measure.	☐	☐	☐	☐
Permanence The scheme and contract includemeasures to guarantee the permanence (non-reversal) of the stored carbon.	☐	☐	☐	☐
Prevention of carbon leakage The scheme includes mechanisms to prevent carbon emitting production elsewhere as an unwanted consequence of producing carbon credits.	☐	☐	☐	☐
Holistic carbon balance analysis The scheme accounts for carbon balance on a holistic scale (farm level, value chain level or by a life cycle analysis (LCA))	☐	☐	☐	☐
Exclusivy of the credits The carbon credits produced are exclusively accounted for the given certificate and double issuance, double incentives and double claiming isprevented, i.a. through a transparent registry.	☐	☐	☐	☐
Use of the credits I have control over how the carbon credits resulting from my activity are used. This means, for instance, to set preference whether the credits are usedas voluntary carbon offsets, in the national GHG inventory/as carbon sinks for mandated sectors or whether there is a secondary market for the credits.	☐	☐	☐	☐
Environmental benefit Carbon sequestration activities contribute to other environmental benefits and do not compromiseequal/ greated environmental benefits through trade-off of measures.	☐	☐	☐	☐
Social benefits That carbon credit scheme is linked to increasing the sustainability of production in a given local area/ regionand that there is a benefit for the local community.	☐	☐	☐	☐
Sensitivity to farm conditions The scheme is adapted, to a feasible degree, to differences in farm conditions, history and carbon sequestration potential.	☐	☐	☐	☐

20. Data management and monitoring, reporting and verification (MRV).

Please give your opinion on the statement about each feature on the scale 1-4.

	1 Stongly agree	2 Partly agree	3 Indifferent /unsure	4 Disagree
A functional carbon credit market must have an open platform for information on the effect of carbon farming measures in different conditions.	☐	☐	☐	☐
Open portal for real-time information on carbon sequestration is useful for farmers.	☐	☐	☐	☐
There must be an open database for carbon credits sold and purchased that enables also to track the supplier (farm).	☐	☐	☐	☐
Carbon credit supply in agriculture should be an attribute controlled within the CAP (EU Common Agriculture Policy), so that CAP conditionality would require reporting of carbon credits produced/ sold.	☐	☐	☐	☐

21. Contract duration. Please indicate your (intuitive) preference regarding the contract period for soil carbon sequestration credits.

	Most preferred	Agreeable	Not aggreeable
1 year	☐	☐	☐
2 years	☐	☐	☐
5 years	☐	☐	☐
10 years	☐	☐	☐
20 years or longer	☐	☐	☐

22. Participation. *

LIFE CarbonFarmingScheme -project will carry out a market pilot for voluntary carbon credits during 2021. In addition, individual real and virtual farm case calculations will be done along with interviews with farm managers about alternative incentives and other factors affecting farm management decisions.

If you are interested in participating in the market pilot or in farm case calculations, please leave your contact information and any relevant basic information about your farm you are able to provide. All information about farm type, production, cropping cycles, as well as of possible soil analyses or research work is useful for us to assess our possibilities to offer anything in return.

In any case, the replies to this survey are anonymous. We will process all information received with high confidentiality and use it only for the purposes of the LIFE CarbonFarmingScheme -project. We will not disclose the information to third parties outside the project.

- [ ] I am not interested in this cooperation, I just want to submit my answers.
- [ ] I am interested and willing to give my contact details as well as relevant information about my farm/business.

23. Consent

I understand, acknowledge and approve that when giving my contact information and other personal orcompany data to Baltic Sea Action Group (Foundation for a Living Baltic Sea sr), I give my consent to use this information for the purposes of the LIFE CarbonFarmingScheme -project. Information in the personal data registry will be handled according to BSAG Data Handling Protocol, available at www.bsag.fi => 'Privacy policy'.

I have read the BSAG Data Handling Protocol and give my consent to store my personal information and to use it according to this protocol.

☐ I accept.
Here are my contact details and relevant information about my farm:

_____

_____

_____

_____

Thank you for participating in this survey, your answers are much appreciated. They help us to understand the market situation for nature-based carbon credits and to develop incentive schemes for armers and forest owners with the aim to increase carbon sequestration and the provision of other ecosystem services. LIFE CarbonFarmingScheme -project runs until May 2022.

Attachment 3

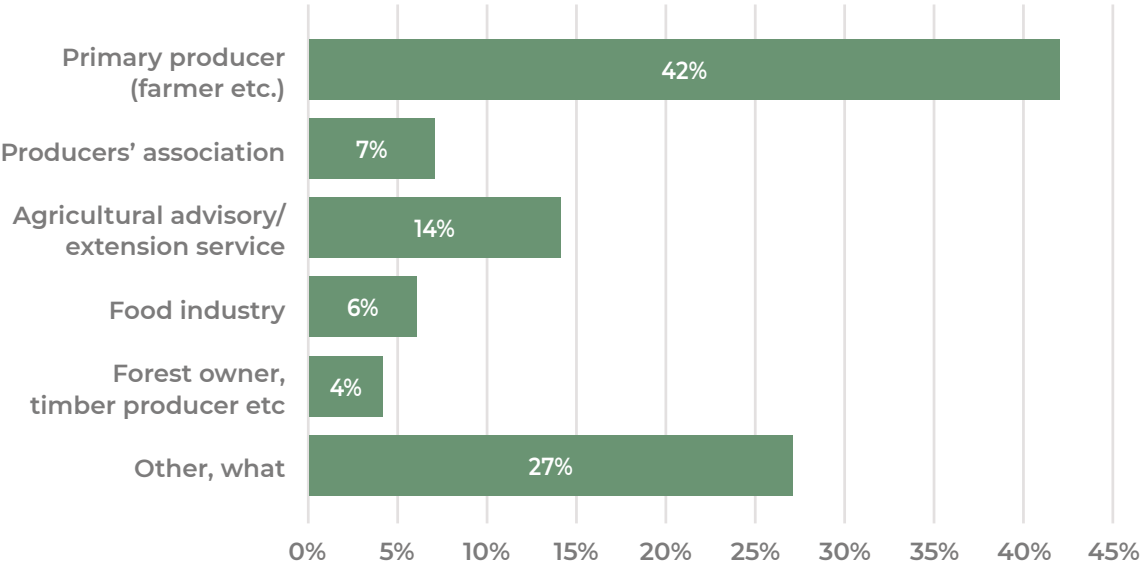
LIFE Carbon Supply Basic report Survey: Nature-based carbon credit supply

Total number of respondents: 71

1. Respondent's sector

Choose your primary business sector

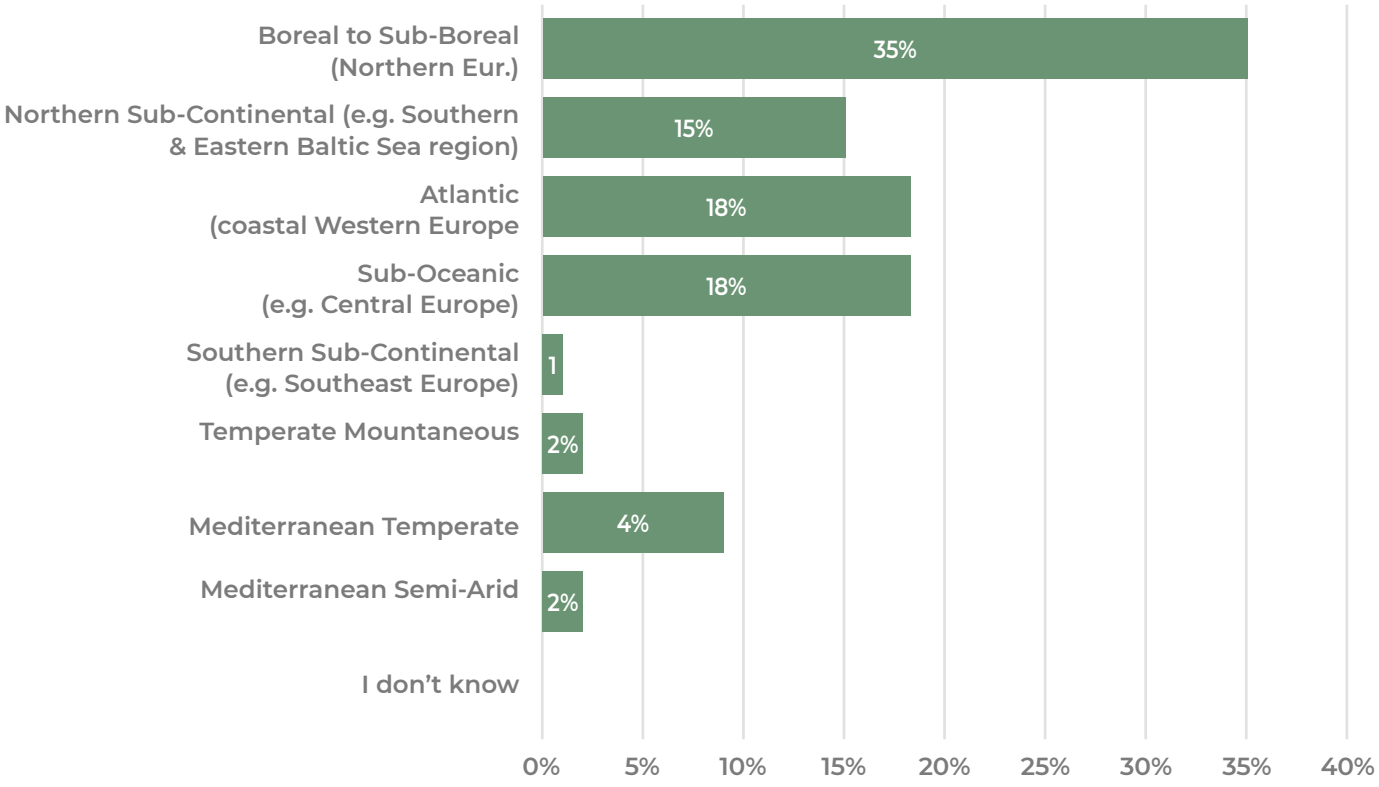
Number of respondents: 71, selected answers: 71



2. Location: geographic region

e.g. according to Barão & Basch (2017)

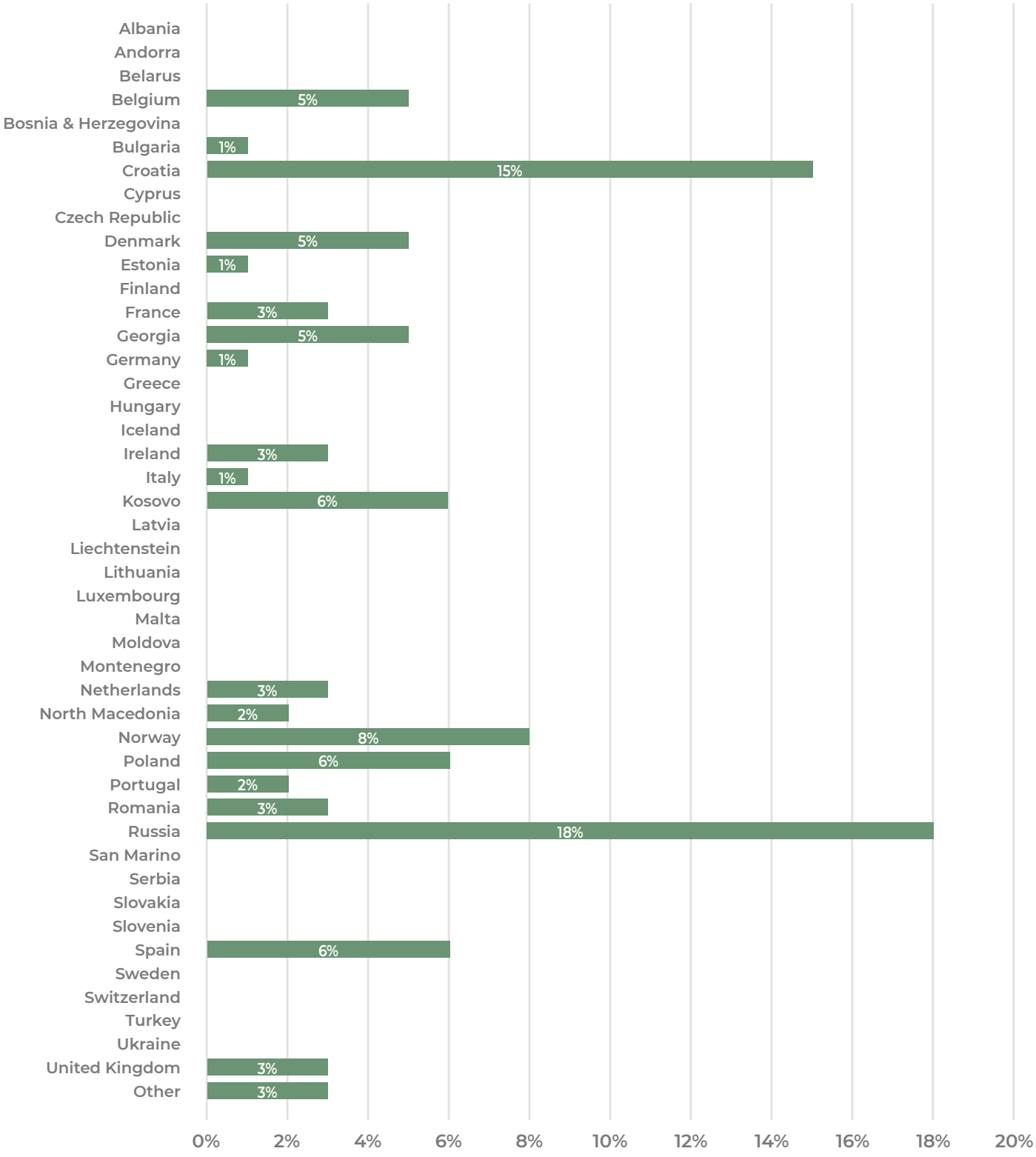
Number of respondents: 66



3. Country

The respondent's country of residence.

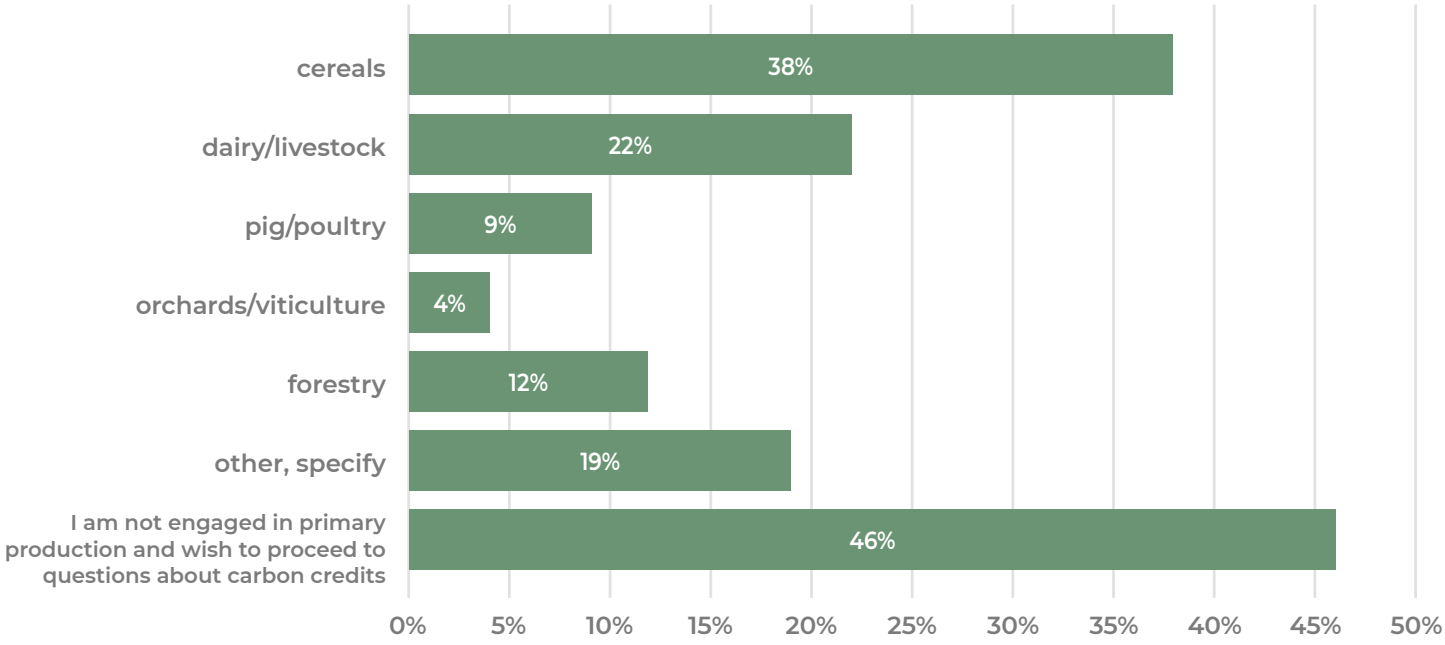
Number of respondents: 66



4. Production sector

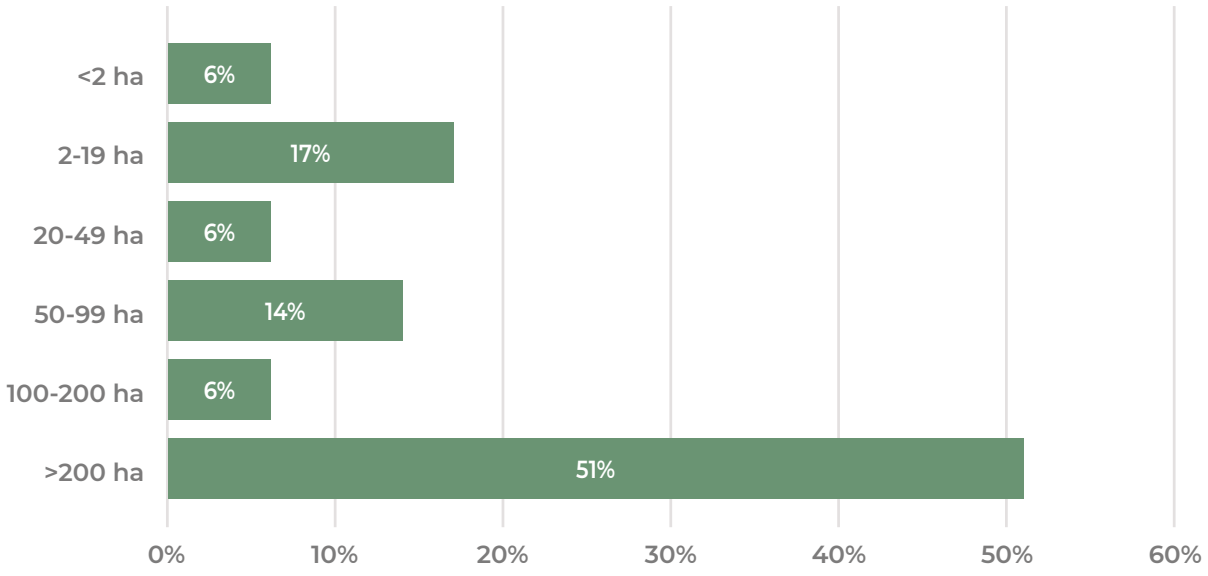
If engaged in primary production, indicate sector(s).

Number of respondents: 68, selected answers: 102



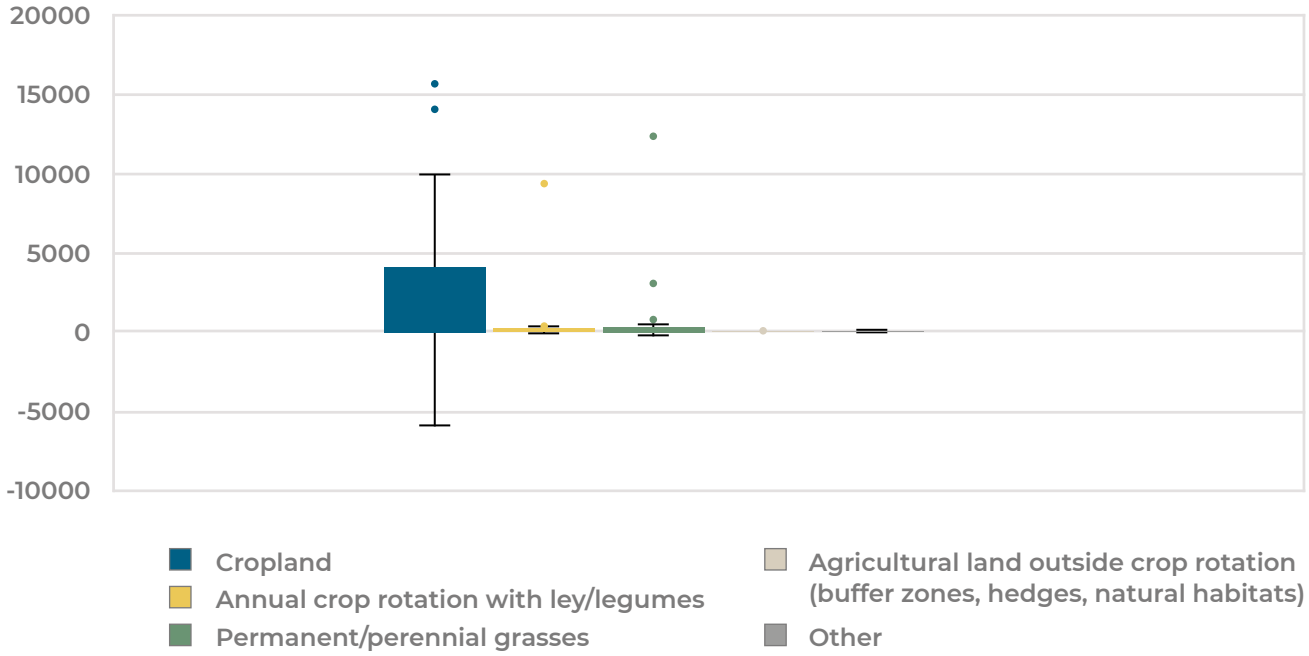
5. Farmiland / forest area, ha

Number of respondents: 35



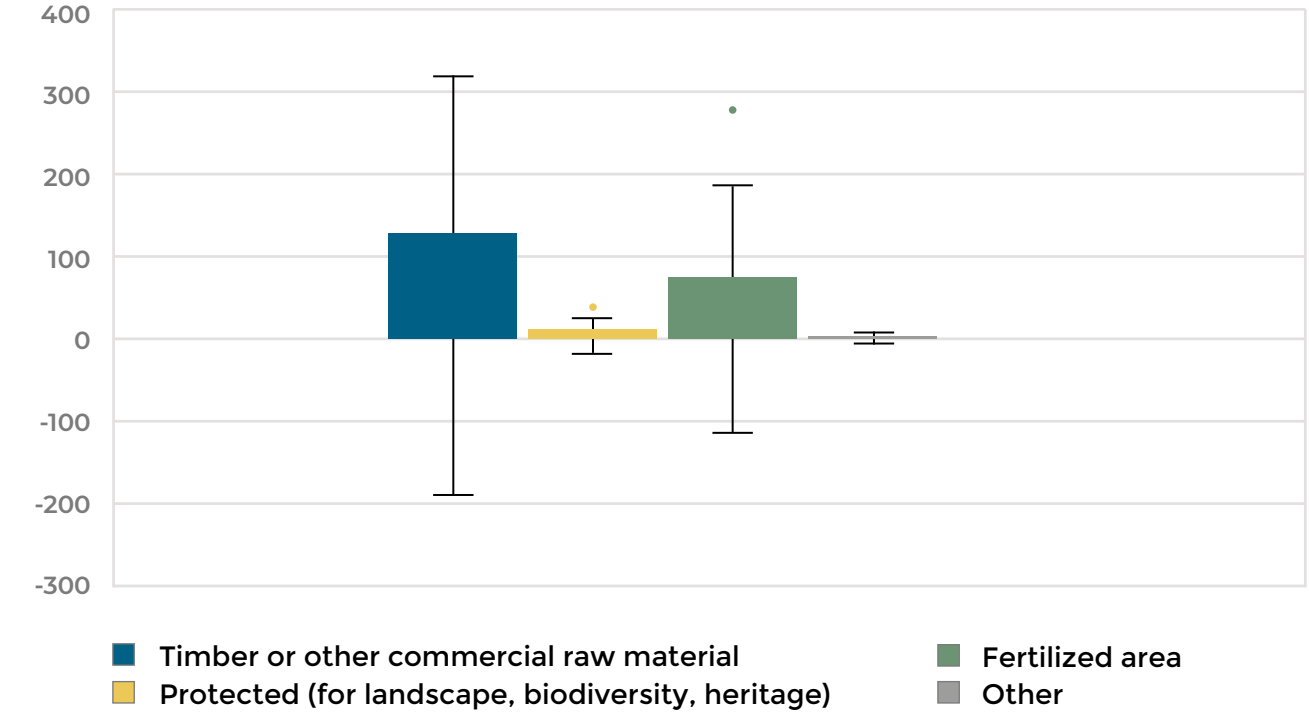
6. hectares (Agricultural land use, ha)

Number of respondents: 33



7. hectares (Forest land use, ha)

Number of respondents: 18



8. Percentage of company income from agricultural activity?

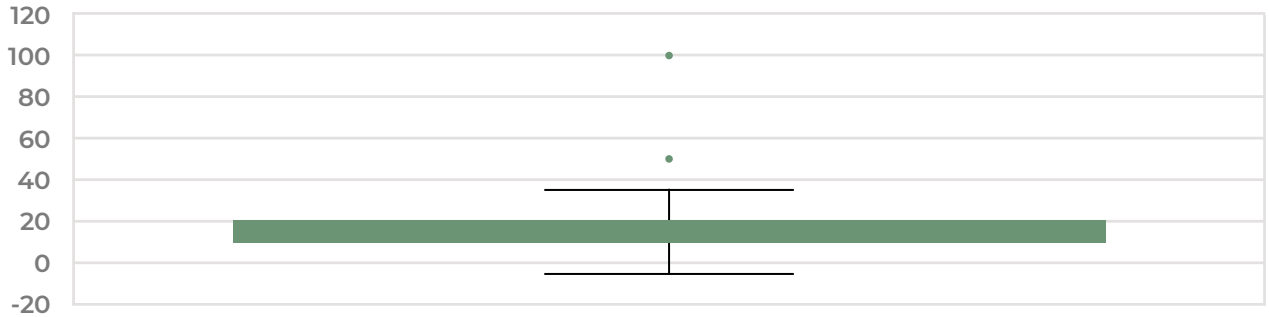
Please reply according to your best knowledge

Number of respondents: 31

9. Percentage of company income from forestry activity?

Please reply according to your best knowledge

Number of respondents: 12



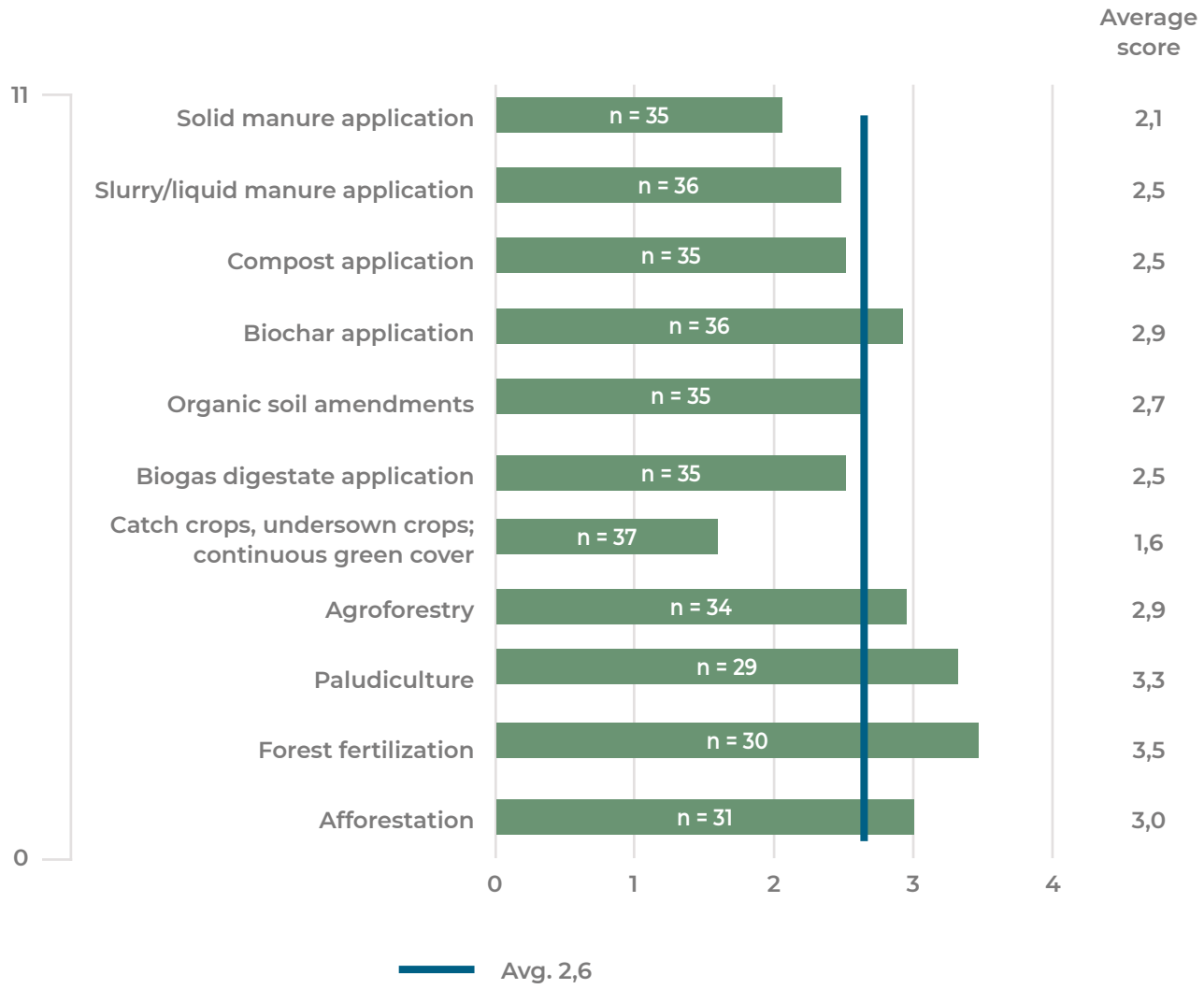
Min value	Max value	Average	Median	Sum	Standard Deviation
0,0	100,0	21,7	10,0	260,0	27,9

10.How suitable/readily adoptable are the following potential carbon farming measures on your farm?

Please answer on a scale 1-4.

(1 = Already in use, 2 = Suitable to adopt, 3 = Difficult to adopt, 4 = Not applicable)

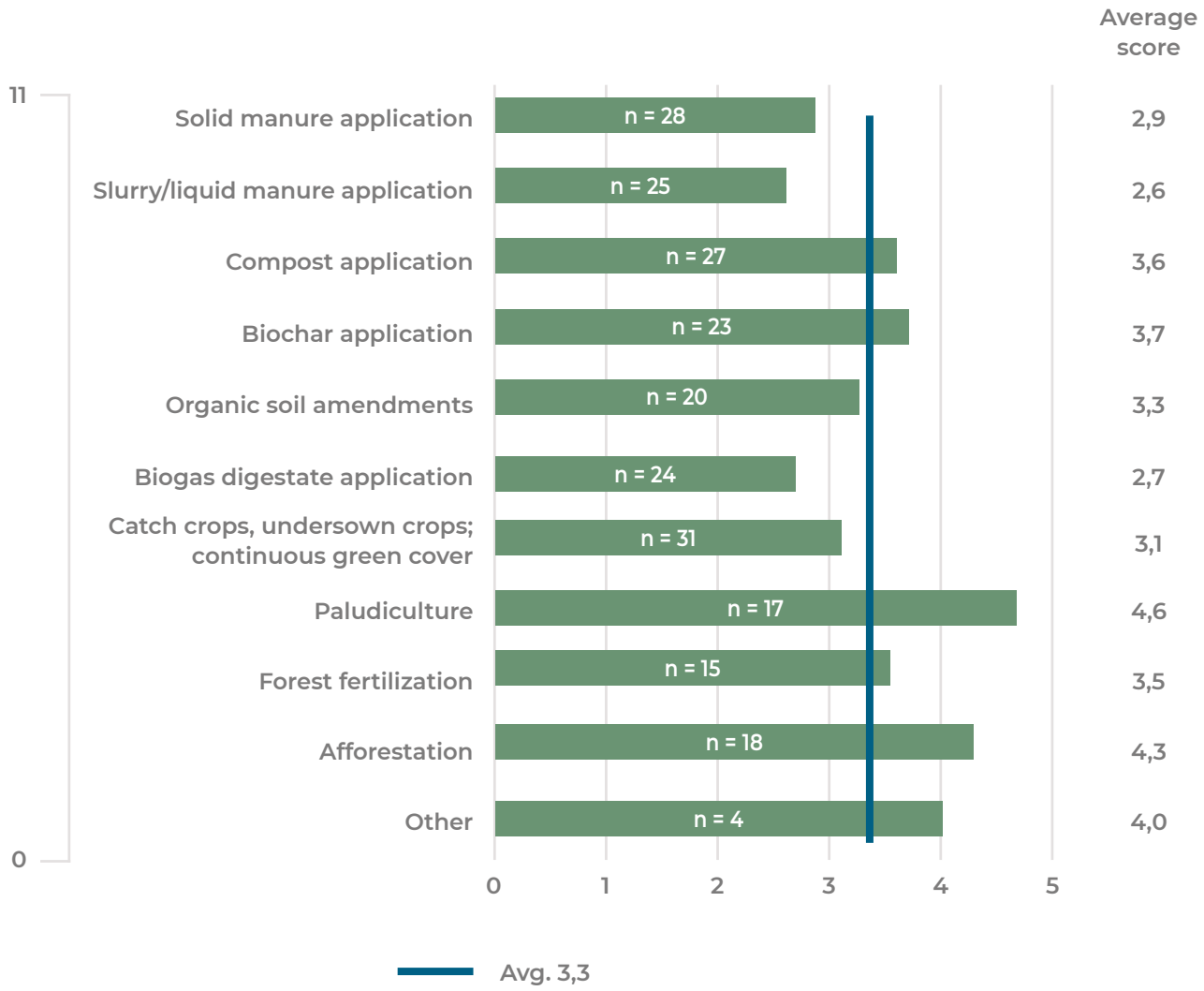
Number of respondents: 37



11. At what minimum compensation level would you implement thefollowing measures? (EUR/ha)?

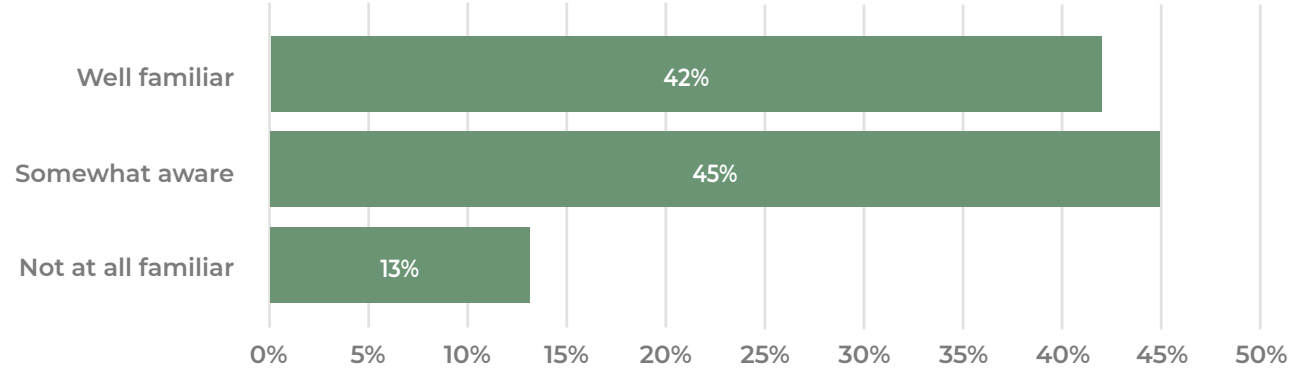
You can also estimate the area in hectares for each measure in the text field.
(1 = 10 €/ha, 2 = 30 €/ha, 3 = 70 €/ha, 4 = 100 €/ha, 5 = >200 €/ha)

Number of respondents: 34



12. How familiar are you generally with the literature, terminology and discussion concerning carbon credit markets, in particular, related to nature-based carbon sequestration?

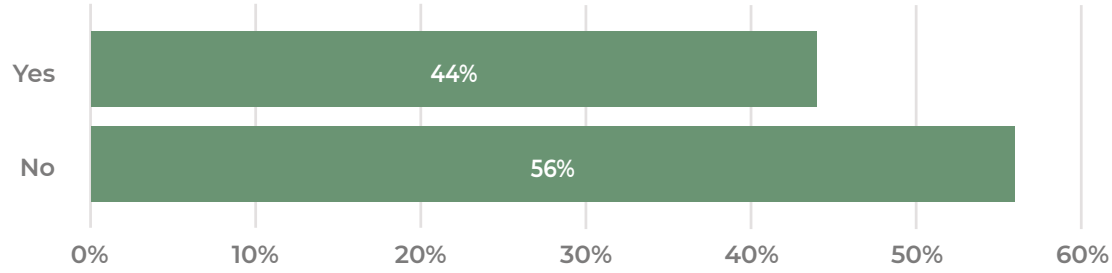
Number of respondents: 71



13. Do you participate or have you participated in a programme aiming to increase carbon sequestration in soil/biomass?

If yes, you can name the project(s) or programme(s) in the text field.

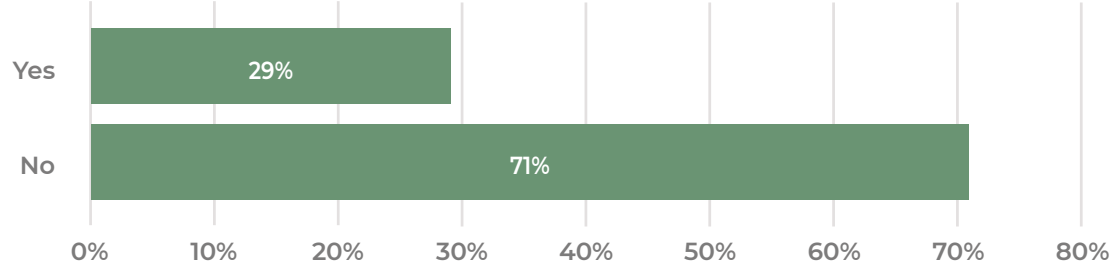
Number of respondents: 71



14. Do you currently implement measures to produce carbon credits?

If yes, you can name the programme(s) in the text field.

Number of respondents: 68



15. How important are the following criteria in a carbon credit scheme from your viewpoint?

Leave empty if unsure or no opinion on the particular issue.

(1 = Critical, 2 = Important, 3 = Desirable, 4 = Negligible)

Number of respondents: 68

15. How important are the following criteria in a carbon credit scheme from your viewpoint?

Leave empty if unsure or no opinion on the particular issue.

(1 = Critical, 2 = Important, 3 = Desirable, 4 = Negligible)

Number of respondents: 68

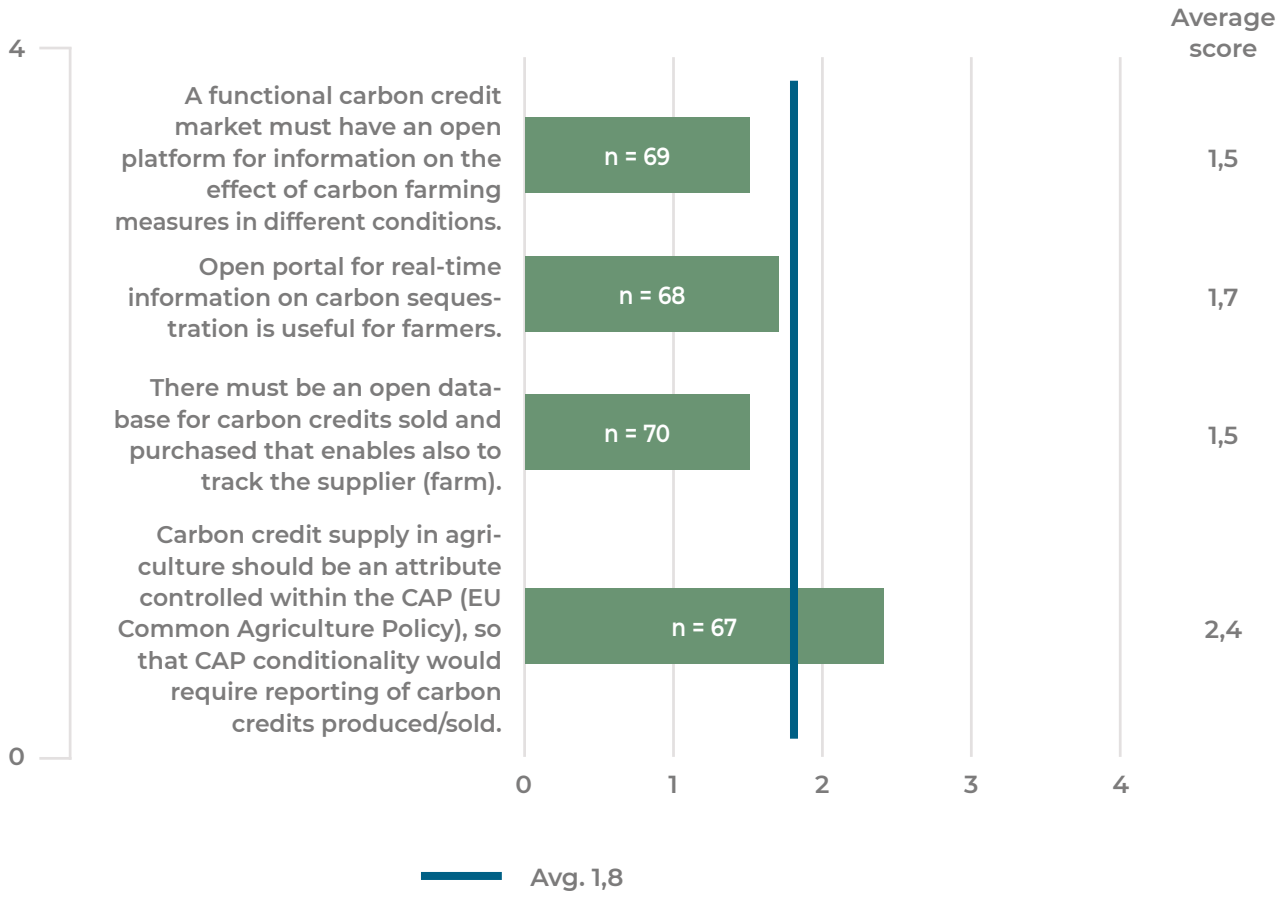
	1 Critical ('dealbraker)	2 important	3 Desirable	4 Negliggible	Average	Median
Amount of soil carbon / SOC content	29,1 %	56,4 %	10,9 %	3,6 %	1,9	2,0
Additionality The carbon stored is additional to the legal baseline and business-as-usual practise and that the carbon payment triggers the measure	35,4 %	46,2 %	13,8 %	4,6 %	1,9	2,0
Permanence The scheme and contract include measures to guarantee the permanence (non-reversal) of the stored carbon.	43,9 %	36,4 %	18,2 %	1,5 %	1,8	2,0
Prevention of carbon leakage The scheme includes mechanisms to prevent carbon emitting production elsewhere as an unwanted consequence of producing carbon credits.	28,8 %	45,5 %	21,2 %	4,5 %	2,0	2,0
Holistic carbon balance analysis The scheme accounts for carbon balance on a holistic scale (farm level, value chain level or by a life cycle analysis (LCA))	29,2 %	43,1 %	21,5 %	6,2 %	2,0	2,0
Exclusivy of the credits The carbon credits produced are exclusively accounted for the given certificate and double issuance, double incentives and double claiming isprevented, i.a. through a transparent registry.	44,6 %	38,5 %	12,3 %	4,6 %	1,8	2,0

	1 Critical ('dealbraker)	2 important	3 Desirable	4 Negliggible	Average	Median
Use of the credits I have control over how the carbon credits resulting from my activity are used. This means, for instance, to set preference whether the credits are usedas voluntary carbon offsets, in the national GHG inventory/as carbon sinks for mandated sectors or whether there is a secondary market for the credits.	37,1 %	35,5 %	19,3 %	8,1 %	2,0	2,0
Environmental benefit Carbon sequestration activities contribute to other environmental benefits and do not compromiseequal/ greated environmental benefits through trade-off of measures.	44,8 %	41,8 %	13,4 %	0,0 %	1,7	2,0
Social benefits That carbon credit scheme is linked to increasing the sustainability of production in a given local area/regionand that there is a benefit for the local community.	27,7 %	46,1 %	20,0 %	6,2 %	2,0	2,0
Sensitivity to farm conditions The scheme is adapted, to a feasible degree, to differences in farm conditions, history and carbon sequestration potential.	36,8 %	44,1 %	14,7 %	4,4 %	1,9	2,0

16. Data management and monitoring, reporting and verification (MRV).

Please give your opinion on the statement about each feature on the scale 1-4.

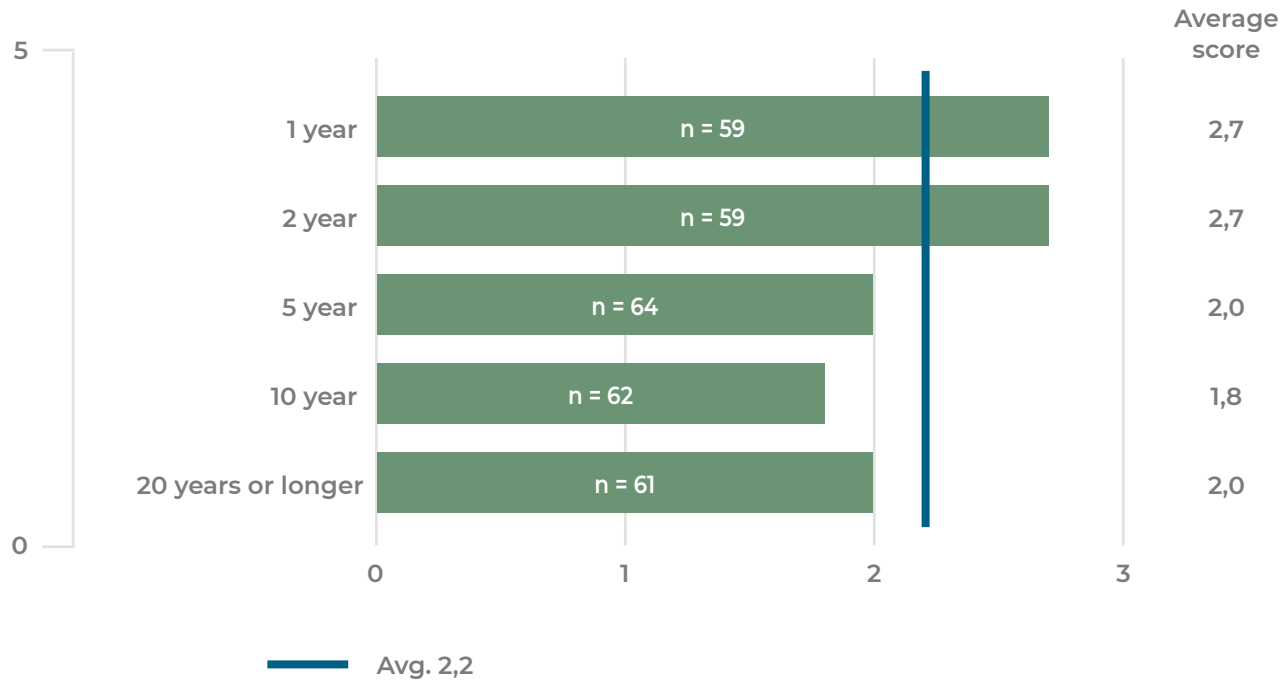
Number of respondents: 34



17. Contract duration. Please indicate your (intuitive) preference regarding the contract period for soil carbon sequestration credits.

(1 = Most prefferred, 2 = Agreeable, 3 = Not agreeable)

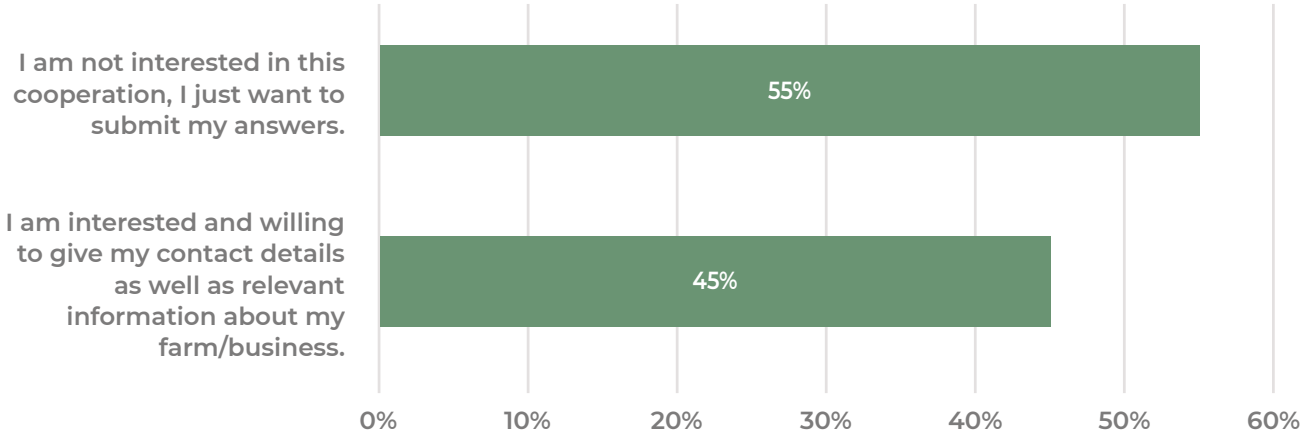
Number of respondents: 69



18.Participation

LIFE CarbonFarmingScheme -project will carry out a market pilot for voluntary carbon credits during 2021. In addition, individual real and virtual farm case calculations will be done along with interviews with farm managers about alternative incentives and other factors affecting farm management decisions. If you are interested in participating in the market pilot or in farm case calculations, please leave your contact information and any relevant basic information about your farm you are able to provide. All information about farm type, production, cropping cycles, as well as of possible soil analyses or research work is useful for us to assess our possibilities to offer anything in return. In any case, the replies to this survey are anonymous. We will process all information received with high confidentiality and use it only for the purposes of the LIFE CarbonFarmingScheme -project. We will not disclose the information to third parties outside the project.

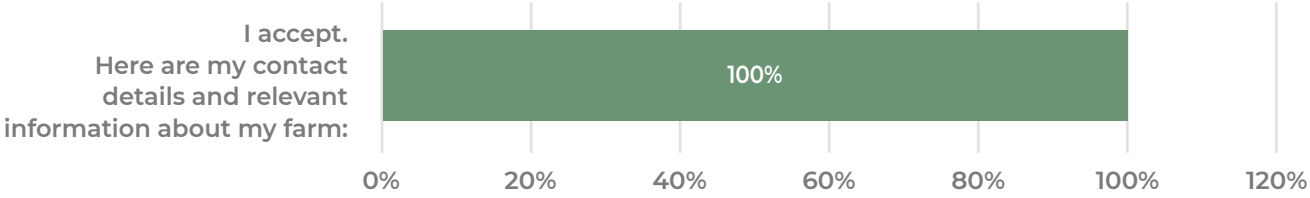
Number of respondents: 71



19.Consent

I understand, acknowledge and approve that when giving my contact information and other personal orcompany data to Baltic Sea Action Group (Foundation for a Living Baltic Sea sr), I give my consent to use this information for the purposes of the LIFE CarbonFarmingScheme -project. Information in the personal data registry will be handled according to BSAG Data Handling Protocol, available at www.bsag.fi => 'Privacy policy'. I have read the BSAG Data Handling Protocol and give my consent to store my personal information and to use it according to this protocol.

Number of respondents: 32, selected answers: 32



Attachment 3 B

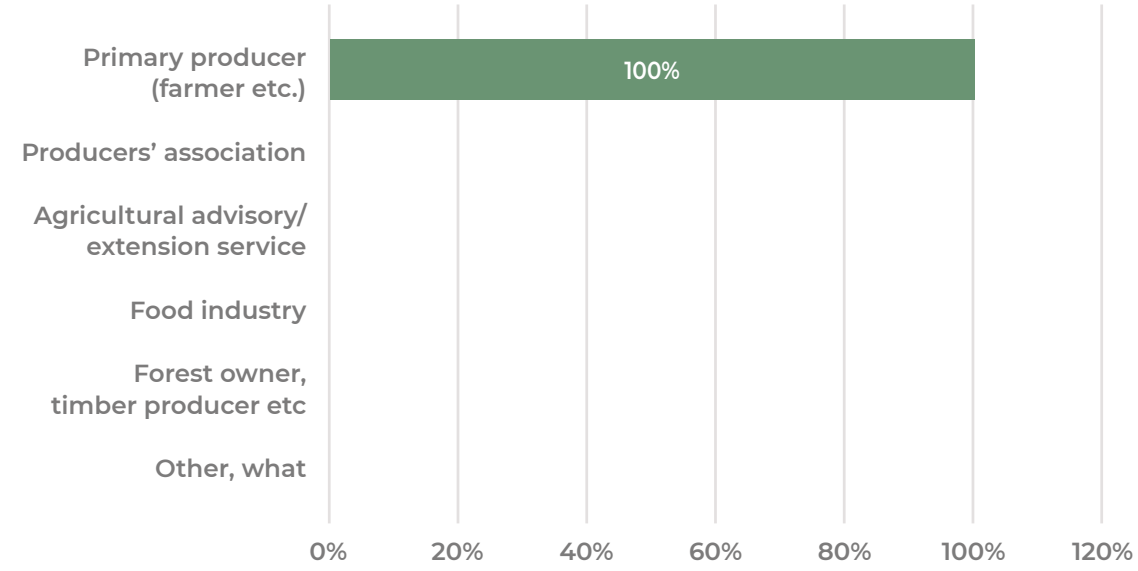
Farmers' responses Survey: Nature-based carbon credit supply

Showing 30 respondents of survey's total 71 respondents

1. Respondent's sector

Choose your primary business sector

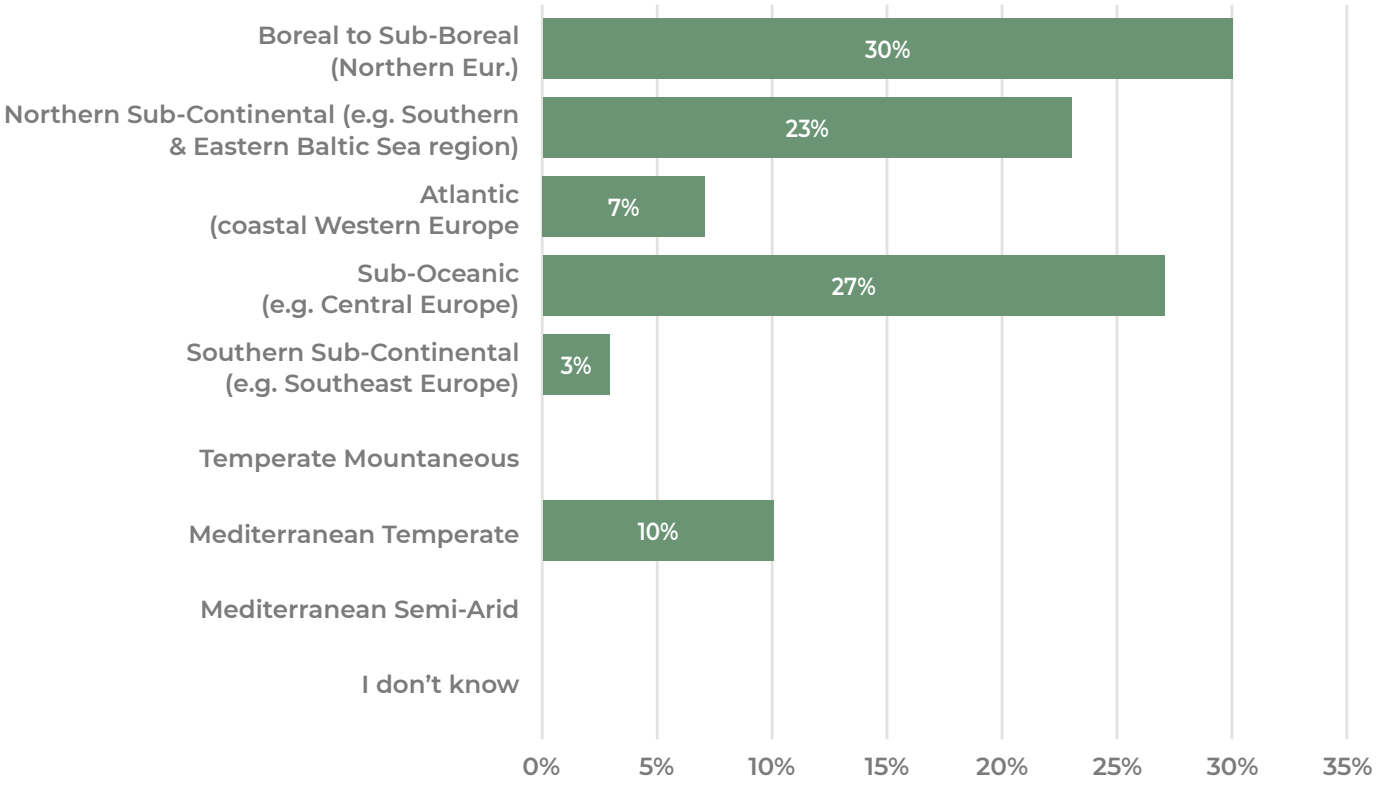
Number of respondents: 30, selected answers: 30



2. Location: geographic region

e.g. according to Barão & Basch (2017)

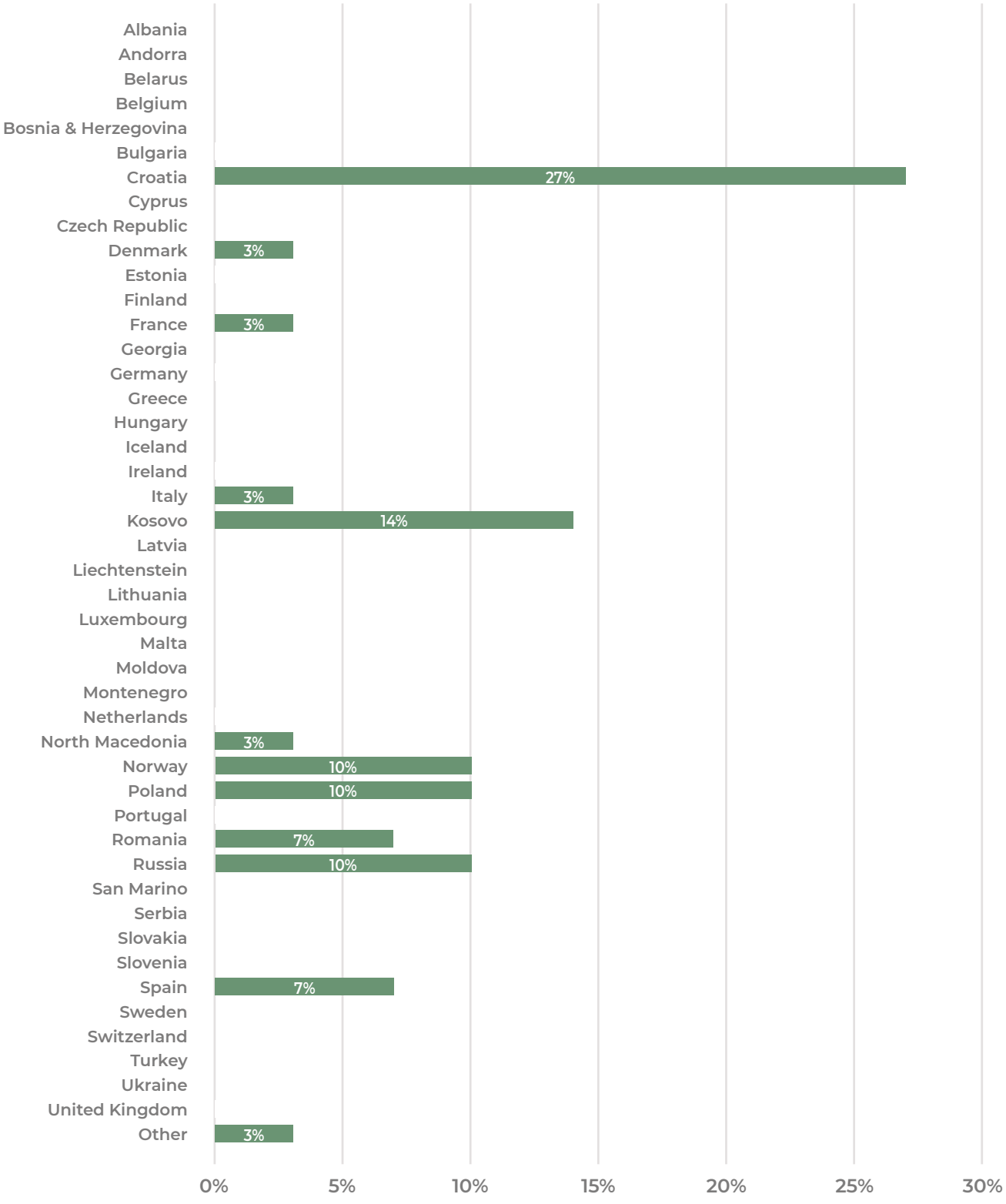
Number of respondents: 30



3. Country

The respondent's country of residence.

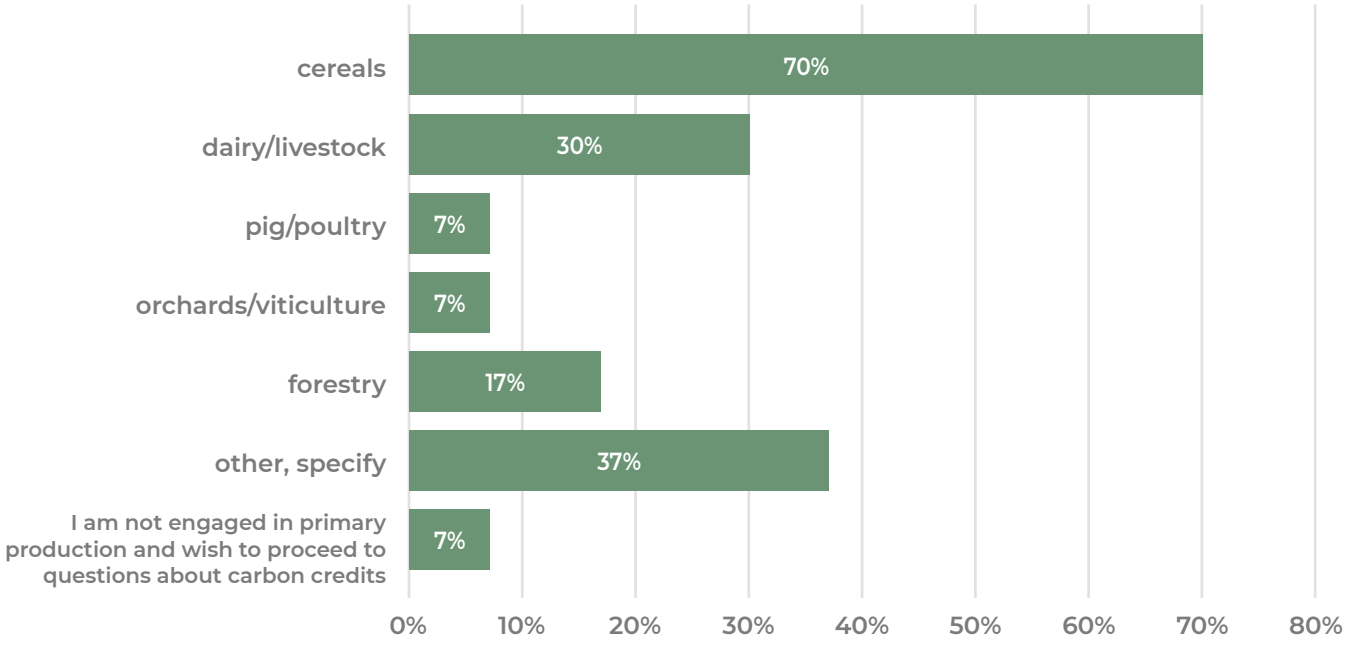
Number of respondents: 30



4. Production sector

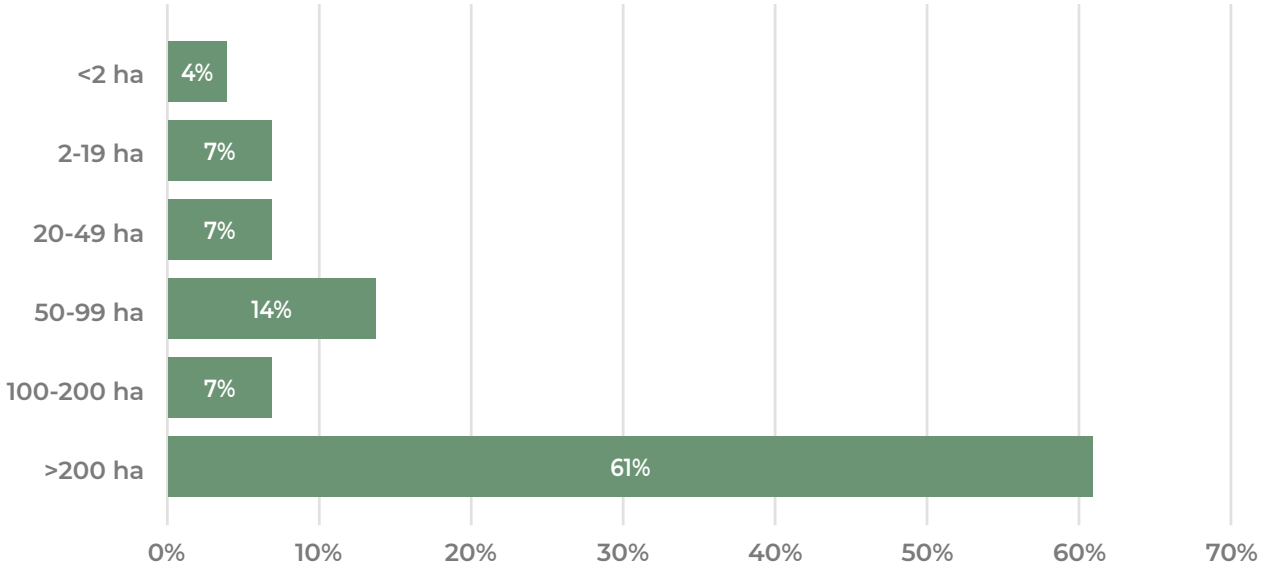
If engaged in primary production, indicate sector(s).

Number of respondents: 30, selected answers: 52



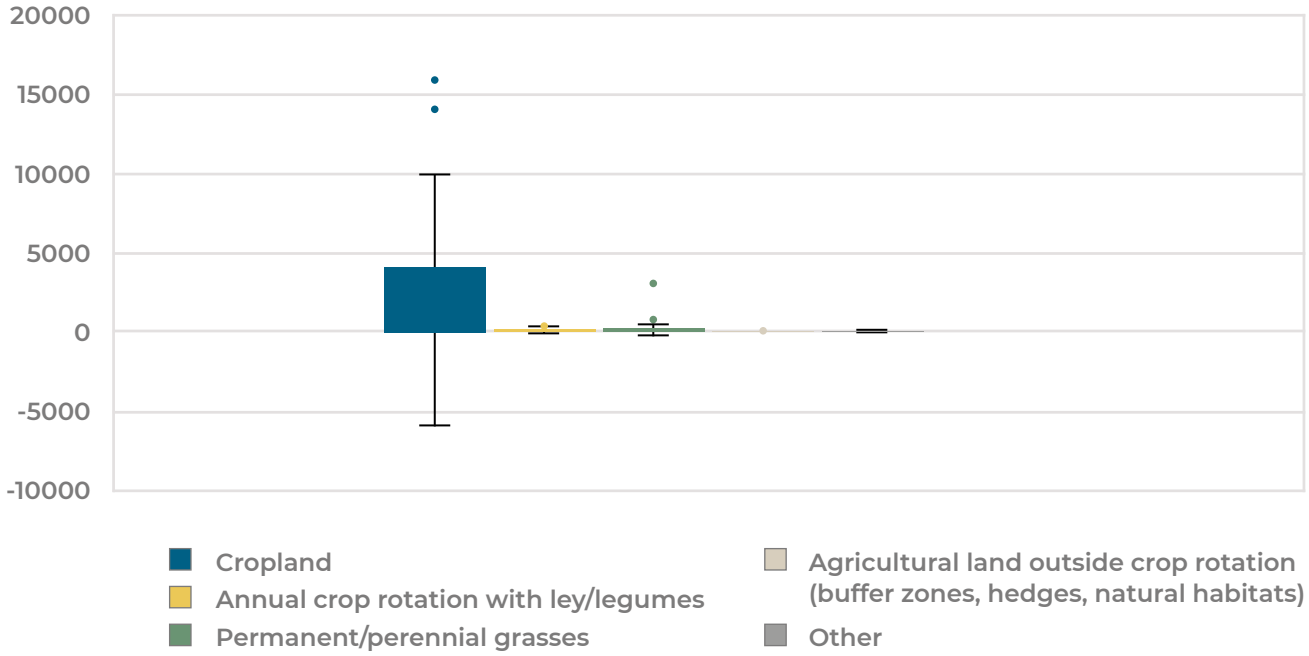
5. Farmiland / forest area, ha

Number of respondents: 28



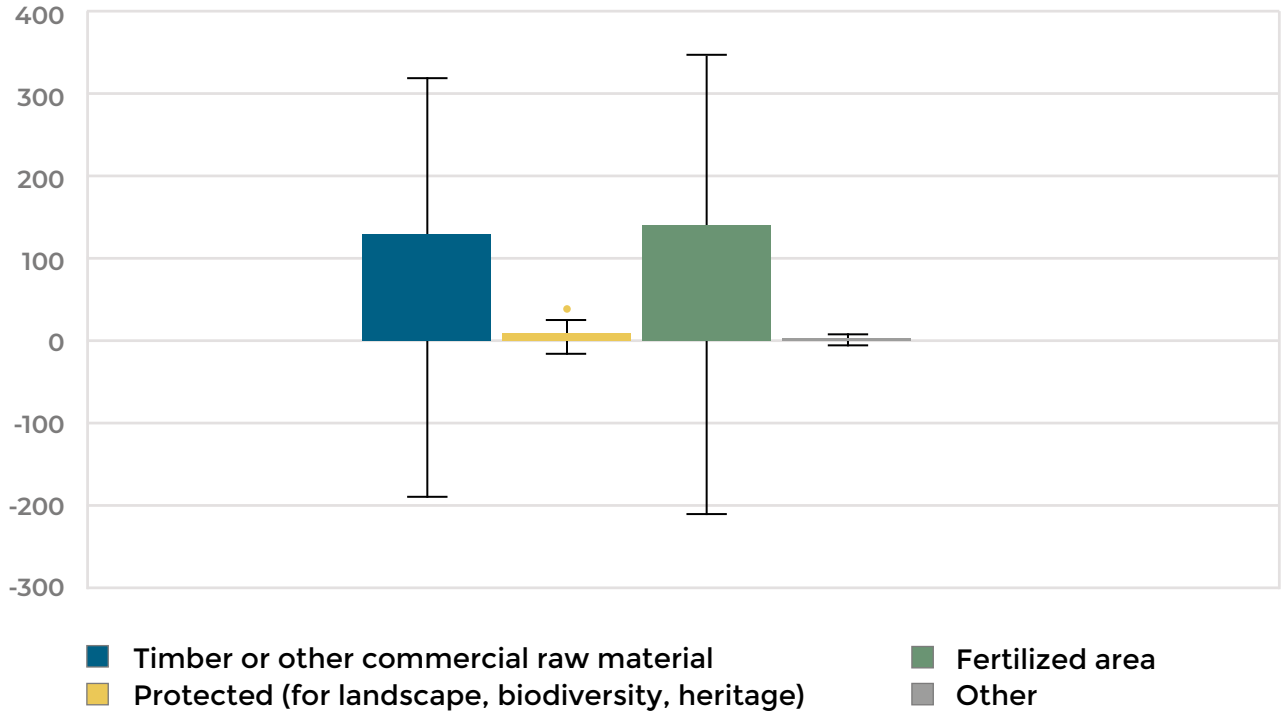
6. hectares (Agricultural land use, ha)

Number of respondents: 33



7. hectares (Forest land use, ha)

Number of respondents: 18

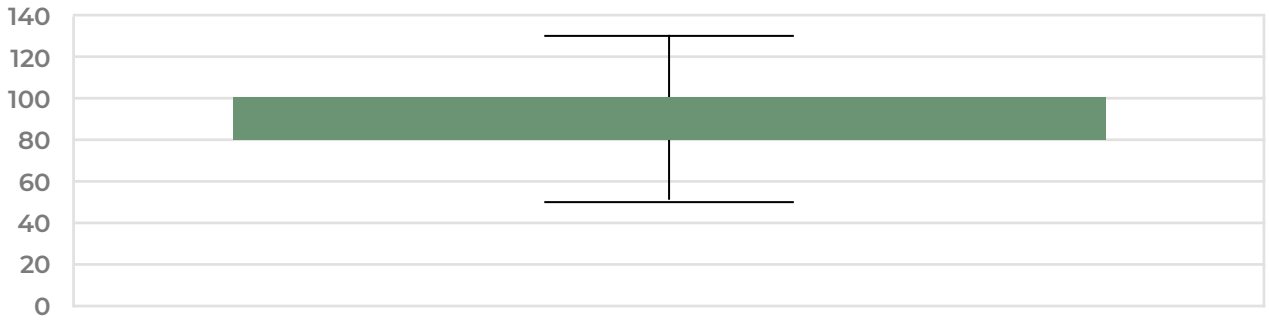


	Min value	Max value	Average	Median	Sum	Standard Deviation
Timber or other commercial raw material	0,0	200,0	62,2	25,0	684,0	76,0
Protected (for landscape, biodiversity, heritage)	0,0	40,0	10,3	6,0	62,0	15,3
Fertilized area	0,0	280,0	65,0	10,0	455,0	107,2
Other	0,0	5,0	1,8	1,0	9,0	2,2

8. Percentage of company income from agricultural activity?

Please reply according to your best knowledge

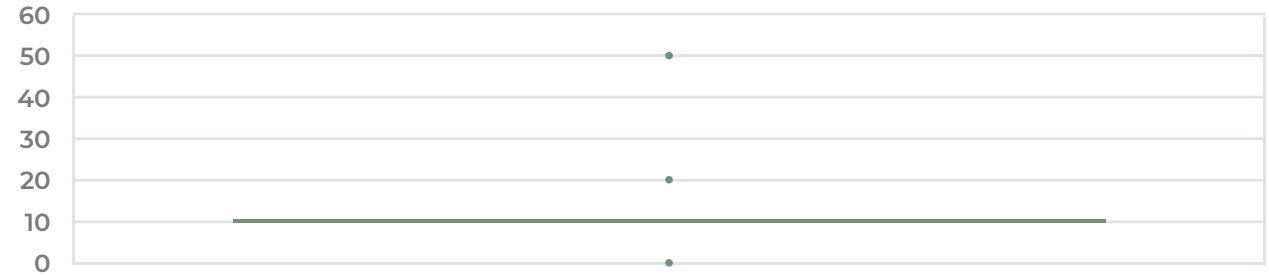
Number of respondents: 25



9. Percentage of company income from forestry activity?

Please reply according to your best knowledge

Number of respondents: 9

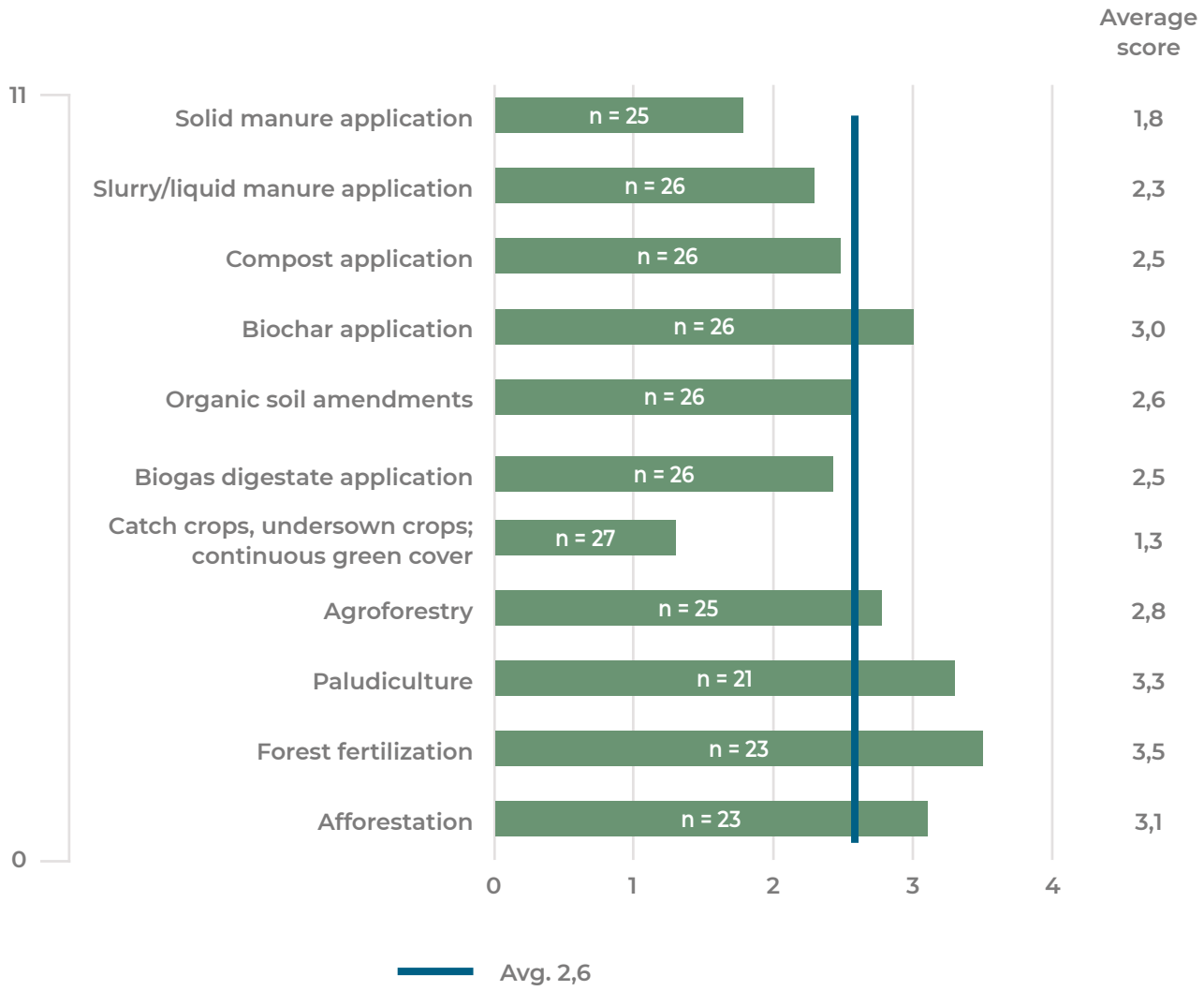


10.How suitable/readily adoptable are the following potential carbon farming measures on your farm?

Please answer on a scale 1-4.

(1 = Already in use, 2 = Suitable to adopt, 3 = Difficult to adopt, 4 = Not applicable)

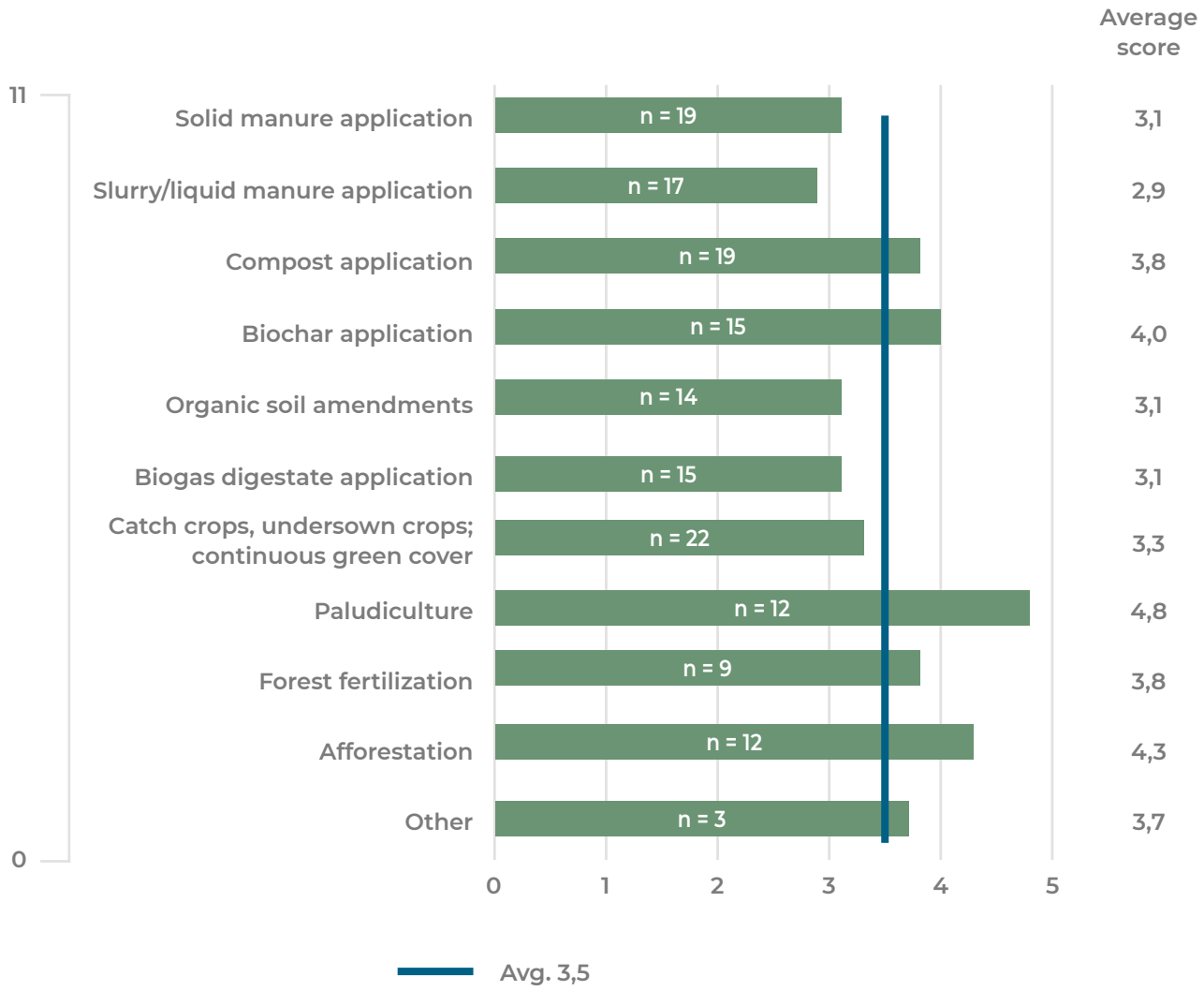
Number of respondents: 27



11. At what minimum compensation level would you implement thefollowing measures? (EUR/ha)?

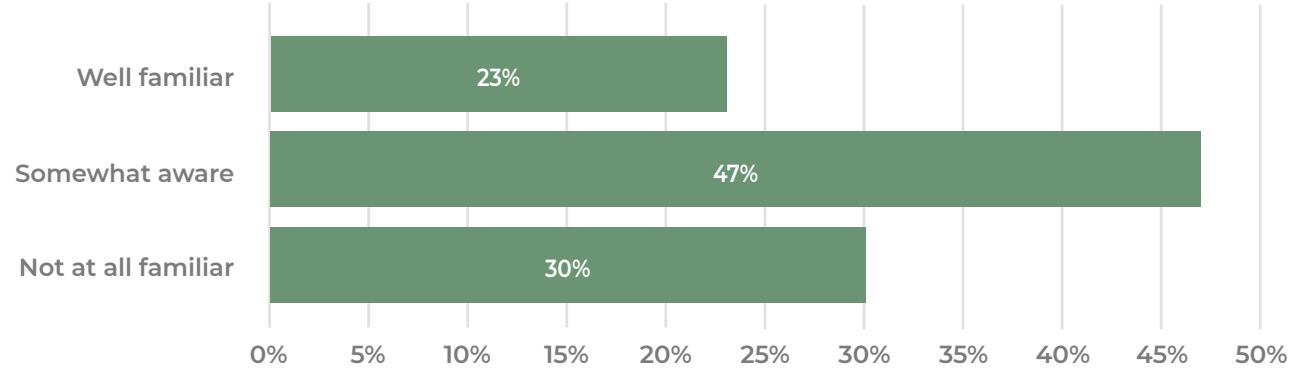
You can also estimate the area in hectares for each measure in the text field.
(1 = 10 €/ha, 2 = 30 €/ha, 3 = 70 €/ha, 4 = 100 €/ha, 5 = >200 €/ha)

Number of respondents: 24



12. How familiar are you generally with the literature, terminology and discussion concerning carbon credit markets, in particular, related to nature-based carbon sequestration?

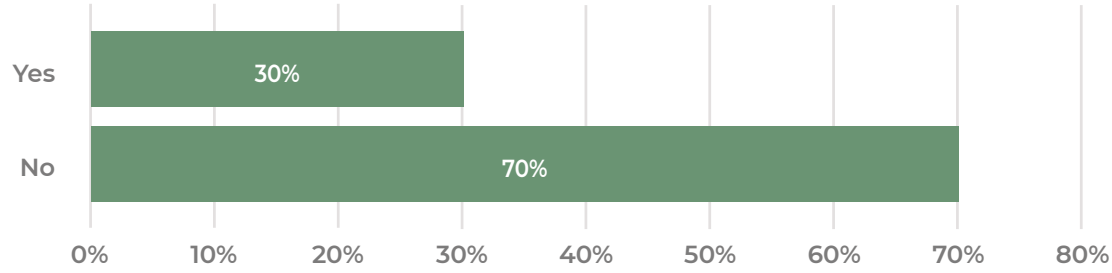
Number of respondents: 30



13. Do you participate or have you participated in a programme aiming to increase carbon sequestration in soil/biomass?

If yes, you can name the project(s) or programme(s) in the text field.

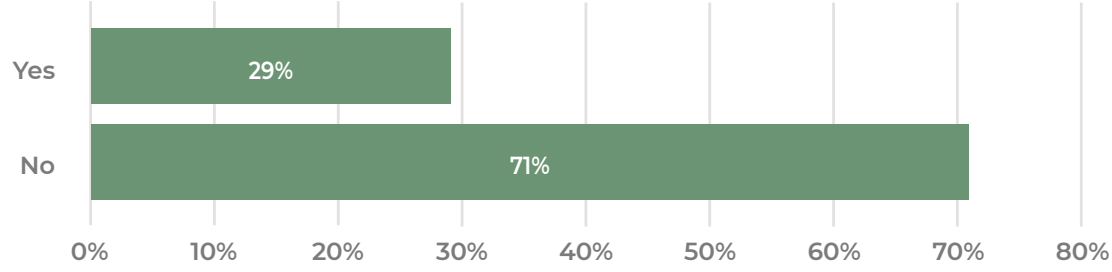
Number of respondents: 30



14. Do you currently implement measures to produce carbon credits?

If yes, you can name the programme(s) in the text field.

Number of respondents: 28



15. How important are the following criteria in a carbon credit scheme from your viewpoint?

Leave empty if unsure or no opinion on the particular issue.

(1 = Critical, 2 = Important, 3 = Desirable, 4 = Negligible)

Number of respondents: 28

15. How important are the following criteria in a carbon credit scheme from your viewpoint?

Leave empty if unsure or no opinion on the particular issue.

(1 = Critical, 2 = Important, 3 = Desirable, 4 = Negligible)

Number of respondents: 68

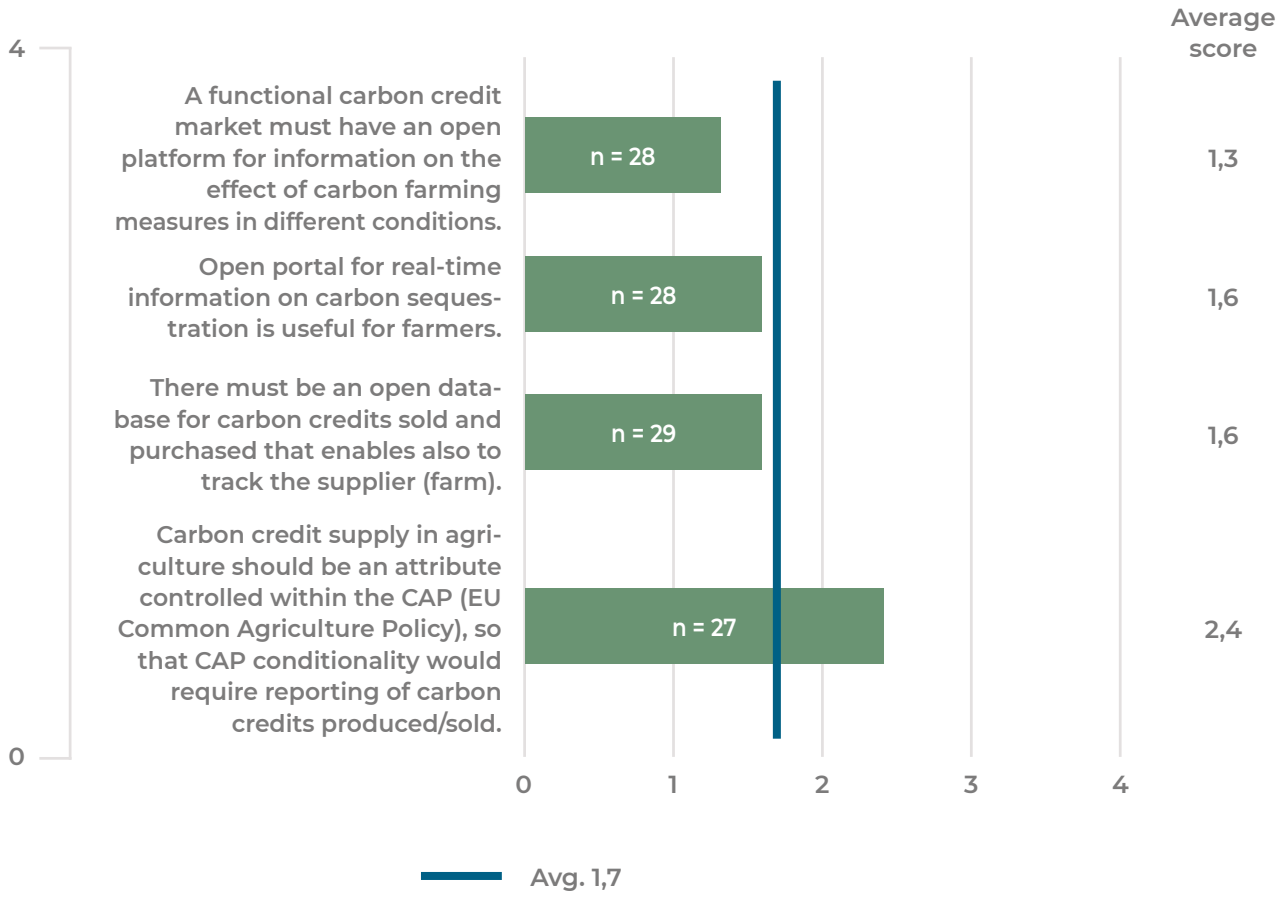
	1 Critical ('dealbraker)	2 important	3 Desirable	4 Negliggible	Average	Median
Amount of soil carbon / SOC content	22,7 %	50,0 %	18,2 %	9,1 %	2,1	2,0
Additionality The carbon stored is additional to the legal baseline and business-as-usual practise and that the carbon payment triggers the measure	15,4 %	65,4 %	11,5 %	7,7 %	2,1	2,0
Permanence The scheme and contract include measures to guarantee the permanence (non-reversal) of the stored carbon.	38,5 %	42,3 %	19,2 %	0,0 %	1,8	2,0
Prevention of carbon leakage The scheme includes mechanisms to prevent carbon emitting production elsewhere as an unwanted consequence of producing carbon credits.	23,1 %	53,9 %	19,2 %	3,8 %	2,0	2,0
Holistic carbon balance analysis The scheme accounts for carbon balance on a holistic scale (farm level, value chain level or by a life cycle analysis (LCA))	32,0 %	52,0 %	16,0 %	0,0 %	1,8	2,0
Exclusivy of the credits The carbon credits produced are exclusively accounted for the given certificate and double issuance, double incentives and double claiming isprevented, i.a. through a transparent registry.	23,1 %	53,9 %	11,5 %	11,5 %	2,1	2,0

	1 Critical ('dealbraker)	2 important	3 Desirable	4 Negliggible	Average	Median
Use of the credits I have control over how the carbon credits resulting from my activity are used. This means, for instance, to set preference whether the credits are usedas voluntary carbon offsets, in the national GHG inventory/as carbon sinks for mandated sectors or whether there is a secondary market for the credits.	36,0 %	28,0 %	28,0 %	8,0 %	2,1	2,0
Environmental benefit Carbon sequestration activities contribute to other environmental benefits and do not compromiseequal/ greated environmental benefits through trade-off of measures.	40,7 %	44,5 %	14,8 %	0,0 %	1,7	2,0
Social benefits That carbon credit scheme is linked to increasing the sustainability of production in a given local area/regionand that there is a benefit for the local community.	34,6 %	42,3 %	15,4 %	7,7 %	2,0	2,0
Sensitivity to farm conditions The scheme is adapted, to a feasible degree, to differences in farm conditions, history and carbon sequestration potential.	39,3 %	42,9 %	10,7 %	7,1 %	1,9	2,0

16. Data management and monitoring, reporting and verification (MRV).

Please give your opinion on the statement about each feature on the scale 1-4.

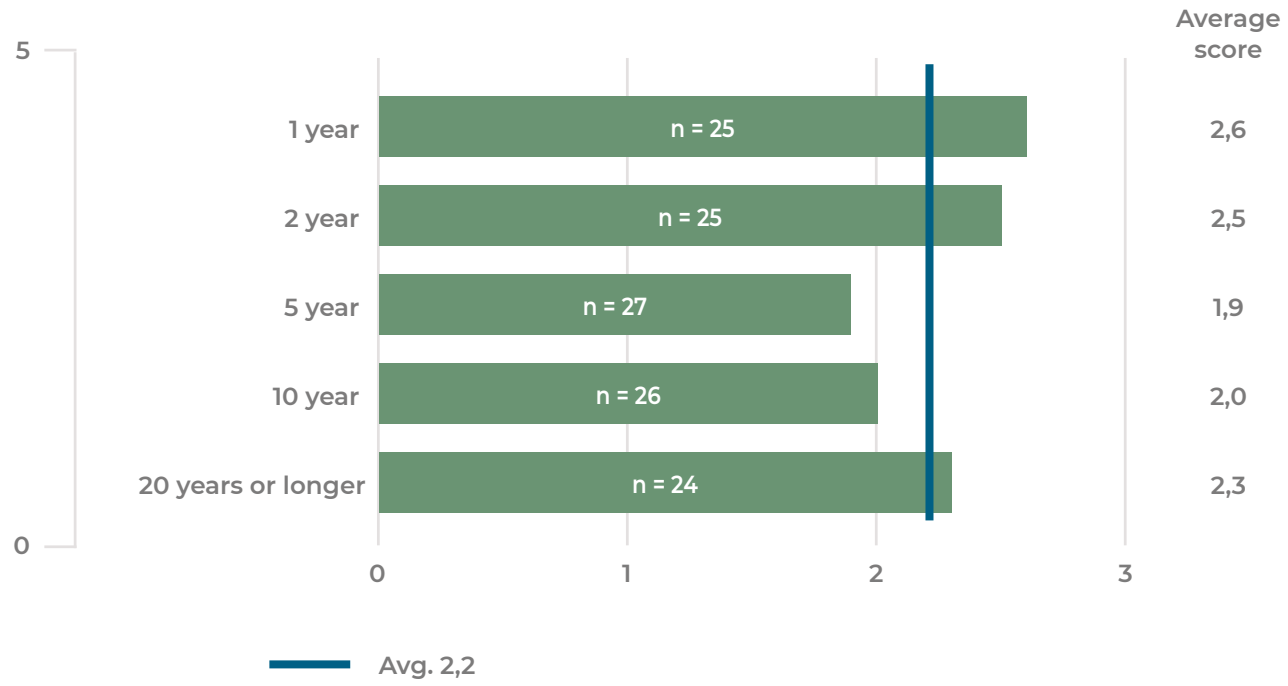
Number of respondents: 29



17. Contract duration. Please indicate your (intuitive) preference regarding the contract period for soil carbon sequestration credits.

(1 = Most prefferred, 2 = Agreeable, 3 = Not agreeable)

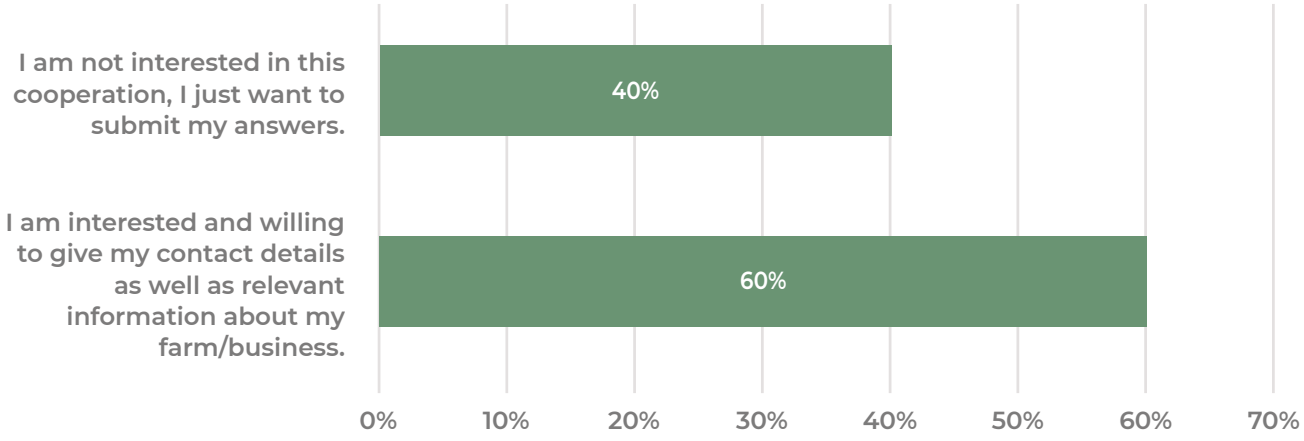
Number of respondents: 29



18.Participation

LIFE CarbonFarmingScheme -project will carry out a market pilot for voluntary carbon credits during 2021. In addition, individual real and virtual farm case calculations will be done along with interviews with farm managers about alternative incentives and other factors affecting farm management decisions. If you are interested in participating in the market pilot or in farm case calculations, please leave your contact information and any relevant basic information about your farm you are able to provide. All information about farm type, production, cropping cycles, as well as of possible soil analyses or research work is useful for us to assess our possibilities to offer anything in return. In any case, the replies to this survey are anonymous. We will process all information received with high confidentiality and use it only for the purposes of the LIFE CarbonFarmingScheme -project. We will not disclose the information to third parties outside the project.

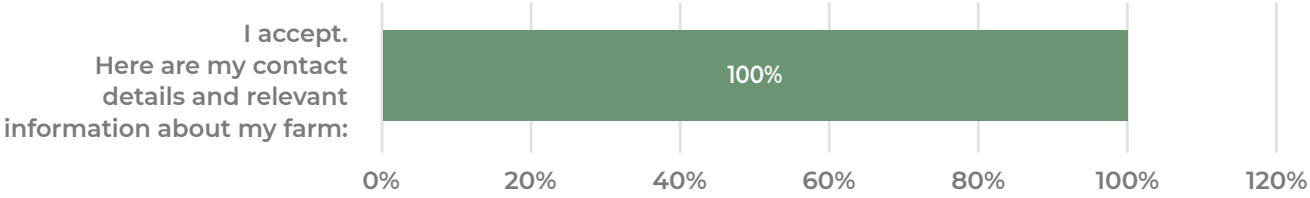
Number of respondents: 30



19.Consent

I understand, acknowledge and approve that when giving my contact information and other personal orcompany data to Baltic Sea Action Group (Foundation for a Living Baltic Sea sr), I give my consent to use this information for the purposes of the LIFE CarbonFarmingScheme -project. Information in the personal data registry will be handled according to BSAG Data Handling Protocol, available at www.bsag.fi => 'Privacy policy'. I have read the BSAG Data Handling Protocol and give my consent to store my personal information and to use it according to this protocol.

Number of respondents: 18, selected answers: 18



Attachment 4

Farm interview form

Form for farm interviews “Testing carbon farming incentive schemes”

Topic and questions	Open interviews, favor questions such as… “Tell me about…” “How do you plan…” “How do you know…” “What do you know about…” “What is it like…” “What is important for you…now…next year… five years from now…” “Why…”
Background information Purpose of this data is to understand the external and historical-cultural conditions the farm operates in as well as the intensity of current CAP support in driving farm decisions and income formation. This is needed primarily for the interpretation and classification of answers. This may include data collected by Luke for the calculations which is used with the permission from thefarm to use thet data for research purposes in this project.	
Geographical data (region, area, soil type, land topography, channels close, biotopes, land use history)	What is the region like? What is the soil like? What is the history of the farmland?
Production data (area, type, cultivation methods)	What is your farmland like? What do you grow?
Farm company (company history, ownership, personnel number, share of permanent/seasonal workers, nationalities, other key characteristics)	What is the history of the farm? Who owned the land before? What is farm ownership now? What is your staff composition like?
Market data (sale of products, types of contracts)	Who do you sell your products to? What kind of contracts do you have? What do you think about the contracts you have?
CAP intensity, contracts	How important is CAP support economically?
Employee Development (current measures and practices related to training and capacity development of employees)	
Occupational Health & Safety (current measures and practices for farm safety, potential lodging at farm premises etc.)	
Social effects (improvements in farmer/ employee wellbeing due to adopted carbon farming practices (i.e. indirect effect through increased income)	

Environmental management	
This part is meant to nderstand generally the state and drivers of environmental management on the farm.	
CAP influence and schemes enrolled (or enrolled before)	
Scope of environmental management on the farm (GHG, water, biodiversity, air quality, hazards)	
Incentives for environmental management (endogenous factors, exogenous factors, standards and incentives from clients)	

Implementation of measures associated with 'carbon farming' ("CF measures, CFM")	
Purpose to understand decision-making, readiness and human capacity to implement the measures in practice, and to surface any tradeoffs between the carbon farming measures in question and other environmental measures.	
Crop rotation, integration of CFM	
Decisions to implement CFM	
Decisions not to implement CFM	
Ease of implementation	
Knowledge, advice, references, peer support available for CFM	
Consideration of CFM with respect to other environmental management measures; weighing and prioritization between environmental objectives	
Possible participation in a Carbon Farming Credit Scheme Have you participated or are there carbon credit schemes available for you?	

Economic effect	
To note and record and direct and indirect economic effect that the farmer has observed or concretized due to adoption of 'environmental practices'. For nonadopters, this is to inspire to consider the possible benefits of environmental practices.	
Yield increase / yield quality increase / yield value increase	
Land value increase, better land lease or insurance terms	
Savings (in fertilizers, plant protection agents, fuel, labour, risk insurance)	
Protection of assets (decreased land erosion, longer lifespan of sub-surface drainage system)	
Pressure to increase farm land area (tobuy/lease/clear new land for cash crop cultivation)	
Eligibility for CAP support; possible tradeoffs?	
Additional cost, nonrecoverable cost (from savings, earnings or CAP support)	

Environmental effect	
In order to understand observed and possible monitored environmental effects from CFM and how farmers perceive environmental effect of CFM.	
Observed environmental effect (water holding capacity, drainage water quality, biodiversity, other)	
Monitored parameters and effect; any parameters monitored/ observed on farm (nutrient balance, soil fertility, soil organic carbon, soil aggregate stability, farmland birds, GHG balance, air emissions, other environment factors or economic factors connected to environmental aspects, e.g. fuel consumption)	
Socio-economiccultural effect Changing and transforming farm management practices and the basic principles of farm management could be constrained and challenged by the socio-cultural context surrounding the farm. There could also be immediate personal impacts to consider. This part looks to surface these effects or possible hinders to CF transition.	
CFM effect (POSITIVE & NEGATIVE) (or considerations prior to CFM adoption) related to ...farm personnel (considerate of different groups of personnel)	
...surrounding landscape	
...local rural community and peer relations	

Keys to sustainability and durability of farm practices for carbon sequestration	
What is needed for the practice to be adopted as routine on the farm	

Carbon market specifics	
This part of the interview focuses on the specific prescriptions of the carbon credit market, in particular, on the key attributes related to the contract terms, baseline and additionality, permanence of the carbon sink, payment and regional pooling of carbon credits.	
Opinion on contracts for carbon credits: Single measure/multiple measures/holistic farm approach, contract parties, restrictions on land use, carbon credit ownership and use, contact length; (typically carbon credit contracts 20+ years, survey respondents avg. preference 10 years), contract flexibility, monitoring and reporting requirements, exit option, no. of contract parties or intermediaries)	
Baseline and additionality of carbon sinks: - environmental baseline and additionality (performance based, regional average, use of proxies); - legal baseline (legal minimum <CAP conditionality); based on type & level of action (measure) - economic baseline (only carbon credit payment triggers CFM)	
Non-permanence and reversal risk mitigation measures (e.g. buffer factor, - 10-30%, reducing carbon credit payment. How these could effect willingness and further farm management? Alternative measures?	
Payment for carbon credit; conditions and timing of payment, price certainty at contract signing, level of payment)	

Pooling Aggregation of carbon sinks regionally, within production systems; no. of contract parties; benefits of pooling (lower risk mitigation factors, lower transaction costs, better access to market, better market competitiveness) Opinion on the possibility to act as a member of an organization which is mandated to run the carbon farming scheme, including financing.	

+ Optional for farmers with good awareness of carbon farming incentives:	
Carbon Contractsf or Difference The scheme modeled after CCfD is presented with certain basic assumptions and the above questions are presented in this frame.	
What is most likely carbon credit measure they would adopt? If not holistic carbon balance? Compensation **RANGE** they would require to implement the measure? Willingness to participate in **auctions**?	

Attachment 5

Soil Amendment methodology

puro·earth

Soil Amendment based carbon storage Methodology
v1.0 published on 16 August, 2021

This methodology quantifies the CO^2 Removal achieved by soil amendment use of biomass residues like pulp and paper mill sludges. This methodology is tested in EU funded project LIFE CarbonFarmingScheme (LIFE19 PRE FI 001). CO^2 Removal is a result of the soil amendment use of biomass residues such as forest industry side streams, which would otherwise be incinerated. Utilizing these side streams as soil improver stores carbon into agricultural soils.

This methodology applies to certificates issued for Puro.earth CO^2 Removal Marketplace.

1. Eligible activity type

Activity that transforms biomass residues such as pulp and paper mill sludges (fiber-, primary-, secondary-, tertiary-, and mixed sludges) to soil improver products that are utilized in agriculture (later: Product or Products).

The Long-Term CO2 Removal is achieved by increasing the soil carbon stock of the field that the Products are applied on. When Products are used as soil improvers, a proportion of the inert organic matter contained in the Product is stored in the soil carbon pool as durable carbon compounds.

Without the activity - the soil amendment use of Products – the sludge would be incinerated by pulp and paper mills, releasing all the carbon (C) contained in the organic matter into the atmosphere. The moisture content of pulp and paper mill sludges is so high (60-75 %) that they have no energy value, and other fuels are needed to aid the incineration process (Alakangas et al. 2016).

1.1. Requirements for activities to be eligible under the methodology

1.1.1.

Products that are used as part of the Activity are manufactured from biomass residues such as fiber-, primary-, secondary-, tertiary- or mixed sludge that is generated as a side stream in pulp, paper, or cardboard production.

1.1.2.

Products made from these materials may be processed by mixing in additives, composting, and / or lime stabilization to modify their properties and to fulfill the requirements of fertilizer and soil amendment legislation. If additives that are used contain carbon, only the carbon from the sludges is included in the calculation of CO2 Removal.

1.1.3.

Products that are used as part of the Activity are registered and approved for soil amendment use as the local fertilizer legislation requires. In Finland, Products must be eligible either for the national type designation list of fertilizer products or, in the case of EC fertilizers, for the list of types of EC fertilizers designations specified in Annex I to EC Regulation 2003/2003 (EU Reg).

1.1.4.

Soil amendment use of Products does not take place on Histosols.

1.2. Requirements for the Product Processing and Use Audit

1.2.1. The Product Processing and Use

Auditor checks the source, processing, and end use of the Products against the Requirements for activities to be eligible under the methodology (section 1.1.), and the Proofs and evidence needed from the CO2 Removal Supplier (section 5). The main requirements include:

- The material used for the Products is of eligible type, they are processed in a suitable manner and the Products are approved for soil amendment use (see sections 1.1.1, 1.1.2, 1.1.3, 5.2.1, and 5.2.2)
- The Products are used in farms for soil amendment according to restrictions set in this methodology (see sections 1.1.4, 5.2.2 and 5.5.2)

1.2.2. The Product Processing and Use

Auditor checks that the CO2 Removal Supplier is capable of metering and quantifying the Output and the Emissions from the Activity in a reliable manner for the Quantification of CO2 Removal (section 4). This check also prepares the CO2 Removal Supplier for producing the periodic Output Report.

- The quantity of Products delivered to farms is quantified and documented in a reliable manner (section 5.2.4)
- The Carbon content of the Products is quantified and documented in a reliable manner (section 5.2.2)
- Emissions from the activity are quantified and documented in a reliable manner (Section 5.4)
- The auditor goes through the Quantification of CO2 Removal requirements with the CO2 Removal Supplier, so that the Supplier is able to calculate the CO2 Removal independently in its Output Report.

1.2.3. Collection of standing data of the CO2 removal supplier

The Product Processing and Use Auditor collects and checks the standing data of the CO2 Removal Supplier. The data to be collected by the Auditor includes:

- A certified trade registry extract or similar official document stating that the organization is validly existing and founded under the laws of the mother country.
- Location of the processing & Product storage facilities.
- Removal Method(s) for which the facility is eligible to receive CO2 removal certificates.
- The Date on which the CO2 removal supplier becomes eligible to receive CO2 removal certificates.

2. Point of creation of the CO2 Removal certificate achieved by soil amendment use of biomass residues such as pulp and paper mill sludges.

2.1. Point of creation

2.1.1.

The point of creation of the certificate is the moment when the Product is delivered to the farm that has purchased it for soil amendment use. The application to the field can take place as soon as the weather conditions allow, but no later than what is required by the local agricultural regulation.

2.1.2.

The seller of the Product is the CO2 Removal Supplier.

3. Activity boundary for the CO2 Removal Certificate

3.1. Activity

Included within the boundary

- Transportation from an industrial source to a processing site
- Processing (if processed)
- Transportation of the Product to the storage site (if used)
- Transportation of the Product to the end user (from processing site / from storage site)
- Application on to a field

Excluded from the boundary

- GHG emissions from the activity where the biomass residues originate from such as sludge processing done in pulp & paper mill
- CO2 emissions from the soil after application

The reasoning for excluded items: GHG emissions from the sludge processing done in pulp & paper mill would occur even if the sludges would be incinerated. Biogenic CO2 emissions from the soil after application of the Product are from the decomposition of renewable biomass.

4. Quantification of CO2 Removal – calculation methodology

4.1. Net CO2 Removal

Net CO2 removal = CO2 storage (20 years) – $Emissions_{activity}$

Where:
CO2 storage = amount of CO2 removed from the atmosphere and retained in the soil for 20 years(t CO2)

$$Emissions_{activity} = E_{processing} + E_{transportation} + E_{application}$$

4.2. CO2 storage (20 years)

The proportion of Product carbon that is left in the soil after 20 years is estimated with Yasso-modelling tool forecasting litter decomposition and soil carbon pool accumulation (Yasso).

Therefore, the amount of CO2 removed from the atmosphere by each Product is calculated according to the following formula:

$$CO2\ storage = Q_{product} * C_{product} * SC_{product} * CF$$

Where:
CO2 storage = amount of CO2 removed from the atmosphere (t CO2)

$Q_{product}$ = Quantity of Product that has been delivered to farms for soil amendment use (in tons)

$C_{product}$ = Average organic carbon content of the delivered Product batch (%)

$SC_{product}$ = Stored Carbon Proportion, Yasso-modelled Proportion of Product organic carbon that is stored in the soil after 20 years (%)

CF = Conversion factor from carbon to carbon dioxide (3,67)

4.3. Emissions from the Activity

Emissions from the Activity consist of emissions from processing, transportation, and field application of the Products within the Activity Boundary.

$$Emissions_{activity} = E_{processing} + E_{transportation} + E_{application}$$

$E_{processing}$ = Emissions from the processing of the Products and emissions from the use of possible additives

$E_{transportation}$ = Emissions from all transportations within Activity boundary

$E_{application}$ = Emissions from field application of the Products in the farmland and soils

4.2.1. Emissions from processing biomass residues into Products

Emissions from processing occur from fossil fuel use of the machinery used for processing, and from the production and transportation of possible additives used in processing (for example lime if Product is lime stabilized). If used additives are also sourced as side streams, no production emission is considered to occur for them.

4.2.2. Emissions from transportation

The side stream and Product transportation emissions are calculated for all transportations occurring within the Activity boundary. These include transportations from side stream source to the Product processing site, from Product processing site to Product storage facility, from the Product storage facility to the farms, and all other occurring transportations.

4.2.3. Emission from field application

Emissions from the field application of the Products are estimated for the total Product quantity delivered by the CO2 removal Supplier. Emissions from the application are included regardless of if the application is performed by the farmer or by the CO2 removal supplier.

5. Proofs and evidence needed from the CO2 Removal Supplier

5.1. Principle

5.1.1.

Output from Activity is determined as eligible for issue of CO2 removal certificates once the Activity and CO2 removal supplier have undergone a process of third-party verification by an auditor against the specific methodology Soil Amendment based Carbon Storage Methodology. The verification ensures that the corresponding CO2 removal has taken place and that the CO2 removal is considered stored for the long term as defined in the methodology.

5.1.2.

For the Activity to be eligible for soil amendment use of biomass residues such as pulp and paper mill sludges for which CO2 removal certificates can be issued, the following proofs (5.2- 5.6) need to be presented by the CO2 Removal Supplier (in this case, the seller of the Product).

5.2. Product source, quality & quantity

5.2.1.

Proof that Products that are used as part of the Activity are manufactured biomass residues such as from fiber-, primary-, secondary-, tertiary-, or mixed sludge that is generated as a side stream in pulp, paper, or cardboard production. This is demonstrated by presenting that the starting point of transportation for each side stream is an eligible source, and by presenting the product information papers that show the ingredients of the Product.

5.2.2.

Proof that Products fulfill the requirements of fertilizer and soil amendment legislation, and proof of all the additives used in Products. Proof to be presented for these are the product information papers that that follow the requirements of local fertilizer and soil amendment legislation and show the ingredients of the Product.

5.2.3.

Proof that shows the organic carbon content of the Products. Proof to be presented is laboratory results that show the content of organic carbon in the Products. (Cproduct)

5.2.4.

CO2 removal supplier provides data and documentation on the quantity of Products delivered to the farms for soil amendment use. Proof to be presented is data on Product deliveries, for example, invoices or record keeping for the transportation, which include transportation destinations and quantity of delivered Product(s). (Qproduct)

5.3. Storage of the Activity (SCproduct)

5.3.1.

CO2 removal supplier provides a Yasso-model results for the Proportion of Product organic carbon that is retained and stored in the soil after 20 years (%).

5.3.2.

The input parameters needed for determining the decomposition rate in the Yasso-model. Proof to be presented is laboratory results for the Product's Carbon content as acid (A), water (W) and ethanol (E) soluble, non-soluble (N) and humus (H) fractions.

5.3.3.

The climate zone of the farms informs the Yasso-model for weather conditions impacting the decomposition rate like rainfall and temperature.

5.4. Emissions from the Activity

Proof that allows quantifying all the emissions occurring from the Activity. CO2 removal supplier needs to present LCA/carbon footprint results for the processing (Eprocessing), logistics (Etransportation), and application (Eapplication) of the Products.

5.5. Proof of the end use of Product

5.5.1.

CO2 removal supplier will present proof that the Products have been sold and delivered to farms (data on deliveries showing end destinations)

5.5.2.

CO2 removal supplier will present proof that use of Products does not take place on Histosols. Proof to be presented is confirmation from the farmer.

5.6. Proof of no double counting or double claiming

5.6.1.

A statement is needed from the CO2 Removal Supplier that the Product or Activity in which the CO2 is stored will not be sold or marketed as “carbon positive” if the CO2 removal certificate associated with the use of Product (soil improvement fibers) is removed from the Product and sold to another stakeholder not associated with the Product.

5.6.2.

No carbon accounting claims can be made by the end-user (user of Product; farms that use Product for soil amendment) that the Product is a carbon sink or carbon removal, if the decoupled CO2 Removal certificate has been sold to and cancelled by another stakeholder not associated with the Product.

6. References

(Alakangas et al. 2016) Alakangas, E., Hurskainen, M., Laatikainen-Luntama, J. & Korhonen, J. 2016. Suomessa käytettävien polttoaineiden ominaisuuksia. VTT Technology 258. Downloaded on 27.1.2021: https://www.vttresearch.com/sites/default/files/pdf/technology/2016/T258.pdf

(EU Reg) Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilizers , Downloaded 13.4.2021 https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32003R2003

(Yasso) Soil carbon model Yasso07, Yasso15 - worldwide litter decomposition and carbon stock mathematical modelling tool based on a global database containing 18 500 measurements of litter decomposition and soil organic carbon. Downloaded 26.4.2021 https://en.ilmatieteenlaitos.fi/yasso-description#Yasso15

Attachment 6

Sales and Marketing data January 2022

puro·earth

Sales status Jan–2022

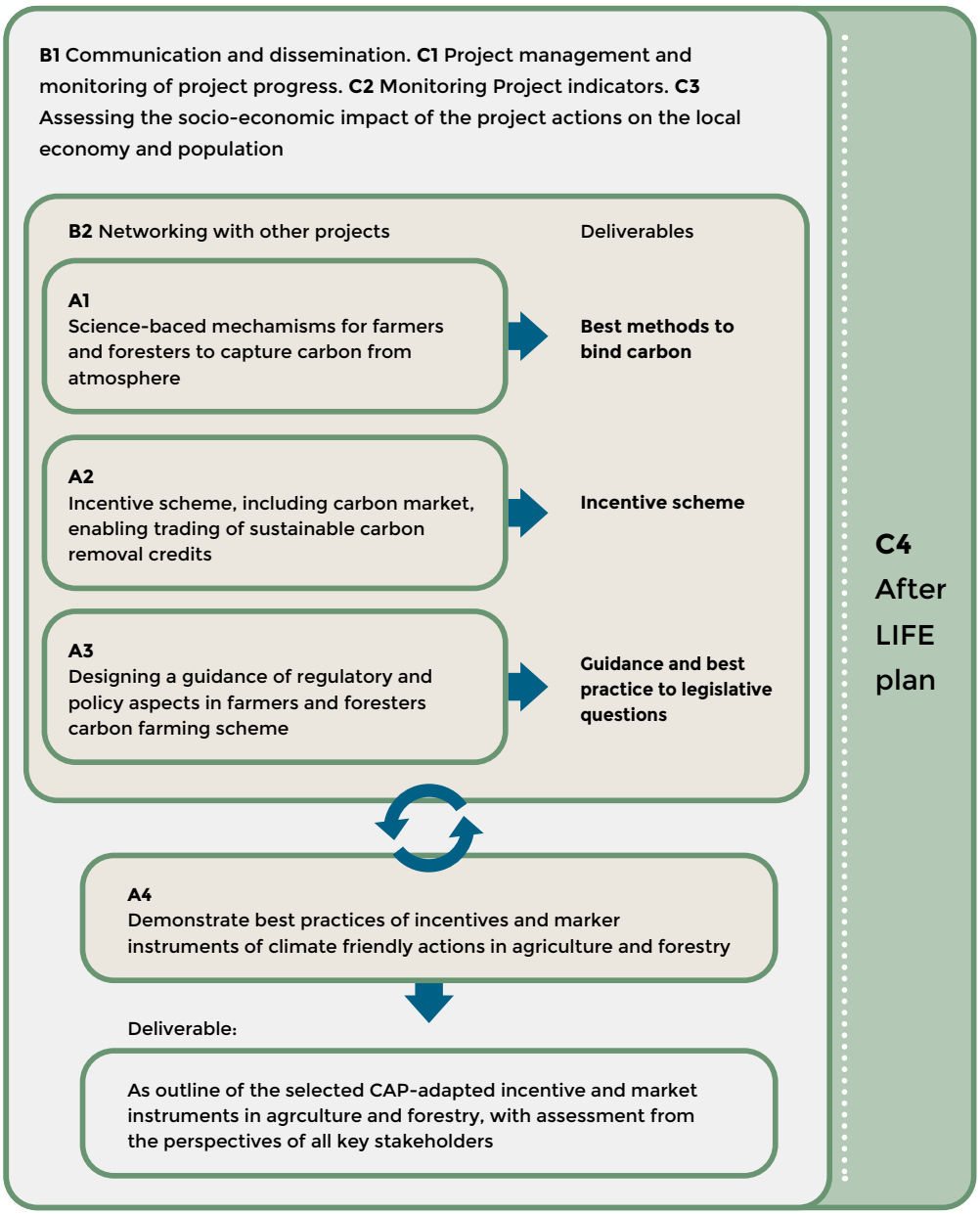
Carbon Farming Scheme
EU LIFE 19 PRE FI001 – S2.828588

Contents of this Status Report

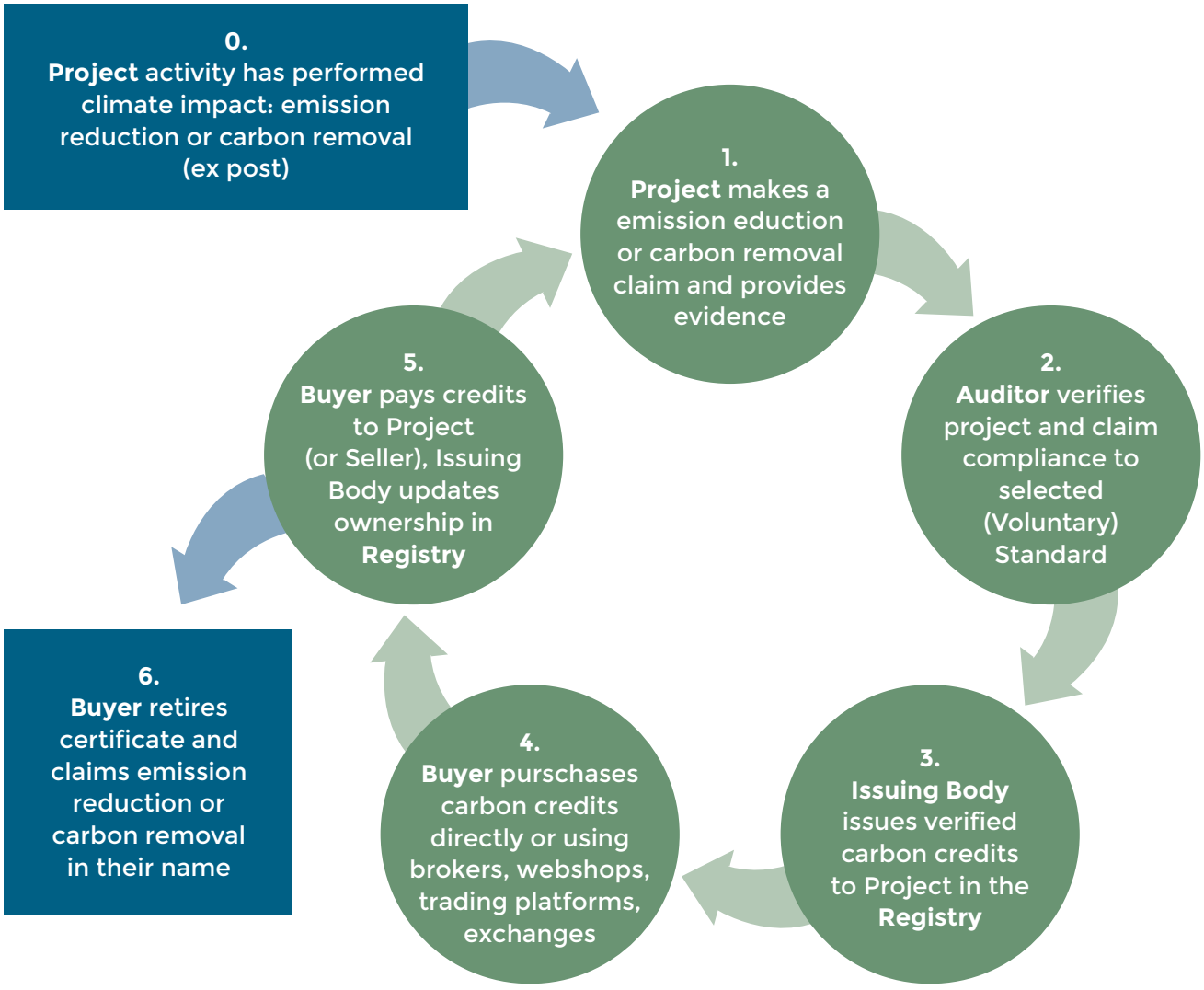
- Work package A4 " Demonstration and testing of incentive mechanism concepts
- Carbon certificate process overview
- Status of certification in A4 work package
- Status of Sales and trading in A4 work package
- Annex 1: Data from marketing campaign in Social media
- Annex 2: Summary of Puro.earth Platform

Work package A4 “Demonstration and testing of incentive mechanism concepts”

Farmers and forest owners have a significant role and potential in mitigating and adapting to climate change globally as well as in Europe. At best, the right measures will also generate multiple co benefits i.a. in other ecosystem services. Application of such practises to increase soil carbon storage or carbon sinks in forestry can be accelerated, for instance, through agricultural and forest policies or by voluntary carbon credit markets.



Carbon certificate process overview



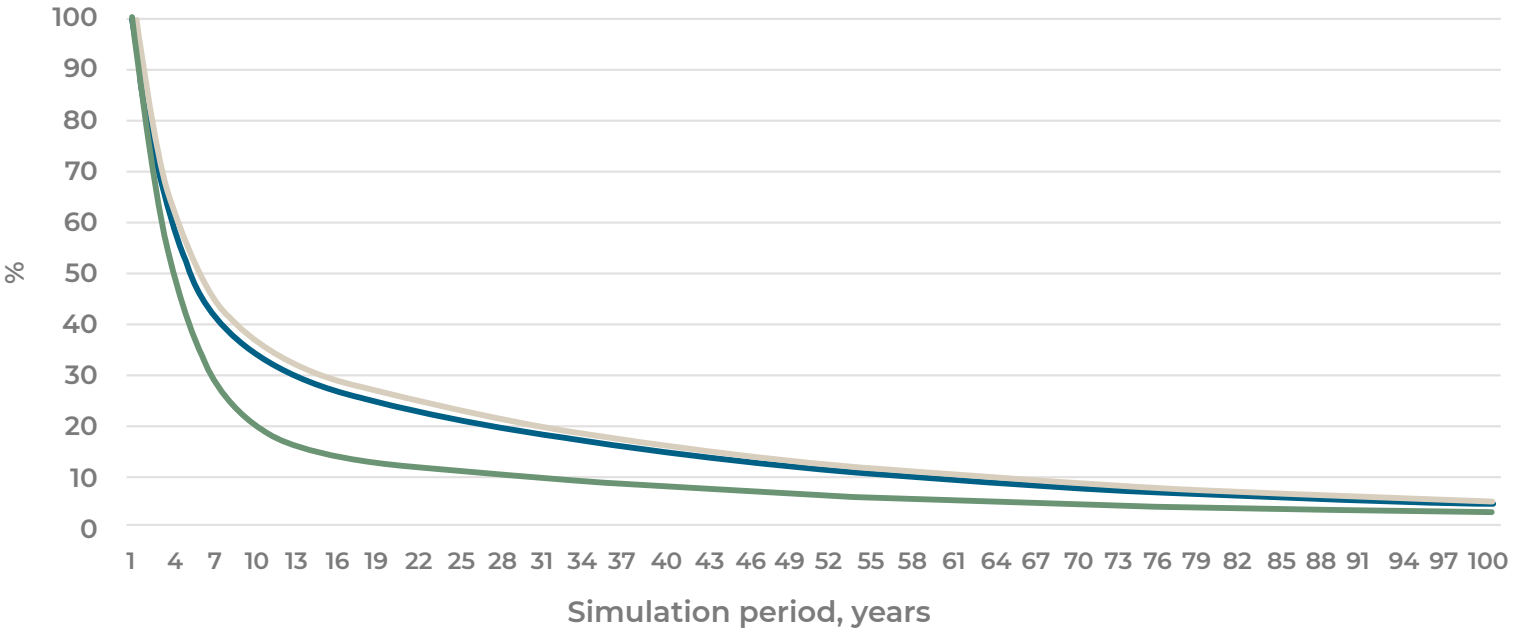
In this demonstration

- IssuingBody = Puro.earth
- Registry = Puro Registry
- Standard = Soil Amendment methodology (pilot)
- Auditor = bio.Inspecta
- Webshop , trading platform = Puro.earth
- Projects = Soil Amendment projects in Finland, UK, France
- Buyers = potential buyers interested in purchasing these credits for their claims

Soil Amendment selected to test trade because it is carbon and permanence can be quantified

- Puro.earth Soil amendments carbon removal methodology

The share of C originatinf from soil enrichment materials remained in the soil after 100 year simulation period



The chemical quality of carbon inputs			
Proportions of AWEN fractions			
A	**W**	**E**	**N**
0,63	0,05	0,02	0,31
0,60	0,04	0,03	0,33
0,83	0,03	0,01	0,13

Status of carbon certification in Puro.earth platform EU LIFE Carbon farming scheme

3 projects piloted in Finland, UK, France

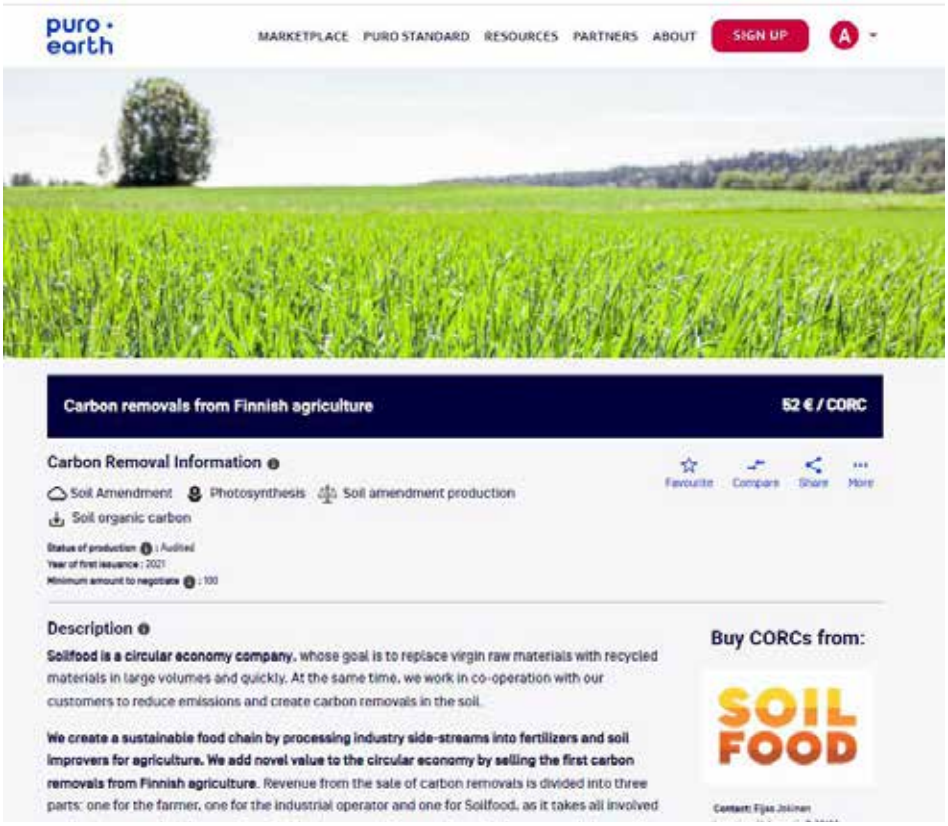
- Finland verified and sales ongoing
- UK, France: verification process on going

Project Finland

- Carbon removals from Finnish agriculture | Puro.earth
- Verification performed by bio.Inspecta in June 2021. Audit statement available here

Standard Soil Amendment

- One Credit represents one tonnes of CO2eq. that remain in soil for 20 years or more
- The carbon removal is achieved with increasing the soil carbon stock by adding organic matter to the farmland. A proportion of the carbon (CO2eq.) contained in the matter is stored in the soil as durable carbon compounds



Status of sales and trading in Puro.earth platform EU LIFE Carbon farming scheme

- Price set by project to 52 Eur / CORC20+
- Wide interest: Views in Puro.earth online shop (800 views in
- Aug Sep, 1100 Oct Jan2022)
- Global marketing and sales activities in Puro.earth platform:
- newsletter, social media, marketing video, online shop, one to
- one sales meetings, RFP answers

- Sales status (status 19.01.2022)
- Few sales transactions completed, five ongoing negotiations
- Slow sales, small volumes
- Potential buyer characteristics: food industry, Technology companies, buyers
- prefer their home country
- Concerns from buyers:
  - Price 52€ is considered to be high compared to permanence of 20 years
  - It is unclear what claim the buyer can make with the 20 year permanence

Date	Even type	Retired corcs	Credit type	Methodology	Beneficiary	Retirement purpose	Country of consump-tion
2021-08-18	Retirement	1	CORC 20+	Soil Amendment	Not available	Not available	Finland
2021-10-21	Retirement	12	CORC 20+	Soil Amendment	Lehmus Roastery Oy	To compensate our emissions from roasting coffee. 100044-001	Finland
2021-12-23	Retirement	40	CORC 20+	Soil Amendment	Not available	Not available	Finland
2022-01-27	Retirement	5	CORC 20+	Soil Amendment	Not available	Not available	Germany

https://registry.puro.earth/carbon-sequestration

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Data from marketing campaign in Social Media

August 2021

Soil Amendment Methodology and Soilfood Social Media Campaign

Total engagement across channels

(LinkedIn, Twitter & Facebook)

8,773	79	1,247	11
impressions	likes	video views	shares

Key learnings:

- Video content performs significantly better across channels, gaining higher engagement rates and tractions than article links
- LinkedIn achieves the highest engagement rates for this type of content. Twitter also performs well. Facebook reaches a smaller audience and less corporate, as we do not focus on this channel.
- Commentators focused on the innovation, benefit to players and the concern of double counting.

LinkedIn results –post 1

Online here

Puro.earth is proud to introduce the brand-new Soil Amendments Carbon Removal Methodology alongside our new CORC20+

We must all make efforts to transform our society and quickly deploy removal strategies at a global scale. One way to achieve this is through soil amendments - materials that improve farming soils and work as carbon removal and storage.

The mechanism is simple: applying these amendments sequesters external carbon within agricultural soils, which is then stored in a stable state for at least two decades. That's why we created a new Removal Certificate with a durability of at least 20 years - the CORC20+.

We are committed to REMOVING as MUCH CO2 as we can, as FAST as we can, for as LONG a duration as we can to fight the climate crisis NOW in the 2020s.

Find out more and check out Puro.earth's first supplier Soilfood in our blog post

https://lnkd.in/guhTFDxY
#CCS #CORCs #CarbonSequestration

54 • 6 comments • 1,247 Views

Organic stats

3,580
impressions

52
Reactions

4,02%
Click-through to

6
Comments

7
Shares

144
Clicks

5,89%
impressions

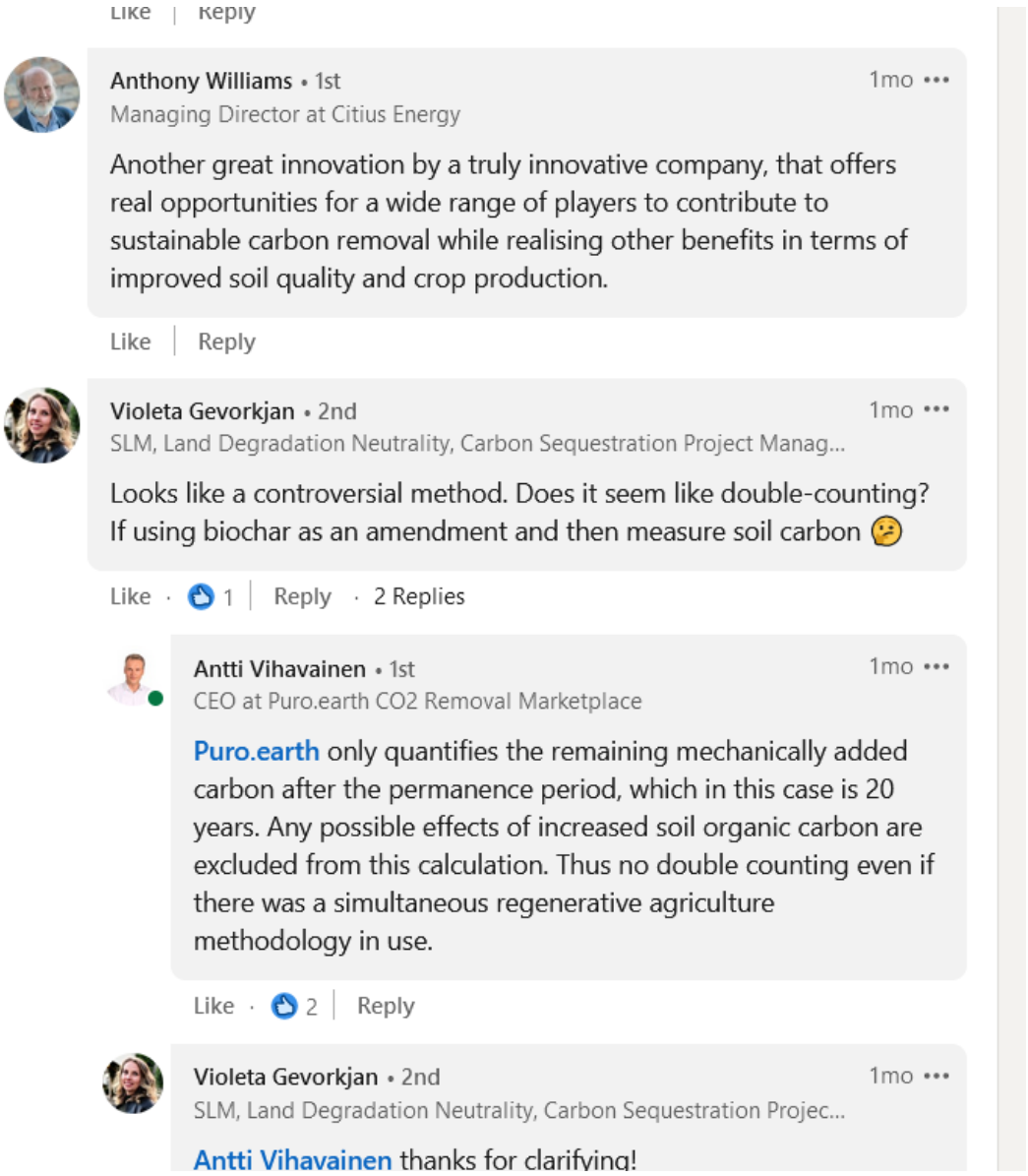
Video views

Targeted to:
All followers

1,247
Total

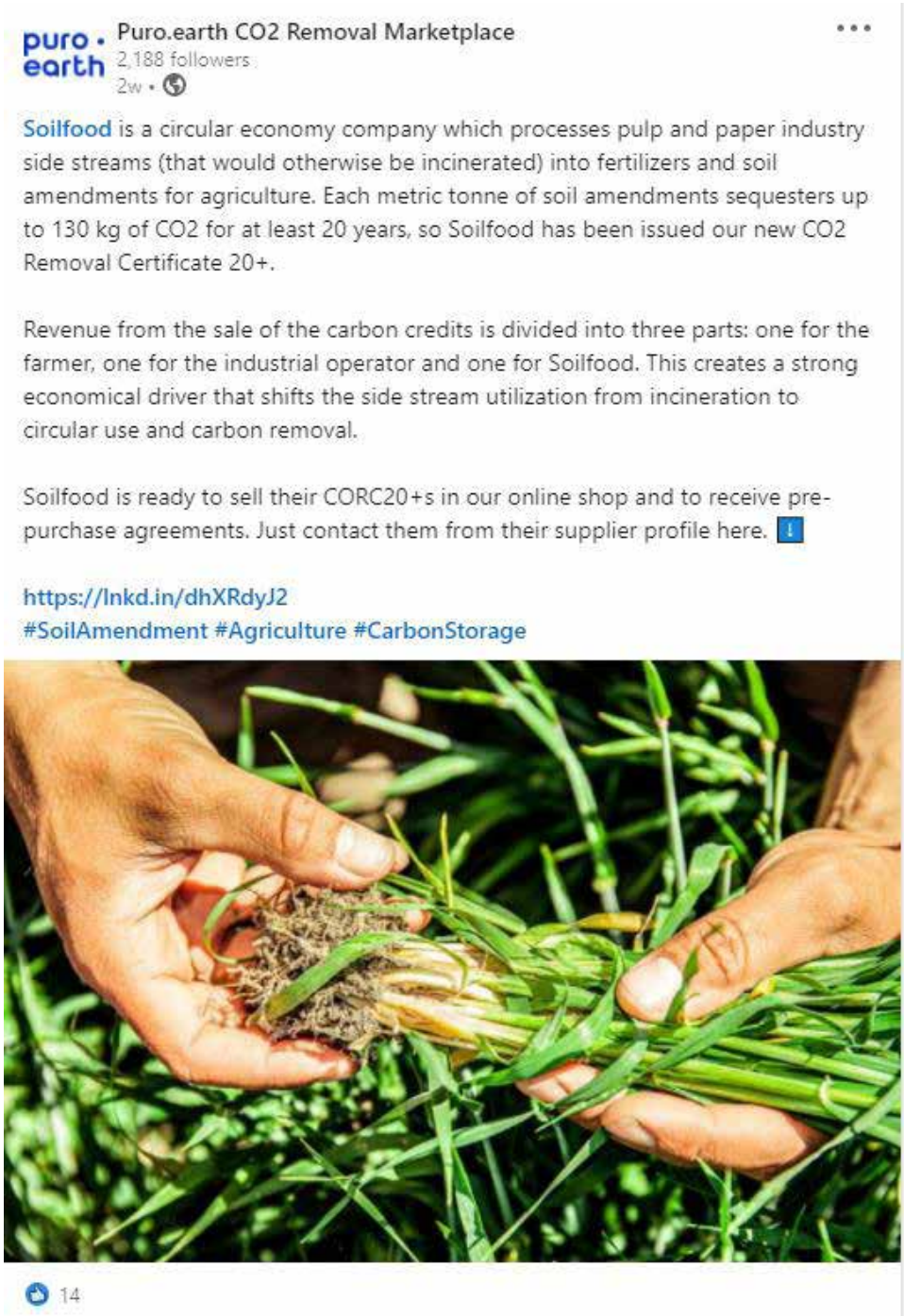
LinkedIn comments –post 1

Online here



LinkedIn results –post 2

Online here



Organic stats

669
impressions

14
Reactions

2,24%
Click-through to

0
Comments

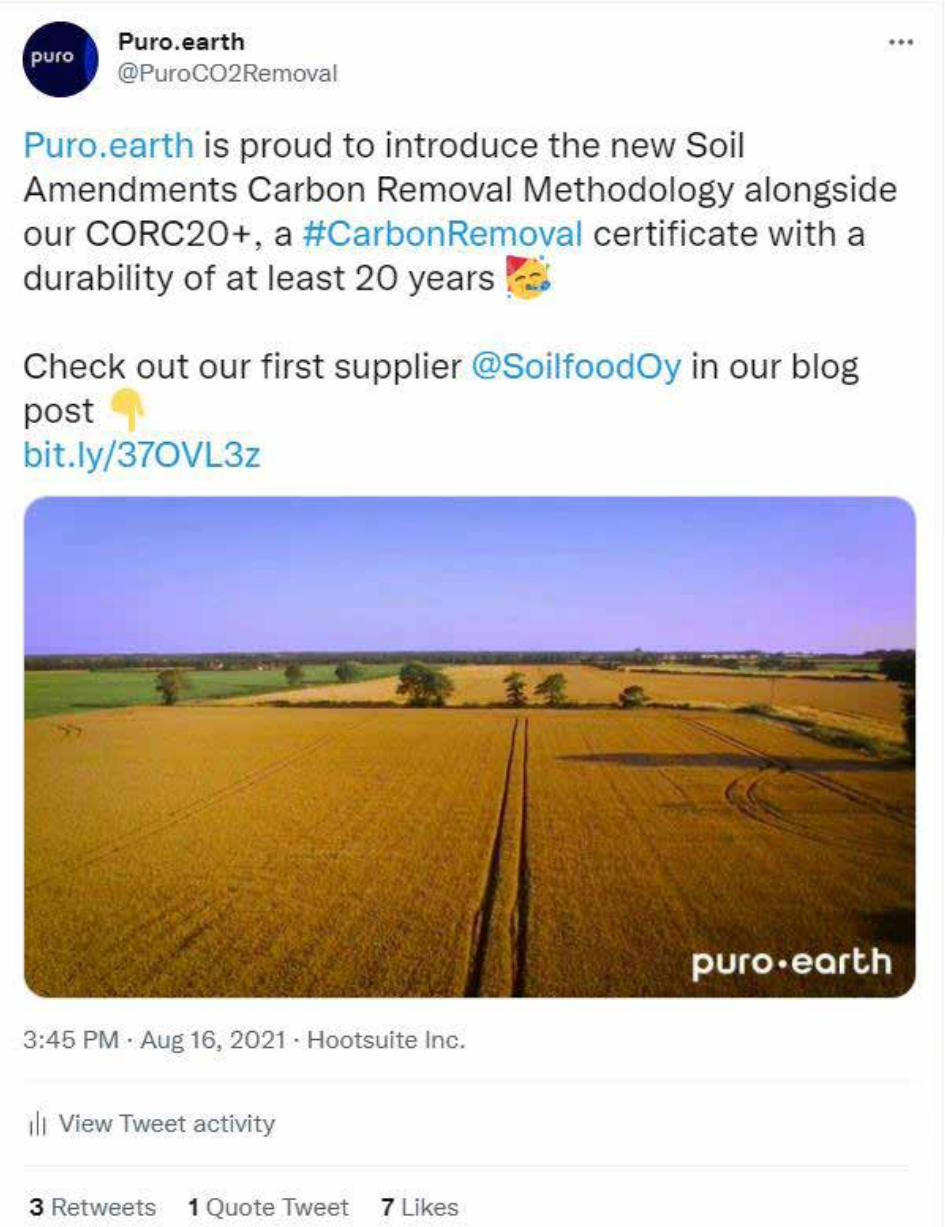
0
Shares

15
Clicks

4,33%
impressions

Twitter results –post 1

Online here



883

Impressions

times people saw this Tweet on Twitter

36

Total enagements

times people interacted with this Tweet

Organic stats

10

Detail expands

times pepole viewed the details about this Tweet

7

Likes

times people liked this Tweet

6

Link clicks

clicks on a URL or Card in this Tweet

4

Retweets

times pepole retweeted this Tweet

4

Media engagements

number of clicks on your media counted across videos, vines, gifts and images

4

Profile clicks

number of clicks on your name, @handle, or profile photo

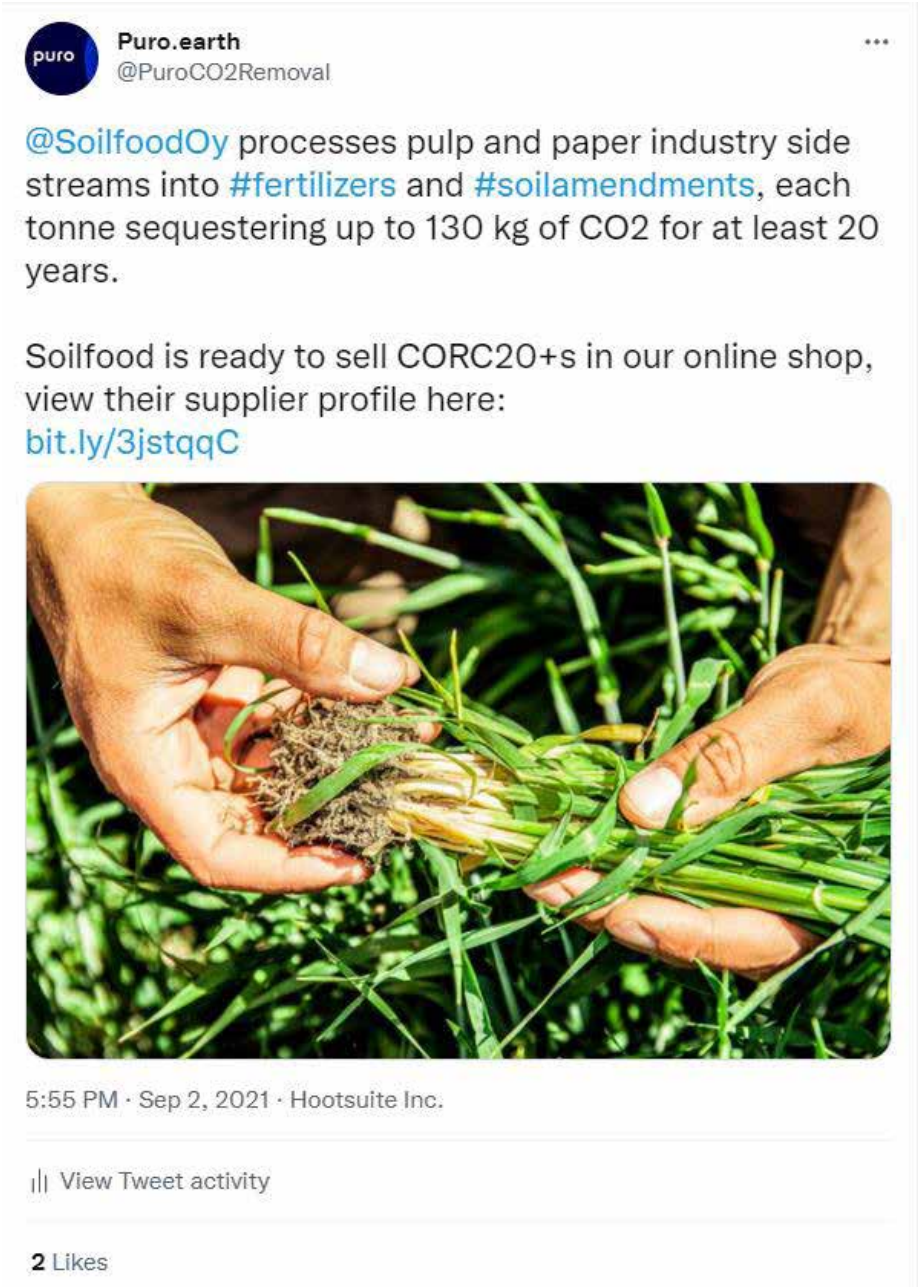
1

Hashtag clicks

clicks on the hashtag(s) in this Tweet

Twitter results –post 2

Online here



47

Impressions

times people saw this Tweet on Twitter

2

Total enagements

times people interacted with this Tweet

Facebook results –post 1 and 2

Facebook results –post 1 and 2

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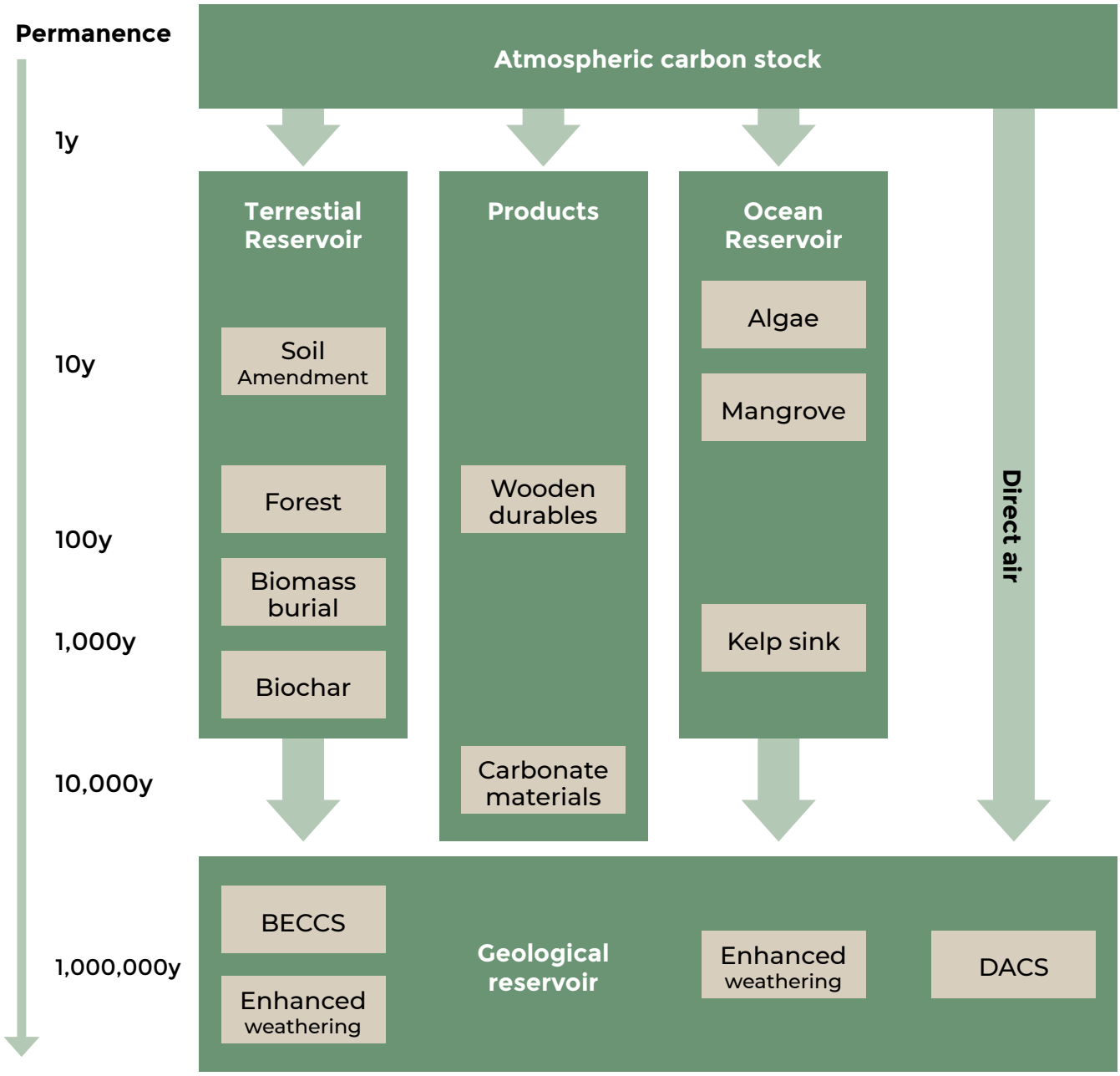
The Carbon Removal Standard, Registry and B2B Marketplace

IPCC definition* Carbon dioxide removal (CDR)

= Anthropogenic activities removing CO2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products.

(* https://www.ipcc.ch/sr15/chapter/glossary/)



General Buyer's selection criteria for Carbon Removal

- Timing can they purchase ex post verified carbon removal credits now
- Scale how many tCO2e available now and over 5 10 years
- Price affordability vs. buyer's current budget
- Price curve price over 5 10 years
- Quality and attributes
    - Verification auditability / reputation risk
    - Permanence
    - Co benefits & SDGs
    - Yes in my back yard (in my supply chain)
- What kind of claim can in make
    - Sponsoring ramp up new practice or technology
    - Net zero claim (match same amount of removals with buyer's emissions in specific time period)

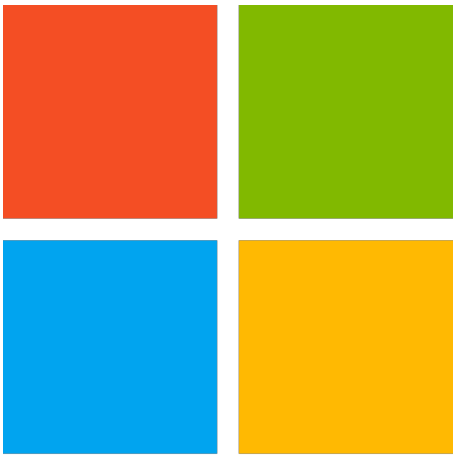
Miten nämä kriteerit täyttyvät / onko helppo täyttää

1) Soil Amendment

2) Other regenerative farming credits (Cover crops)

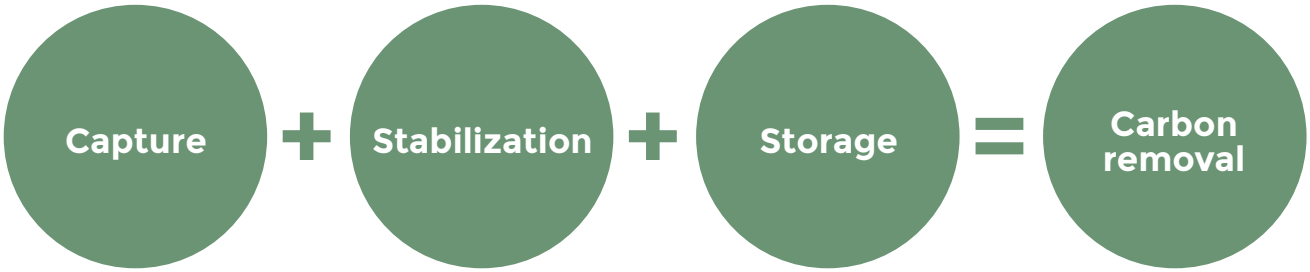
3)

Puro.earth reference customers



Microsoft

Requirements for CO_2 removal methods



Quantification by measuring

Minimal margin of error

Verification

3rd party auditor ex-post

→ Methodology →

CORC

= 1 tonne of CO_2 removed from circulation

Long- term

Beyond the peak of human emissions

50 to 1000+ year permanence

Volume potential

Industrial scaling model