



LILAS4SOILS D2.1 – CFPs co-creation and macro-environment characterisation (I)

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Table of Contents

Table of Contents	1
Abbreviations	3
Executive Summary.....	4
1. Introduction.....	6
1.1 Purpose of the deliverable	6
1.2 Role of D2.1 within WP2.....	7
1.3 Continuity with WP1 and the Living Lab launch process.....	8
2. Methodological approach	10
2.1 Overall co-creation process.....	10
2.2 Preparatory questionnaires and pre-work activities	11
2.3 Co-creation workshops: organisation, structure and reporting tools	13
2.4 Approach for synthesising results across Living Labs	14
3. Overview of the first WP2 co-creation cycle	15
3.1 Timeline of questionnaires and workshops.....	15
3.2 Stakeholders involved	16
3.3 Carbon Farming Practices addressed across Living Labs	18
3.4 Main outcomes from the preparatory questionnaires.....	19
4. Results from the Living Labs	21
4.1 SHARE – Italy	23
4.2 IBERSOILL – Spain/Portugal	24
4.3 GRECF ^{L2} – Greece.....	24
4.4 RAGILL – Israel.....	25
4.5 SOFRALL – France.....	25
5. Cross-Living Lab synthesis	26
5.1 Main macro-environmental barriers and opportunities	26
5.2 Practical challenges and co-developed solutions for CFP implementation	33
5.3 Common needs for training, advisory support and MRV	35
5.4 Key similarities and differences across Living Labs.....	36
6. Implications for the next project activities	40
6.1 Implications for cross-fertilisation between Living Labs.....	40
6.2 Implications for CFP implementation and monitoring	41
6.3 Recommendations for the next co-creation cycle	42
7. Conclusions.....	46
8. References.....	47

9. Annexes	48
Annex 1. Preparatory questionnaire template.....	48
Annex 2. Summary of questionnaire responses by Living Lab	57
Annex 3. Co-creation workshop agendas and dates	62
Annex 4. Reporting tables used for Task 2.1 and Task 2.2	66
Annex 5. Completed reporting tables by Living Lab	68
Annex 6. Additional workshop material and visual documentation.....	95

Abbreviations

CFP – Carbon Farming Practice

CRCF – Carbon Removal Certification Framework

DSS – Decision Support System

EU – European Union

ETS – Emission Trading Scheme

LL – Living Lab

MRV – Monitoring, Reporting and Verification

RDP – Rural Development Programme

SOC – Soil Organic Carbon

WP – Work Package

Executive Summary

Deliverable D2.1 – **CFPs co-creation and macro-environment characterisation (I)** reports the outcomes of the first co-creation cycle carried out within Work Package 2 (WP2) of the LILAS4SOILS project. Its purpose is to document how the five LILAS4SOILS Living Labs moved from the set-up and launch phase developed under WP1 towards the operational co-development of Carbon Farming Practices (CFPs). The deliverable provides a structured synthesis of stakeholder perceptions, macro-environmental barriers and opportunities, practical implementation challenges, co-developed solutions, training and advisory needs, and Monitoring, Reporting and Verification (MRV) requirements.

The deliverable is intended to support consortium partners, Living Lab coordinators, farmers, technical advisors, researchers, value-chain actors, public authorities, policymakers and actors involved in certification, advisory services or MRV. It is particularly relevant for understanding which conditions may enable or constrain the adoption of carbon farming under real farming conditions.

Activities completed. The first WP2 co-creation cycle was implemented between October 2025 and February 2026 across the five LILAS4SOILS Living Labs: SHARE in Italy, IBERSOILL in Spain and Portugal, GRECFL² in Greece, RAGILL in Israel and SOFRALL in France. The process followed a harmonised but locally adaptable approach and included two main activities. First, preparatory questionnaires were disseminated to different stakeholder macro-categories to collect preliminary information on carbon farming perceptions, priority practices, barriers, enabling factors, incentives, carbon markets and Living Lab expectations. Second, each Living Lab organised a co-creation workshop using common guidelines and reporting tools, combining discussion of macro-environmental barriers and opportunities with more practical work on CFP implementation at Living Lab and demo-site level.

Quantified achievements. The first cycle generated the following main outputs:

- **256 responses** were collected through the preparatory questionnaires across the five Living Labs;
- respondents included **162 representatives of the farming sector**, including farmers and technical advisors, **38 agri-food industry and civil society actors**, and **56 representatives from research, schools, public authorities and foundations**;
- **228 stakeholders** participated in the co-creation workshops across the five Living Labs;
- stakeholders identified **206 barriers and 129 opportunities** across four macro-environmental dimensions: technical, economic/market, socio-cultural and administrative/policy/regulatory;
- harmonised Task 2.1 and Task 2.2 reporting tables were completed to support both Living Lab-specific analysis and cross-Living Lab comparison.

Principal findings. Three principal findings emerged from the first WP2 co-creation cycle.

First, stakeholders recognised carbon farming as a promising approach, but not as a simple or automatic solution. CFPs were associated with benefits for soil health, nutrient-use efficiency, erosion control, water regulation, biodiversity, climate resilience and, in some cases, farm productivity. The practices most frequently discussed included cover crops, reduced soil disturbance, improved rotations, nutrient planning and application, manure and organic matter management, grassland management and agroforestry-related practices. However, stakeholders consistently stressed that these practices must be adapted to local soils, climates, farming systems, machinery availability, labour organisation and market conditions.

Second, carbon farming adoption is constrained by **systemic barriers**. The most recurrent barriers concerned technical knowledge gaps, limited advisory support, machinery and investment constraints,

uncertain profitability, low or unstable carbon market returns, administrative complexity, regulatory uncertainty and difficulties related to MRV. These findings show that carbon farming cannot be promoted only through farm-level technical recommendations; it also requires stable incentives, coherent policy frameworks, trusted advisory systems and practical monitoring tools.

Third, the Living Labs identified concrete opportunities and practical solutions. Stakeholders highlighted the value of peer-to-peer learning, demonstration farms, field visits, machinery demonstrations, farmer training, decision-support tools and continuous advisory support. Co-developed solutions focused on adaptive management, shared or cooperative access to machinery, locally adapted CFP combinations, stronger knowledge translation, and MRV systems that are useful not only for carbon accounting but also for farm management.

A common message across Living Labs was that MRV should include soil organic carbon, but also broader soil health and productivity indicators such as soil structure, nutrient status, water retention, biological activity, biomass production and crop performance. This broader approach would make monitoring more useful for both certification and decision-making.

Limitations and lessons learned. Although the first cycle used common templates and reporting tools, differences in questionnaire implementation, stakeholder categorisation, response coding and reporting formats made cross-Living Lab comparison more complex. The results should therefore be interpreted as a structured participatory evidence base rather than as a statistically representative survey. This confirms the need to improve the standardisation of pre-workshop data collection in the second co-creation cycle, while preserving the flexibility required by the Living Lab approach.

Implications and next actions. The results indicate that future LILAS4SOILS activities should move from broad discussion of carbon farming towards more practical, thematic and field-based work. Cross-fertilisation between Living Labs should focus on common operational issues such as cover crop management, reduced tillage transition, nutrient and manure management, machinery adaptation, economic feasibility and MRV. At demo-site level, the co-developed outputs should be used to refine practical protocols, clarify follow-up actions and test CFP combinations under real farming conditions.

The policy implications are also important. Stakeholders need clearer and more stable frameworks for carbon farming, including simplified administrative procedures, credible certification systems, affordable MRV requirements, and incentives that reward both new adoption and the maintenance of existing good practices. Policy support should not focus only on carbon credits, but also recognise wider ecosystem services such as soil fertility, water regulation, biodiversity, erosion control and climate resilience.

The next actions emerging from D2.1 are to refine CFP implementation pathways at demo-site level, strengthen cross-Living Lab learning, improve the standardisation of the next pre-workshop survey, increase stakeholder engagement, align WP2 outputs with WP3/WP4 monitoring planning, and develop practical MRV approaches that are scientifically robust but also usable by farmers and advisors. Overall, D2.1 confirms the value of the Living Lab approach for carbon farming. The next challenge will be to transform the shared understanding developed through this first cycle into locally adapted, credible and scalable carbon farming pathways.

1. Introduction

1.1 Purpose of the deliverable

This deliverable, **D2.1 – CFPs co-creation and macro-environment characterisation (I)**, reports the outcomes of the first co-creation cycle carried out within Work Package 2 (WP2) of the LILAS4SOILS project. WP2 focuses on the co-development of Carbon Farming Practices (CFPs) and on the exchange of knowledge and experiences across the Living Labs (LLs). In this context, D2.1 provides the first structured synthesis of the participatory activities conducted across the five LILAS4SOILS Living Labs after their initial launch and set-up phase.

The deliverable covers the first WP2 cycle implemented between October 2025 and February 2026. This cycle included two main steps. First, preparatory questionnaires and pre-work activities were carried out from October 2025 onwards to collect initial information from Living Lab stakeholders, identify priority issues, and support the design of the subsequent workshops. Second, dedicated co-creation workshops were organised in each Living Lab, between December 2025 and February 2026. These workshops aimed to discuss barriers and opportunities for the uptake of CFPs, assess practical implementation challenges, and co-develop possible solutions with farmers, technical actors, researchers, value-chain representatives, public authorities and other relevant stakeholders (Figure 1).



Figure 1. Scope of Deliverable D2.1 within the first WP2 co-creation cycle. The deliverable builds on the Living Lab set-up and launch activities carried out under WP1 and summarises the outcomes of preparatory questionnaires and co-creation workshops implemented across the five LILAS4SOILS Living Labs.

The deliverable therefore has a dual purpose. On the one hand, it documents the process followed by each Living Lab during the first WP2 co-creation cycle, including the role of preparatory questionnaires, workshop organisation and reporting tools. On the other hand, it provides a comparative synthesis of the main outcomes emerging across the Living Labs, with particular attention to macro-environmental barriers and opportunities, practical challenges for CFP implementation, co-developed solutions, training and advisory needs, and Monitoring, Reporting and Verification (MRV) requirements.

The results presented in D2.1 are intended to support the next phases of LILAS4SOILS by informing the implementation of CFPs at demo-site level, supporting future cross-fertilisation activities between Living Labs, and providing evidence for subsequent project tasks related to monitoring, knowledge transfer, policy engagement and long-term sustainability.

1.2 Role of D2.1 within WP2

WP2, led by UNICATT, is dedicated to the **co-development of Carbon Farming Practices and cross-fertilisation between Living Labs**. Its overall role is to accompany the transition from the initial Living Lab set-up phase towards the practical implementation, adaptation, and refinement of CFPs under real farming conditions. WP2 is designed to ensure that the CFPs promoted by LILAS4SOILS are not treated as fixed technical packages, but rather as practices that need to be discussed, adapted and improved in relation to local farming systems, stakeholder needs, environmental conditions, policy frameworks and market contexts.

Within WP2, D2.1 is the first formal reporting output summarising the results of Tasks 2.1 and 2.2. Task 2.1 focuses on identifying the macro-environmental barriers and opportunities affecting the implementation of CFPs. These include cultural, regulatory, economic, market-related, social, and institutional factors that may either facilitate or hinder the uptake of carbon farming at regional level. Task 2.2 addresses the evaluation and co-development of practical carbon farming solutions, with particular attention to the implementation of CFPs at Living Lab and demo-site level, the identification of practical constraints, and the co-development of solutions with stakeholders.

D2.1 is therefore positioned at the interface between strategic analysis and practical implementation. It captures both the broader enabling conditions for carbon farming and the concrete challenges faced when translating CFPs into farm-level actions. This dual focus is essential for the LILAS4SOILS approach, as the uptake of carbon farming depends not only on the agronomic performance of individual practices, but also on the availability of technical knowledge, financial incentives, advisory support, monitoring systems, market opportunities, and policy alignment.

The deliverable also plays an important role in establishing a harmonised knowledge base across the five Living Labs. Although each LL operates in a specific regional context, with different farming systems, stakeholder networks and priority CFPs, the use of common questionnaires, co-creation workshop structures, and reporting tables allows for the comparison of outcomes across territories. This comparative perspective is essential for identifying common barriers, transferable solutions, and Living Lab-specific needs, thereby preparing the ground for the cross-fertilisation activities foreseen later in WP2.

The position of D2.1 within the overall WP2 workflow, from the preparatory activities to the subsequent cross-fertilisation and implementation phases, is summarised in Figure 2.

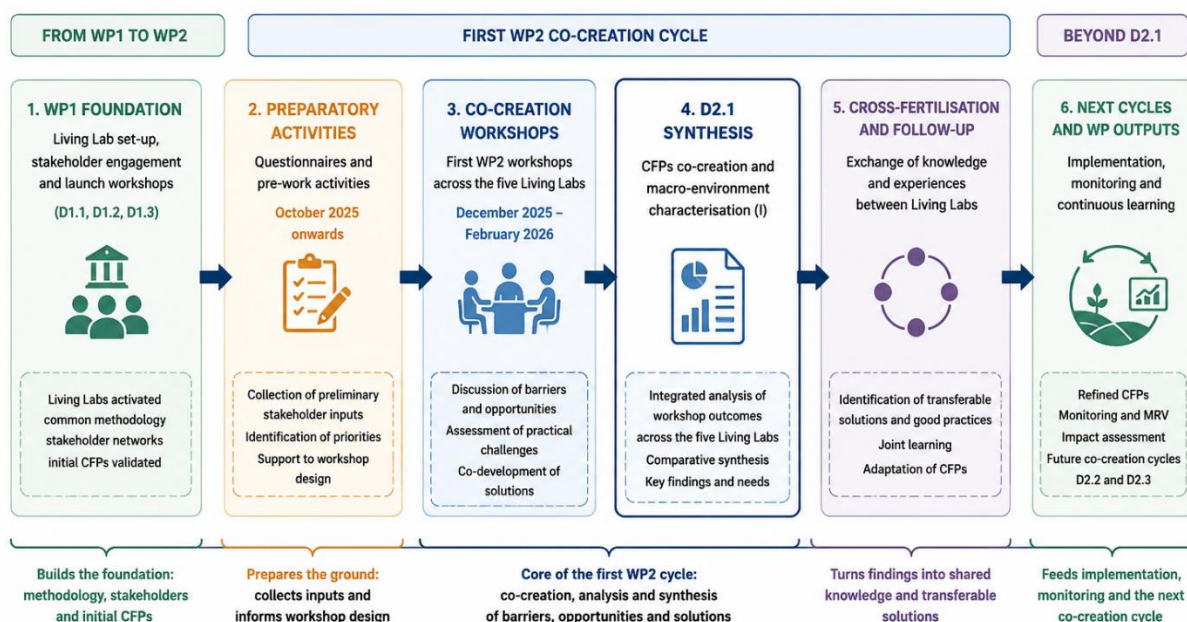


Figure 2. Position of D2.1 within WP2, highlighting its role as the first integrated synthesis of the co-creation activities and as a bridge towards cross-fertilisation, CFP implementation support, monitoring activities and the following co-creation cycles.

1.3 Continuity with WP1 and the Living Lab launch process

D2.1 builds directly on the work carried out in WP1, which established the methodological and operational foundations of the LILAS4SOILS Living Labs. WP1 defined the common framework for setting up and managing the Living Labs, developed the stakeholder engagement approach, and organised the launch events through which each LL was formally activated. The first WP2 co-creation cycle reported in this deliverable should therefore be understood as a continuation of that process.

D1.1 provided the **Living Labs set-up protocol and co-creation guidelines**, defining the shared principles and operational steps for establishing the LILAS4SOILS Soil Health Living Labs. It emphasised the need for active user involvement, multi-stakeholder participation, real-life experimentation, co-creation, and adaptive learning. These principles guided the design of the WP2 co-creation activities, ensuring that the workshops were not limited to one-way information transfer, but structured as participatory spaces for discussing local needs, validating CFP implementation pathways and identifying practical solutions.

D1.2 established the **Stakeholder engagement plan**, identifying the main stakeholder groups to be involved in the project and clarifying the expected levels and forms of engagement. This provided an important basis for the WP2 activities, as the quality of the co-creation process depends on the capacity of each Living Lab to involve the appropriate combination of actors. Farmers and primary producers, agri-food industry representatives, regional and national authorities, researchers, technical advisors, environmental and civil society organisations, technology developers and other relevant actors all have distinct roles in shaping the uptake of carbon farming. The preparatory questionnaires and co-creation workshops reported in D2.1 therefore relied on the stakeholder networks and engagement principles developed during WP1.

D1.3 reported the outcomes of the **Living Lab launch workshops**, which represented the formal activation of the five LILAS4SOILS Living Labs: IBERSOILL in Spain and Portugal, SOFRALL in France, SHARE in Italy, GRECFL2 in Greece, and RAGILL in Israel. During these launch events, the Living Labs introduced the LILAS4SOILS project to their regional stakeholder communities, discussed mission and vision, identified local soil and agricultural challenges, and carried out an initial validation of the proposed CFPs. These activities created the initial common ground on which the first WP2 co-creation cycle was built.

The transition from WP1 to WP2 marks a shift from Living Lab establishment to Living Lab operation. While WP1 focused on building the participatory infrastructure of the project, WP2 focuses on using that infrastructure to co-develop carbon farming solutions, identify barriers and opportunities, and support the adaptation of practices to local contexts. The questionnaires and workshops reported in D2.1 represent the first structured step in this operational phase.

This continuity is particularly important because carbon farming implementation requires both strategic alignment and practical adaptation. The Living Lab launch events created the conditions for stakeholder engagement and shared understanding. The WP2 co-creation workshops then moved the process forward by focusing more specifically on the factors that may enable or constrain CFP uptake, the practical issues emerging at farm and demo-site level, and the solutions that stakeholders consider feasible within their own contexts.

Table 1 summarises how the main WP1 outputs provide the methodological, engagement, and operational basis for the first WP2 co-creation cycle reported in D2.1.

Table 1. Continuity between WP1 outputs and D2.1, highlighting how the methodological framework, stakeholder engagement strategy and Living Lab launch outcomes developed under WP1 provide the basis for the first WP2 co-creation cycle.

WP1 output	Main contribution to D2.1
D1.1 – Living Labs Set-Up Protocol and Co-Creation Guidelines	Provided the methodological basis for co-creation, participatory processes, and Living Lab operation.
D1.2 – Stakeholder Engagement Plan	Defined stakeholder categories, engagement principles and participation levels relevant for the WP2 workshops.
D1.3 – Results of LLs Launching Workshops	Provided the starting point for the first WP2 co-creation cycle, including LL activation, initial stakeholder engagement, local challenges, and preliminary CFP validation.
D2.1 – CFPs co-creation and macro-environment characterisation (I)	Built on WP1 to report the first structured cycle of WP2 questionnaires and co-creation workshops, focusing on barriers, opportunities, implementation challenges and co-developed solutions.

In this perspective, D2.1 does not repeat the work already documented in WP1. Instead, it uses WP1 as the foundation for analysing how the Living Labs are beginning to move from initial mobilisation towards the co-development and implementation of carbon farming solutions. The deliverable therefore represents a key step in the progressive learning cycle of LILAS4SOILS, linking stakeholder engagement, field-level implementation and cross-Living Lab knowledge exchange.

2. Methodological approach

2.1 Overall co-creation process

The first WP2 co-creation cycle was designed as a harmonised but locally adaptable process implemented across the five LILAS4SOILS Living Labs. The methodological approach aimed to ensure consistency in the collection of stakeholder inputs while allowing each Living Lab to adapt the process to its own territorial context, farming systems, stakeholder composition and priority Carbon Farming Practices (CFPs).

The process followed a two-step structure. First, a preparatory phase was carried out through online questionnaires and pre-work activities. This phase aimed to stimulate early reflection among stakeholders, collect preliminary information on perceptions, priorities, opportunities and barriers related to carbon farming, and provide each Living Lab with a structured basis for organising the subsequent co-creation workshop. Second, dedicated co-creation workshops were organised in each Living Lab to discuss the questionnaire results, identify macro-environmental barriers and opportunities for CFP uptake, and co-develop practical solutions for CFP implementation at Living Lab and demo-site level.

This approach was consistent with the WP2 logic described in the Description of Action, where co-creation workshops are expected to support both Task 2.1, focused on macro-environmental barriers and opportunities, and Task 2.2, focused on the evaluation and co-development of practical carbon farming solutions. The preparatory questionnaires were not intended as stand-alone surveys, but as a tool to inform and structure the participatory work carried out during the workshops.

The overall process was coordinated by the WP2 and Task leaders, while Living Lab leaders were responsible for translating, locally adapting, disseminating, and implementing the tools with their own stakeholder communities. Common instructions, questionnaire templates, workshop guidelines, and reporting tables were shared with all Living Labs to ensure comparability of the outputs. At the same time, each Living Lab was allowed to make minor adaptations, for example, to reflect locally relevant CFPs or specific stakeholder characteristics (Figure 3).

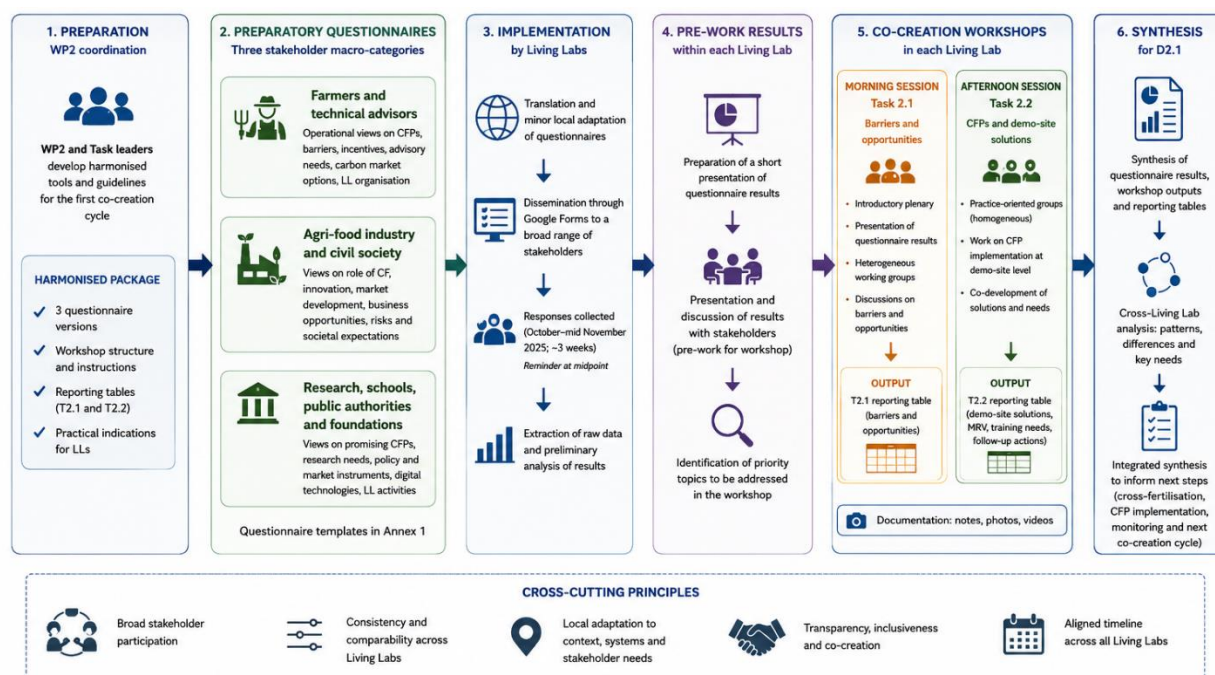


Figure 3. Methodological workflow of the first WP2 co-creation cycle, from the preparation of harmonised questionnaires to the collection of workshop outputs and their synthesis in D2.1.

2.2 Preparatory questionnaires and pre-work activities

The preparatory phase was launched in October 2025, before the organisation of the first WP2 co-creation workshops. Its objective was to collect preliminary inputs and insights from a broad range of stakeholders and to support Living Lab leaders with evidence for identifying the most relevant issues to be discussed during the workshops.

Three questionnaire versions were developed to address different stakeholder macro-categories. These macro-categories were derived from the stakeholder groups defined in the Deliverable D1.2 and were grouped into broader categories to simplify the questionnaires' design while ensuring more targeted and accessible questions. The three versions were addressed to: (i) farmers and technical advisors; (ii) agri-food industry and civil society organisations; and (iii) researchers, schools, public authorities and foundations (Table 2).

All questionnaires shared a common purpose: to prepare the upcoming co-creation workshops and stimulate early reflection on carbon farming practices, soil health, enabling conditions, barriers, opportunities for adoption, market mechanisms, and the expected role of the Living Labs. However, the structure and terminology, and emphasis of the questions were adapted to the expected knowledge, interests and role of each stakeholder group.

The questionnaire for farmers and technical advisors included an initial profiling section, followed by specific questions on CFPs already applied or considered as the most effective. Additional sections addressed enabling factors and structural barriers, perceived benefits of increasing soil organic matter, awareness of financial incentives, carbon credit market options, and expectations, and organisational

preferences for the Living Lab. This version was designed to capture direct operational experience and practical constraints from actors closely involved in farm-level implementation.

The questionnaire for agri-food industry and civil society focused on the perceived role of carbon farming in climate mitigation, the contribution of technological innovation, limits and risks of carbon farming, carbon credit market development, business opportunities and market risks, and the activities considered most relevant for the Living Lab. This questionnaire version was designed to capture perspectives from actors involved in agricultural value chains, market development, social acceptance and wider societal expectations.

The questionnaire for research, schools, public authorities and foundations focused on promising CFPs, the combination of practices, the role of digital technologies, research and experimentation needs, opportunities and limits of carbon farming, carbon credit market development, and priority Living Lab activities. This version was designed to collect inputs from actors involved in knowledge generation, public policy, education, institutional support, and innovation systems.

Living Lab leaders were asked to translate the questionnaires and implement them through Google Forms, to ensure consistency across the consortium. They were also encouraged to reach a broad stakeholder base, beyond the farmers already involved in demonstration sites or the closest institutional contacts. This wider dissemination strategy was intended to enlarge stakeholder diversity during the first co-creation cycle and provide a more representative and robust dataset for identifying priorities and barriers at Living Lab level.

To ensure a harmonised timeline across all Living Labs, the questionnaires were planned to be disseminated in late October 2025 and kept open for approximately three weeks, with a reminder sent by LLs leaders around the middle of the response period to encourage participation. After the questionnaires closure, Living Lab leaders were asked to extract the raw data from Google Forms and prepare a short presentation of the results. These summaries with results were then used as pre-work material and presented at the beginning of the co-creation workshops as an evidence-based starting point for the co-creation process and for selecting priority topics for discussion.

The questionnaire templates are provided in **Annex 1**. The summary of questionnaire responses by Living Lab is reported in **Annex 2**.

Table 2. Stakeholder macro-categories and questionnaire versions used in the preparatory phase

Questionnaire version	Main stakeholder groups covered	Main purpose
Farmers and technical advisors	Farmers, farm businesses, demo-site managers, agronomic and technical advisors	Collect operational views on CFPs, barriers, incentives, advisory needs, carbon market options and Living Lab organisation.
Agri-food industry and civil society	Agri-food value-chain actors, industry representatives, civil society organisations, and other non-farming stakeholders	Collect views on the role of carbon farming, technological innovation, market development, business opportunities, risks and societal expectations.
Research, schools, public authorities and foundations	Researchers, educational institutions, public authorities, foundations and institutional actors	Collect views on promising CFPs, research needs, policy and market instruments, digital technologies and Living Lab activities.

2.3 Co-creation workshops: organisation, structure and reporting tools

Following the preparatory questionnaire phase, each Living Lab organised a dedicated co-creation workshop between December 2025 and February 2026. The workshops were designed to produce tangible and comparable outputs across the Living Labs, while allowing flexibility for local adaptation in terms of format, stakeholder composition, thematic focus, and discussion priorities.

The workshop structure was divided into two main sessions. The morning session was linked to Task 2.1 and focused on identifying macro-environmental barriers and opportunities for the uptake of carbon farming. The afternoon session was linked to Task 2.2 and focused on the practical implementation and co-development of CFPs at Living Lab and demo-site level.

The Task 2.1 session aimed to align participants on key project concepts and objectives, present the results of the preparatory questionnaires, and collect stakeholder perceptions, expectations, barriers and opportunities related to carbon farming. Living Labs were encouraged to organise heterogeneous working groups, with a balanced mix of stakeholder categories, to support the exchange of different perspectives. The questionnaire results were used to guide the choice of discussion topics, for example by focusing on the most relevant practices, the most frequently mentioned needs, or the most critical barriers identified during the pre-work phase.

The outputs from the Task 2.1 session were collected through a harmonised reporting table. This table required Living Labs to identify external barriers and opportunities for carbon farming and to classify them into four categories: technical, economic/market, socio-cultural, and administrative/policy/regulatory. For each category, Living Labs were also asked to provide a score, allowing both qualitative description and preliminary prioritisation of the issues raised by stakeholders.

The Task 2.2 session was designed as the more practice-oriented part of the workshop. It focused on refining, adapting, or co-developing CFPs for each demo-site. In this session, participants were expected to work more directly on concrete implementation issues, particularly with farmers, demo-site managers and technical actors. Living Labs were encouraged to organise homogeneous working groups, for example according to farm type, agroecosystem, soil type, management system, or other locally relevant criteria.

The outputs from the Task 2.2 session were collected through a second harmonised reporting table. This table required Living Labs to provide, for each demo-site or group of demo-sites, a problem summary, proposed solutions, draft or adapted practical protocols, MRV requirements, training needs, and follow-up actions specifying responsibilities and indicative timing. This reporting structure was intended to ensure that the workshops produced operational outputs, rather than only general discussion points.

In addition, Living Lab leaders and facilitators were also asked to document the workshops through notes, photos and/or videos, and to prepare an overall appreciation of the workshop, including how the meeting contributed to the synthesis of key lessons learned. The expected outputs for each Living Lab included: one completed Task 2.1 Excel table, one Task 2.2 Excel table covering demo-site-level information, and one short qualitative report or appreciation of the workshop. The co-creation workshop agendas are reported in **Annex 3**. The reporting tables used for Task 2.1 and Task 2.2 are provided in **Annex 4**, while the completed reporting tables by Living Lab are included in **Annex 5**. **Annex 6** reports additional workshop materials and pictures. Table 3 summarises the co-creation workshop structure and expected outputs.

Table 3. Structure and expected outputs of the first WP2 co-creation workshops

Workshop component	Related task	Main objective	Group organisation	Expected output
Morning session	Task 2.1	Identify macro-environmental barriers and opportunities for CFP uptake.	Heterogeneous groups including different stakeholder categories.	Completed Task 2.1 reporting table on barriers and opportunities, classified by category and scored.
Afternoon session	Task 2.2	Refine, adapt and co-develop practical CFP implementation solutions at Living Lab and demo-site level.	Homogeneous or practice-oriented groups based on farm type, agroecosystem, demo-site characteristics or other relevant criteria.	Completed Task 2.2 reporting table including problems, solutions, practical protocols, MRV requirements, training needs and follow-up actions.
Workshop documentation	Cross-cutting	Document the process and capture key lessons learned.	LL leaders and facilitators.	Overall appreciation of the workshop, notes, photos and supporting material where available.

2.4 Approach for synthesising results across Living Labs

The results collected through the questionnaires, workshop discussions, and reporting tables were synthesised to provide both Living Lab-specific and cross-Living Lab insights. The analysis followed a pragmatic approach, combining structured comparison of the harmonised reporting tables with qualitative interpretation of stakeholder inputs.

At Living Lab level, the synthesis focused on identifying the main priorities, barriers, opportunities, and practical needs emerging from each territory. This included the interpretation of questionnaire results, workshop outputs, and the specific regional and agricultural context of each Living Lab. The purpose was not to rank Living Labs, but rather to describe how carbon farming challenges and opportunities emerged in different regional, agronomic and stakeholder contexts.

At cross-Living Lab level, the synthesis focused on identifying both recurrent patterns and context-specific differences. For Task 2.1, the aggregation of results was based on the harmonised reporting tables completed by each Living Lab. Barriers and opportunities identified during the workshops were first organised according to the four macro-environmental dimensions used in the reporting template: technical, economic/market, socio-cultural, and administrative/policy/regulatory. Similar entries were then grouped thematically to identify recurrent issues across Living Labs, while preserving relevant context-specific elements. The scoring system included in the Task 2.1 reporting tables was used as a support for prioritisation. Scores were interpreted as an indication of the perceived relevance of each barrier or opportunity within the workshop discussion. In the cross-Living Lab synthesis, particular attention was given to items rated as important or very important, corresponding to scores of 4 or 5. Average scores were used only as indicative values to support interpretation, not as statistically representative measures. This is because Living Labs differed in workshop format, stakeholder composition, number of working groups and level of reporting detail.

For Task 2.2, the synthesis focused on practical CFP implementation. The reporting tables were used to identify common problem types, proposed solutions, draft practical protocols or adaptations, MRV requirements, training needs, and follow-up actions. This allowed the analysis to move beyond the identification of general barriers and opportunities to concrete implementation issues, linking stakeholder perceptions with operational needs at demo-site level.

The synthesis also considered the link between questionnaire results and workshop outputs. Questionnaire data provided an initial picture of stakeholder expectations and concerns, while workshops discussions enabled participants to validate, refine, and deepen these inputs. In this sense, the questionnaires and workshops were treated as complementary components of the same co-creation process, combining individual perspectives with collective ones.

The cross-Living Lab synthesis presented in this deliverable is intended to support the next steps of LILAS4SOILS. First, it provides inputs for the following cross-fertilisation activities, by identifying issues that may benefit from exchange between Living Labs. Second, it supports CFP implementation and monitoring by highlighting practical constraints, MRV needs, and training requirements. Third, it informs future co-creation cycles, including the preparation of Deliverables D2.2 and D2.3, where the evolution of identified barriers, opportunities, and practical solutions will be monitored (in WP3), updated and assessed over time.

3. Overview of the first WP2 co-creation cycle

3.1 Timeline of questionnaires and workshops

The first WP2 co-creation cycle was implemented between October 2025 and February 2026. It started with the dissemination of preparatory questionnaires across the five LILAS4SOILS Living Labs and continued with the organisation of the first WP2 co-creation workshops.

The questionnaires were launched as a preparatory activity to stimulate stakeholder reflection before the workshops and to provide Living Lab leaders with preliminary evidence on perceptions, priorities, barriers and opportunities related to carbon farming. The common timeline proposed to all Living Labs was to send the questionnaires by 24 October 2025, keep them open for approximately three weeks (ideally until 14 November 2025), and send a reminder to stakeholders around the middle of the response period.

The workshops were then organised between December 2025 and February 2026, with some variation across Living Labs depending on local planning needs, stakeholder availability, and logistical constraints. The French Living Lab SOFRALL held its workshop first, on 11 December 2025 in Montpellier. IBERSOILL organised a two-day workshop on 29–30 January 2026 in Idanha-a-Nova, Portugal. GRECFL2 held its workshop on 6 February 2026 at Perrotis College, American Farm School, Thessaloniki, Greece. RAGILL organised its workshop on 19 February 2026 at the Mevo'ot Hermon Regional Council center, Israel, while SHARE held its workshop on 25 February 2026 at Università Cattolica del Sacro Cuore, Piacenza, Italy.

Overall, the timeline allowed the questionnaire results to be used as pre-work for the workshops. In several Living Labs, the results were presented at the beginning of the event and used to focus the discussion on the most relevant barriers, opportunities, practices, and stakeholder needs. An overview of the first WP2 co-creation workshops is provided in Table 4.

Table 4. Overview of the first WP2 co-creation workshops across the five LILAS4SOILS Living Labs.

Living Lab	Workshop date	Location	Main format	Main outputs available
SOFRALL – France	11 December 2025	Montpellier, France	Working groups based on the WP2 reporting structure	T2.1 and T2.2 reporting tables
IBERSOILL – Spain/Portugal	29–30 January 2026	Idanha-a-Nova, Portugal	Two-day workshop with facilitated working groups following the advised WP2 structure and field visit	T2.1 and T2.2 reporting tables; workshop appreciation report
GRECFL2 – Greece	6 February 2026	Perrotis College, American Farm School, Thessaloniki	Combined plenary and group-based discussion, with in-person and online participation	T2.1 and T2.2 reporting tables; workshop appreciation report
RAGILL – Israel	19 February 2026	Mevo'ot Hermon Regional Council center, Israel	Plenary sessions and facilitated roundtables	T2.1 and T2.2 reporting tables; workshop appreciation report
SHARE – Italy	25 February 2026	Università Cattolica del Sacro Cuore, Piacenza	Morning plenary discussion and afternoon small-group interviews with farmers	T2.1 and T2.2 reporting tables; workshop appreciation report

3.2 Stakeholders involved

According to the Living Lab-specific questionnaire materials, the preparatory phase collected 256 responses across the five LILAS4SOILS Living Labs. SHARE accounted for the largest number of responses, followed by IBERSOILL, SOFRALL, RAGILL and GRECFL². At stakeholder level, the largest group was represented by the farming sector, including farmers and technical advisors, with 162 responses. Agri-food industry and civil society accounted for 38 responses, while research, schools, public authorities and foundations accounted for 56 responses.

The distribution of respondents by stakeholder macro-category and by Living Lab is shown in Figure 4. The two panels are based on the same total number of responses, but provide complementary views of the preparatory questionnaire phase. The first panel highlights the stakeholder composition of the respondent pool, while the second shows the distribution of responses per Living Lab.

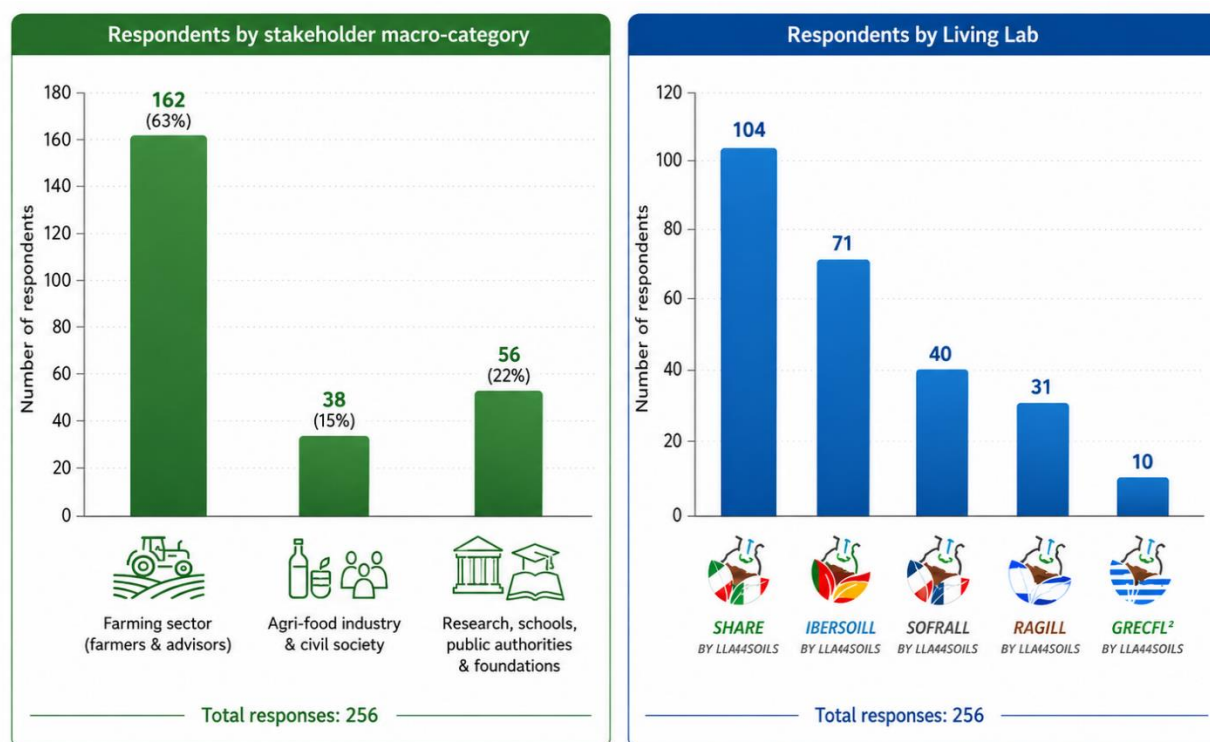


Figure 4. Distribution of respondents to the preparatory questionnaires by stakeholder macro-category and Living Lab.

The strong representation of farmers and technical advisors reflects the operational focus of WP2, which required direct input from actors involved in the implementation of Carbon Farming Practices (CFPs). At the same time, the involvement of representatives from the agri-food industry, civil society, research, schools, public authorities and foundations maintained the multi-actor perspective of the Living Lab approach. The questionnaires were therefore able to collect differentiated perspectives from stakeholders with different roles in carbon farming: those directly implementing practices, those involved in value chains and societal acceptance, and those contributing to research, education, policy, and institutional support.

The workshops also involved a diverse set of stakeholders, although the exact composition varied across Living Labs. In total, 228 stakeholders participated in the co-creation workshops conducted in the five LLs. The distribution of stakeholders per category across all LLs is presented in Figure 5. Farmers represented the largest group, with 84 participating (37%), followed by researchers (49; 22%), policy representatives (34; 15%), agri-food industry stakeholders (30; 13%), technical advisors (19; 8%), and NGOs (12; 5%). All Living Labs brought together stakeholders with complementary expertise, as shown in the right panel of Figure 5. SHARE had the highest number of participants involving farmers, technical consultants, representatives from academia and research, agro-industry, input suppliers, public authorities and environmental organisations' stakeholders. IBERSOILL involved participants from Portugal and Spain, including farmers, technical advisors, researchers, public authorities and agri-food industry representatives. SOFRALL involved farmers and primary producers, agri-food industry actors, environmental and civil society representatives, research and technical partners, and technology developers. RAGILL involved farmers, researchers, extension agents, industry representatives, NGOs, and policy stakeholders. GRECFLL² involved farmers, advisors, researchers and policy-related stakeholders, with both physical and online participation.

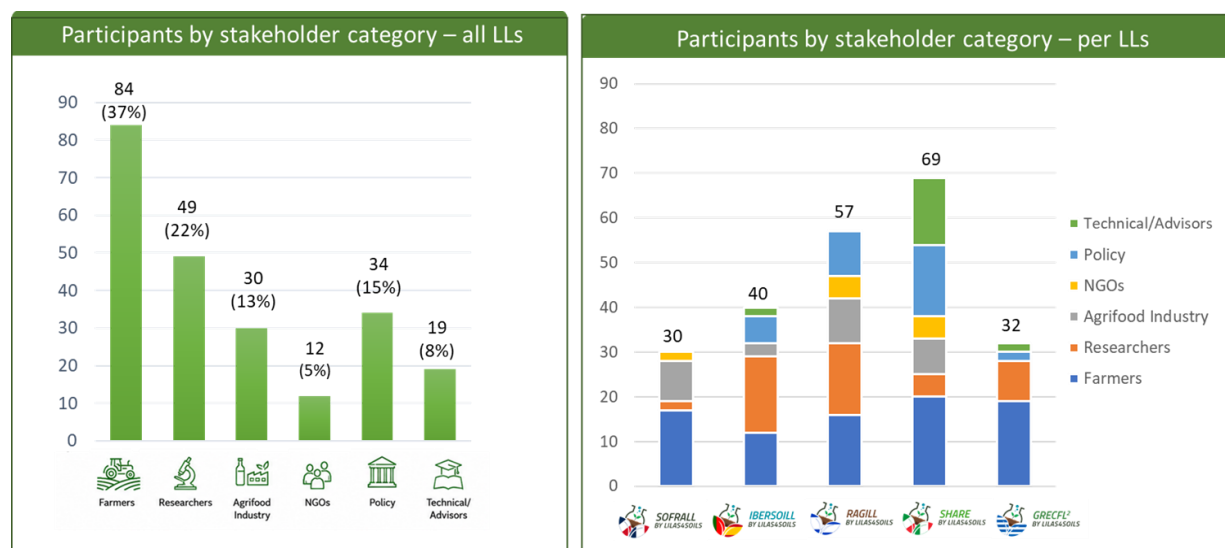


Figure 5. Distribution of stakeholders per category across all LLs in the co-creation workshops

Overall, the composition of both the questionnaire respondents and the workshop participants was broadly consistent with the Quintuple Helix approach adopted in LILAS4SOILS. However, the balance between stakeholder categories differed among Living Labs. Some Living Labs had a stronger farmer and technical-advisory profile, while others included broader participation from industry, NGOs, research and policy actors. These differences reflected both the local structure of each Living Lab and the practical aim of the first WP2 cycle, which was to combine strategic discussion with operational feedback on the implementation of CFPs.

3.3 Carbon Farming Practices addressed across Living Labs

The first WP2 co-creation cycle was framed around the common LILAS4SOILS classification of CFPs, subsequently confirmed and consolidated within WP3. This classification includes 21 CFPs organised into six main practice domains: peatland management, agroforestry, livestock management, nutrient management, maintaining soil organic carbon (SOC) on mineral soils, and reduced soil disturbance in cropland and grassland systems.

The use of a common CFP classification was important for two reasons. First, it ensured consistency across Living Labs, allowing locally different farming systems to be discussed within a shared project framework. Second, it allowed workshop discussions to move from broad concepts such as “carbon farming” or “regenerative agriculture” towards specific, actionable practices that could be evaluated, adapted and implemented at demo-site level.

Across the Living Labs, the practices most frequently addressed belonged to the domains of nutrient management, livestock and manure management, agroforestry, and maintaining SOC on mineral soils. In particular, stakeholders repeatedly discussed CFP 11, manure incorporation into soil; CFP 12, improving nutrient planning and fertilisation strategy; CFP 13, improving timing and application of nutrients; CFP 15, cover cropping introduction or improvement; CFP 16, improved crop rotations; CFP 20, management of

grassland; and CFP 21, reduced soil disturbance in cropland, ranging from reduced or minimum tillage to no-till.

The preparatory questionnaires showed that cover crops, reduced or no-tillage, improved crop rotations, and fertilisation optimisation were among the practices perceived as most effective for increasing soil organic carbon or improving soil health. These results were broadly consistent with the practices prioritised during the workshops, where stakeholders tended to focus on CFPs that were both relevant for climate and soil objectives and feasible within their local farming systems.

The Living Labs addressed different combinations of CFPs according to their agroecosystems and stakeholder priorities. SHARE focused strongly on CFP 11, CFP 12, CFP 13, CFP 15, CFP 16 and CFP 21, with specific attention to manure and slurry management, nutrient efficiency, cover crops, reduced tillage, no-tillage, rice systems and crop diversification. IBERSOILL addressed a broad range of CFPs relevant to arable, livestock, sheep, woody crop and agroforestry systems, including CFP 4, CFP 10, CFP 11, CFP 12, CFP 15, CFP 16, CFP 20 and CFP 21. SOFRALL structured its workshop around fertilisation, cover crops, tillage reduction and pasture management, corresponding mainly to CFP 12, CFP 13, CFP 15, CFP 20 and CFP 21. GRECFL² focused on cover crops, reduced soil disturbance, nutrient management, organic inputs and crop rotations, mainly corresponding to CFP 12, CFP 13, CFP 15, CFP 16 and CFP 21. RAGILL addressed practices adapted to Israeli farming systems, including cover crops and service crops, reduced or no tillage, nutrient optimisation, compost use, manure incorporation, pruning residue management and regenerative soil management, corresponding mainly to CFP 11, CFP 12, CFP 13, CFP 15, CFP 16 and CFP 21.

Overall, the results indicate that the first WP2 co-creation cycle did not treat CFPs as isolated technical measures. Instead, stakeholders generally discussed them as part of integrated management strategies adapted to local pedoclimatic conditions, farm structures, available machinery, labour constraints and market opportunities. This was particularly evident for cover cropping and reduced tillage, which were frequently discussed together with nutrient management, organic matter inputs, weed control, soil trafficability and transition risks.

The recurrence of a core set of CFPs across Living Labs suggests strong potential for cross-fertilisation in the next stages of the project. At the same time, the differences among Living Labs confirm the need for local adaptation. While CFP 15, CFP 16 and CFP 21 were relevant across several territories, their implementation challenges differed substantially between irrigated arable systems, Mediterranean dryland systems, woody crops, grasslands, rice systems and mixed crop-livestock contexts. This confirms the role of the Living Labs as spaces where common carbon farming objectives can be translated into context-specific implementation pathways.

3.4 Main outcomes from the preparatory questionnaires

The preparatory questionnaires provided an initial overview of stakeholder perceptions of carbon farming before the co-creation workshops. The results were used to support discussion during the workshops and to identify priority topics for the first WP2 co-creation cycle. The main messages emerging from the questionnaires are summarised in Table 5.

A first result was the generally positive perception of carbon farming as a contribution to climate action. Among respondents from agri-food industry and civil society, 51% stated that CFPs can play an important role in tackling climate change, while 40% considered that they can be a pillar of climate mitigation strategies. This indicates broad recognition of the potential contribution of agriculture, although the

questionnaires also showed that stakeholders are aware of the uncertainties and limitations associated with carbon farming.

Soil organic matter was perceived as central to the value of CFPs. Among farmers and technical advisors, the most frequently identified benefits of soils rich in organic matter were reduced water and wind erosion, higher yields and production stability, lower need for fertilisers or amendments, and increased soil biodiversity and biological activity. These results suggest that stakeholders do not view carbon farming only as a carbon credit or climate mitigation strategy, but also as a pathway to improve agronomic resilience and soil functionality.

The questionnaires also highlighted a clear hierarchy of perceived CFP effectiveness. Cover crops, reduced or no-tillage, crop rotations and fertilisation optimisation emerged as the most frequently selected practices. However, the comparison between perceived effectiveness and actual application showed some gaps. For example, crop rotations and fertilisation optimisation were widely recognised as effective, but their actual implementation appeared less frequent than their perceived relevance. Conversely, no-tillage was reported as applied by a relevant share of respondents, despite being selected less frequently among the most effective practices, suggesting that local feasibility, existing experience and farm structure influence adoption patterns.

The main enabling factors identified by farmers and technical advisors were access to professional advisory services, frequent exchange of experiences with other farmers or technicians, and financial incentives or support for buying new equipment. These findings confirm the importance of combining technical support, peer learning and economic instruments. Similarly, research and institutional stakeholders identified on-farm application trials, long-term experiments, and sensors or soil health indicators as priority areas for strengthening research and innovation.

The questionnaires also revealed several barriers and risks. Among farmers and technical advisors, the most important structural barriers were investment in machinery and equipment, lack of technical knowledge during the transition, an unfavourable cost-benefit ratio, and the persistence of traditional approaches compared with innovation. Across stakeholder categories, carbon farming business models were also perceived as constrained by uncertainty about carbon sequestration and the stability of soil carbon stocks, lack of solid certification systems, high project implementation costs, and insufficient advisory capacity.

The carbon credit market emerged as a relevant but uncertain opportunity. Stakeholders showed stronger support for policy and value-chain mechanisms than for a purely voluntary carbon market approach. Measures such as including dedicated support in Rural Development Programmes and national policies, promoting supply-chain agreements between agribusiness and farmers, and developing hybrid incentive systems combining adoption support with generated credits were perceived as promising. By contrast, respondents also expressed concerns about the risk that carbon credits could delay direct emission reductions, the need for strict additionality and transparency criteria, and the lack of credible certification and registry systems.

Finally, the questionnaires confirmed the perceived role of Living Labs as spaces for practical learning and exchange. Demonstration visits, peer-to-peer exchanges, thematic meetings, training activities and collaboration with other Living Labs were repeatedly identified as priority services. This result was consistent across stakeholder categories and directly informed the design of the co-creation workshops, which combined presentation of results, stakeholder discussion, practical working groups and, in some cases, field visits.

Table 5. Main messages emerging from the preparatory questionnaires.

Topic	Main outcome
Climate and soil health	Stakeholders broadly recognized the contribution of CFPs to climate action and linked carbon farming to soil functionality, resilience and productivity.
Priority CFPs	Cover crops, reduced tillage, crop rotations and fertilisation optimisation emerged as the most relevant practices.
Adoption gap	Some practices were perceived as highly effective but were less frequently applied, indicating constraints related to feasibility, knowledge, costs or farm organisation.
Enabling factors	Advisory services, peer-to-peer exchange, financial support and access to suitable inputs were identified as key conditions for CFP uptake.
Research needs	On-farm trials, long-term experiments and soil health indicators were considered priority areas to support adoption and monitoring.
Main barriers	Machinery investment, lack of technical knowledge, unfavourable cost-benefit ratio and transition risks were the most recurrent barriers.
Carbon market	Stakeholders saw opportunities in carbon markets but stressed uncertainty around carbon sequestration, certification, additionality, transparency and project costs.
Role of Living Labs	Demonstration visits, peer-to-peer exchanges, training, thematic workshops and collaboration with other LLs were identified as priority Living Lab activities.

Overall, the questionnaire results provided a clear basis for the co-creation workshops. They confirmed stakeholders' interest in carbon farming but also showed that adoption depends on the availability of trusted technical support, economic incentives, credible monitoring systems, and practical examples adapted to local conditions. The workshops therefore built on these preliminary findings to move from general perceptions to more concrete discussion of barriers, opportunities and practical implementation pathways.

4. Results from the Living Labs

This chapter presents the main results emerging from the first WP2 co-creation cycle in each LILAS4SOILS Living Lab. The objective is not to reproduce the full workshop documentation, which is reported in Annex 5, but to summarise the main evidence emerging from the reporting tables, workshop outputs and Living Lab-specific reports.

The synthesis focuses on three aspects: the CFPs mainly addressed in each Living Lab, the barriers and opportunities identified under Task 2.1, and the practical implementation issues and needs discussed under Task 2.2. This structure allows the Living Lab-specific results to be compared while preserving the territorial specificities of each context.

To facilitate comparison across Living Labs, Figure 6 provides a synthetic overview of the main CFP domains addressed during the first WP2 co-creation cycle. The figure does not replace the Living Lab-specific synthesis reported in Table 6, but helps visualise areas of convergence and differentiation across territories. It shows that several practice domains, especially nutrient management, cover crops, crop rotations and reduced soil disturbance, were recurrent across Living Labs, while agroforestry, grassland management and livestock-related practices were more strongly linked to specific farming systems and regional contexts.

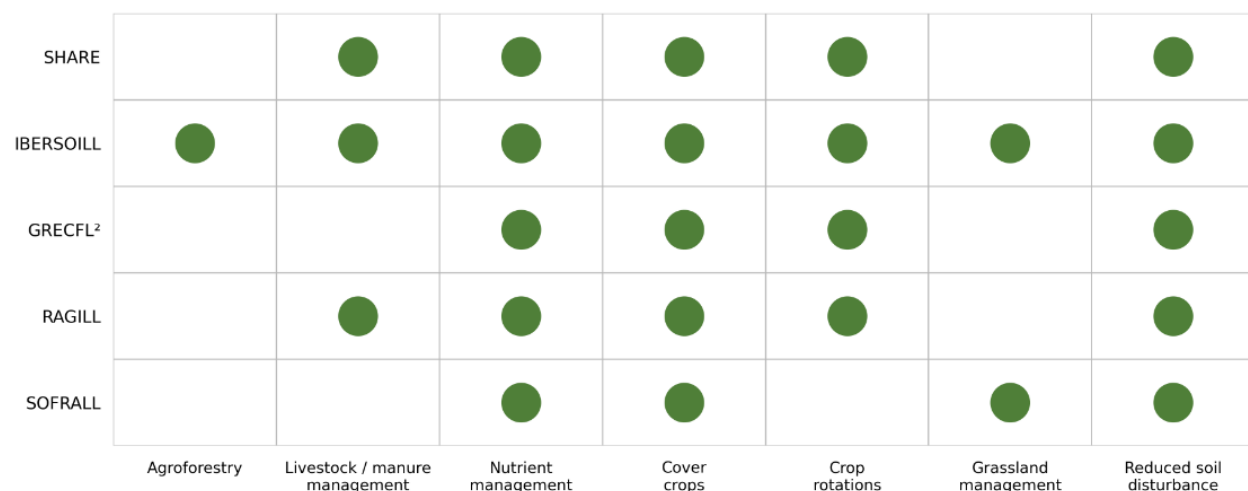


Figure 6. CFP domains addressed across the five Living Labs during the first WP2 co-creation cycle. Filled cells indicate that the domain was explicitly addressed in the Living Lab workshop outputs and/or reporting tables. The figure highlights both the recurrence of a common core of CFP domains and the need for context-specific adaptation.

The visual overview confirms that the first co-creation cycle combined a common project framework with Living Lab-specific priorities. Nutrient management, cover crops and reduced soil disturbance were addressed in all or most Living Labs, while agroforestry, livestock-related practices and grassland management reflected more specific production systems. Table 6 complements this overview by summarising the main CFPs, barriers, opportunities and implementation needs identified in each Living Lab.

Table 6. Summary of the main Living Lab-specific results from the first WP2 co-creation cycle.

Living Lab	Main CFPs addressed	Main T2.1 barriers and opportunities	Main T2.2 implementation issues and needs
SHARE	CFP 11, 12, 13, 15, 16, 21	Administrative complexity, uncertain carbon market returns, technical knowledge gaps, machinery and soil trafficability constraints; opportunities linked to existing LL network, long-term experience and supply-chain engagement	Transition to no-till/reduced tillage, manure and slurry management under conservation systems, weed control, rice rotation constraints, machinery adaptation, need for advisory and MRV support
IBERSOILL	CFP 4, 10, 11, 12, 15, 16, 20, 21	Technical knowledge, cost-benefit uncertainty, weak farmer networks, machinery needs, labour constraints; opportunities linked to diversified farming systems, agroforestry, livestock integration and peer learning	Direct sowing, cover crop management, grazing and pasture management, manure use, crop rotations, contractor availability, field demonstration and practical training
GRECFL ²	CFP 12, 13, 15, 16, 21	Soil structure limitations, compaction, nutrient management inefficiencies, limited diversification, uncertainty about carbon outcomes; opportunities linked to	Cover crop establishment, reduced tillage adaptation, soil and nutrient data interpretation, organic input

		integrated practice combinations and digital tools	logistics, rotation planning, practical MRV protocols
RAGILL	CFP 11, 12, 13, 15, 16, 21	Yield and economic uncertainty, limited trusted knowledge, advisory gaps, regulatory and market constraints, MRV uncertainty; opportunities linked to innovation capacity, demonstration and knowledge translation	Compost and manure quality, nutrient planning, service crops, reduced/no tillage, pruning residues, grazing interactions, farmer confidence and region-specific adaptation
SOFRALL	CFP 12, 13, 15, 20, 21	Cover crop complexity, soil diagnosis difficulties, economic risk, weed control, compaction, runoff, uncertainty in carbon quantification; opportunities linked to soil structure, OM improvement, pasture management and technical/MRV tools	Fertilisation, cover crop establishment, tillage reduction, pasture management, soil profile interpretation, decision support and clearer MRV indicators

4.1 SHARE – Italy

In SHARE, the co-creation process confirmed that carbon farming is perceived as technically relevant but strongly conditioned by economic, regulatory and operational constraints. The CFPs most frequently discussed were manure incorporation into soil, nutrient planning and application, cover crops, improved rotations and reduced soil disturbance in cropland.

Under Task 2.1, stakeholders identified four main categories of barriers. The first concerned administrative and regulatory complexity, including insufficient alignment between regional and national rules and uncertainty about how carbon farming schemes may interact with existing policy instruments. The second concerned the economic viability of carbon farming, especially the perceived mismatch between implementation and monitoring costs and the current value of carbon credits. The third concerned technical knowledge and advisory needs during the transition towards conservation and regenerative practices. The fourth concerned operational constraints, particularly machinery availability, soil trafficability and timing of field operations.

The main opportunities identified were linked to the existing strength of the SHARE Living Lab. Stakeholders recognised the value of long-term field experience, the presence of farmers already applying conservation practices, the availability of research and monitoring infrastructures, and the involvement of technical advisors and agri-food actors. These elements were seen as important conditions for testing CFPs, demonstrating their feasibility and connecting carbon farming with broader benefits such as soil health, nutrient efficiency and resilience.

Under Task 2.2, the discussion became highly operational. The reporting tables show recurrent issues related to the transition to no-tillage or reduced tillage on clay and silty soils, including compaction, water stagnation, weed control and the need for machinery adaptation. Manure and slurry management were also discussed as critical issues, especially when organic inputs must be incorporated or managed under reduced soil disturbance. In rice systems, stakeholders highlighted limited rotation options and pest pressure, while in other arable systems the discussion focused on strip-till, cover crops, continuous no-till and nutrient management.

The main needs emerging from SHARE were therefore practical and implementation-oriented: targeted technical advice, machinery demonstrations, peer-to-peer exchange, clearer economic scenarios, and MRV

protocols able to capture not only carbon but also broader soil fertility and nutrient-related indicators. SHARE also highlighted the importance of recognising farmers who have already adopted CFPs before formal certification schemes are established.

4.2 IBERSOILL – Spain/Portugal

In IBERSOILL, the results reflected the diversity of farming systems covered by the Living Lab, including arable crops, livestock systems, sheep farming, woody crops and agroforestry. The CFPs most frequently addressed included agroforestry, grazing management, manure incorporation, nutrient planning, cover crops, improved rotations, grassland management and reduced soil disturbance.

Under Task 2.1, the main barriers concerned technical knowledge, economic feasibility, machinery investment, labour constraints and limited farmer networks. Stakeholders stressed that several CFPs require changes in farm organisation, access to specific machinery or contractors, and confidence that the practices will not compromise productivity. The cost-benefit ratio was therefore considered a key determinant of adoption, particularly for practices such as direct sowing, cover crops and pasture improvement.

At the same time, IBERSOILL identified several opportunities. The presence of diversified Mediterranean and Atlantic farming systems creates space for combining CFPs with objectives such as erosion control, pasture productivity, drought resilience, biodiversity and improved nutrient cycling. Agroforestry and livestock integration were particularly relevant because they allow carbon farming to be discussed at both field and landscape level.

Under Task 2.2, the main implementation issues varied by production system. In arable systems, stakeholders discussed reduced soil disturbance, direct sowing, cover crop establishment, weed control and limited access to suitable contractors. In woody crops, the focus was on managing cover crops, pruning residues and competition with the main crop. In livestock and pasture systems, the main issues concerned grazing management, grassland improvement, manure management and the integration of animal production with soil carbon objectives.

The main needs emerging from IBERSOILL were improved advisory support, practical training, access to appropriate machinery and contractors, farmer-to-farmer learning, and demonstration under real farm conditions. The results also indicate that CFPs in IBERSOILL should be developed as flexible combinations adapted to different farming systems, rather than as uniform prescriptions.

4.3 GRECFL² – Greece

In GRECFL², the co-creation process focused mainly on cover crops, reduced soil disturbance, nutrient management, organic inputs and crop rotations. These CFPs were generally discussed as interconnected practices aimed at improving soil structure, nutrient use efficiency and resilience under Greek farming conditions.

Under Task 2.1, the main barriers concerned soil structure limitations, compaction, wet-field access, nutrient management inefficiencies and limited crop diversification. Stakeholders also highlighted the difficulty of interpreting soil data and translating it into practical fertilisation decisions. Uncertainty about carbon outcomes and the need for practical MRV approaches were recurrent points.

The main opportunities were linked to integrated management. Stakeholders recognised that individual CFPs may have limited effects if implemented alone, whereas combinations of cover crops, reduced tillage,

nutrient management, organic inputs and rotations could provide more robust agronomic and environmental benefits. Digital tools and monitoring systems were also considered useful, provided that they are connected to agronomic expertise and practical decision-making.

Under Task 2.2, the implementation issues were mainly related to cover crop selection and management, machinery adaptation for reduced tillage, interpretation of soil and nutrient data, logistics of organic inputs, and planning of crop rotations. Cover crops were considered promising but sensitive to establishment conditions, sowing windows, water availability and competition with the main crop. Reduced tillage was also considered relevant but dependent on soil conditions and machinery availability.

The main needs emerging from GRECFL² were targeted technical guidance, farmer-oriented experimentation, better use of soil and nutrient data, and practical MRV protocols. The Living Lab results suggest that carbon farming adoption in this context will depend on the ability to demonstrate locally adapted practice combinations and to link them with measurable soil health and carbon-related outcomes.

4.4 RAGILL – Israel

In RAGILL, the results highlighted the importance of adapting carbon farming and regenerative practices to highly specific climatic, agronomic and market conditions. The CFPs most frequently discussed included manure and compost management, nutrient planning and application, cover crops and service crops, improved rotations, reduced or no tillage, and management of pruning residues.

Under Task 2.1, the main barriers concerned uncertainty about yield effects and economic returns, lack of accessible and trusted knowledge, insufficient advisory capacity, regulatory constraints, market limitations and uncertainty around MRV and carbon credit mechanisms. Stakeholders stressed that farmers need clear evidence and trusted guidance before changing established practices.

A key opportunity identified in RAGILL was knowledge translation. The Living Lab was seen as a potential interface between research, farmers, advisors, industry, policy actors and civil society. Demonstration, peer learning and professional support were considered essential for building farmer confidence. Stakeholders also recognised the potential role of monitoring tools and data collection in creating a shared language between farmers, researchers and market or policy actors.

Under Task 2.2, implementation issues were grouped around several practice areas. For manure and compost use, the main concerns were quality, maturity, timing, costs, weed or pathogen risks, and long-term soil response. For nutrient planning, stakeholders highlighted the need for accessible professional knowledge and better coordination. For cover crops and service crops, the main issues concerned pests, machinery, maintenance, labour, fire risk, grazing interactions and adaptation to specific cropping systems. For rotations and reduced soil disturbance, the discussion also included market demand and economic feasibility.

The main needs emerging from RAGILL were region-specific technical adaptation, trusted advisory support, demonstration of successful cases, better coordination among actors, and clearer MRV systems. The results show that adoption is not only a matter of technical feasibility, but also of trust, risk management and economic clarity.

4.5 SOFRALL – France

In SOFRALL, the co-creation process focused on fertilisation, cover crops, tillage reduction and pasture management. These themes correspond mainly to nutrient management, cover cropping, grassland

management and reduced soil disturbance. The available materials show a strong emphasis on practical farm-level needs and on linking CFPs with soil diagnosis and field observation.

Under Task 2.1, the main barriers concerned the technical complexity of cover crops, uncertainty about establishment success and agronomic benefits, economic risks, weed control, soil compaction, runoff and difficulties in carbon quantification. Stakeholders also highlighted the challenge of interpreting soil analyses and using them to guide management decisions.

The main opportunities were related to improving soil organic matter, strengthening soil structure, reducing erosion and runoff, improving pasture management and developing better support tools for farmers. The involvement of technical partners and technology developers also created opportunities for improving monitoring, advisory services and MRV support.

Under Task 2.2, cover crops were discussed as promising but variable, depending on species choice, sowing date, water availability, destruction method and interaction with the main crop. Tillage reduction was considered relevant for maintaining SOC but raised concerns about compaction, crusting, trafficability and weed management. Fertilisation and organic matter management were linked to soil diagnosis, nutrient availability and humic content. Pasture management was addressed as a way to maintain or increase SOC while supporting productive systems.

The main needs emerging from SOFRALL were clearer technical guidance, improved soil diagnosis tools, practical decision support, stronger advisory follow-up and MRV protocols that are understandable and usable at farm level. The results indicate that stakeholders are interested in CFPs but require more operational evidence of agronomic and economic benefits before scaling up implementation.

5. Cross-Living Lab synthesis

5.1 Main macro-environmental barriers and opportunities

The co-creation workshops produced a substantial set of macro-environmental barriers and opportunities for the uptake of Carbon Farming Practices (CFPs) across the five Living Labs. As described in Section 2.4, barriers and opportunities were aggregated according to the four macro-environmental dimensions used in the WP2 reporting tables: technical, economic/market, socio-cultural, and administrative/policy/regulatory. In total, stakeholders identified 206 barriers and 129 opportunities across these four dimensions (Figure 7 and Table 7). Therefore, barriers were more numerous than opportunities, with approximately 1.6 barriers identified for each opportunity.

The scoring system was used as an indicative prioritisation tool. Overall, stakeholders assigned relatively high importance to several opportunities, suggesting that the same co-creation process that revealed constraints also identified clear entry points for action. The administrative/policy/regulatory dimension received the highest average scores for both barriers and opportunities, with average scores of 3.1 for barriers and 3.0 for opportunities. This indicates that policy clarity, administrative simplification, regulatory stability and institutional support are central issues for the future development of carbon farming. These scores should be interpreted as workshop-based prioritisation results, rather than as statistically representative indicators.

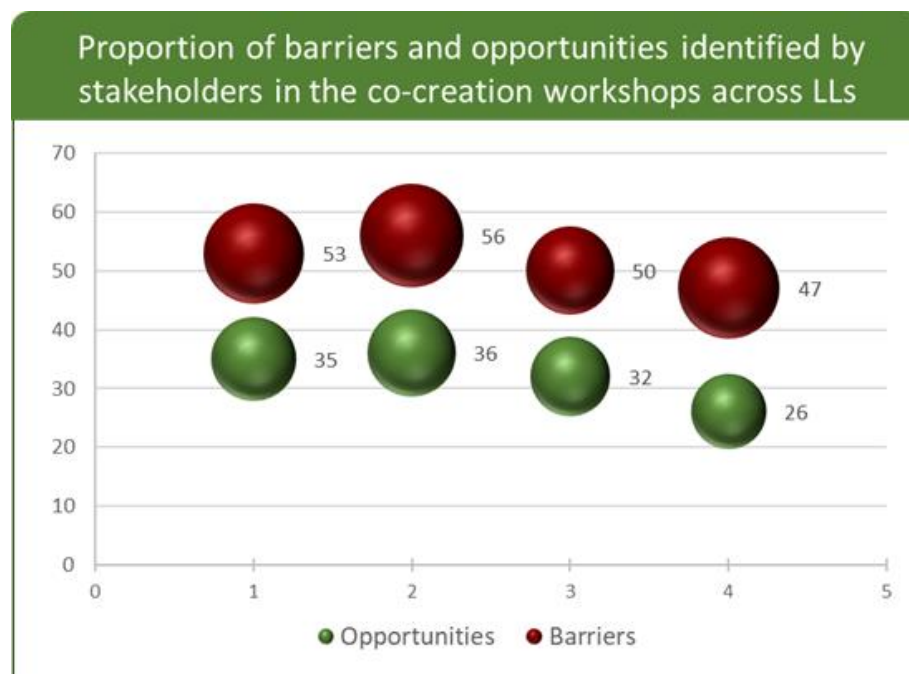


Figure 7. Distribution of barriers and opportunities identified by stakeholders across the four macro-environmental dimensions used in the WP2 reporting framework. The figure summarises the relative weight of technical (1), economic/market (2), socio-cultural (3) and administrative/policy/regulatory (4) issues emerging from the co-creation workshops.

Table 7. Total number of barriers and opportunities identified by stakeholders, the number of scores of 4 or 5 and the average score

Group	Barriers	Score	Opportunities	Score	Average score per barrier	Average score per opportunity
Technical	53	140	35	99	2.6	2.8
Economic/market	56	147	36	106	2.6	2.9
Socio-cultural	50	107	32	89	2.1	2.8
Admin/policy/reg	47	144	26	78	3.1	3.0
Total	206	538	129	372	2.6	2.9

To focus on the issues considered most relevant by stakeholders, the following synthesis gives particular attention to barriers and opportunities rated as important or very important, corresponding to scores of 4 or 5 in the prioritisation exercise. To support the interpretation of these results, Figure 8 focuses on high-priority barriers and opportunities identified across Living Labs and macro-environmental dimensions. This visualisation helps identify which dimensions were perceived as most critical within each Living Lab, without implying a direct ranking of territories. Differences among Living Labs may reflect workshop format, stakeholder composition, number of working groups and level of reporting detail.

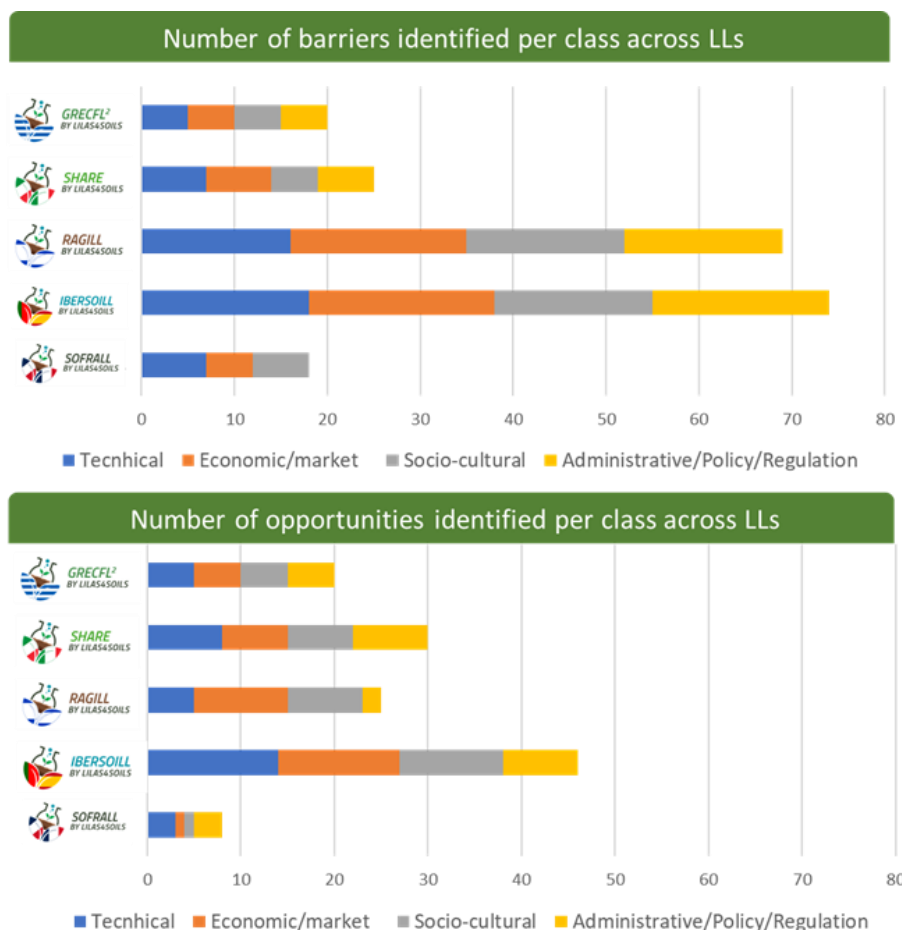


Figure 8. Number of high-priority barriers and opportunities identified across Living Labs and macro-environmental dimensions. High-priority items correspond to barriers or opportunities receiving scores of 4 or 5 in the Task 2.1 prioritisation exercise. The figure should be interpreted as a workshop-based prioritisation output rather than as a statistically representative comparison among Living Labs.

Overall, IBERSOILL and RAGILL identified the highest number of barriers and opportunities, while SOFRALL, SHARE and GRECF2² reported a smaller number of prioritised issues. These differences should not be interpreted as a direct ranking of Living Labs, but rather as the result of different workshop formats, stakeholder composition, group dynamics and level of detail in the reporting tables. Across all Living Labs, economic/market, administrative/policy/regulatory and technical barriers were among the most frequently reported high-priority issues, confirming that the uptake of carbon farming depends not only on agronomic feasibility, but also on economic viability, policy stability and practical implementation conditions.

Stakeholders identified several interconnected barriers and opportunities for adopting carbon farming. These are summarised in Table 8, which organises the workshop outputs into the four macro-environmental dimensions used in the WP2 reporting framework.

Table 8. Main barriers and opportunities for adopting carbon farming: from the co-creation workshop.

Technical	
Barriers	
1. Insufficient knowledge and advisory support	Lack of farmer training, limited technical guidance, and weak knowledge-sharing systems, along with insufficient scientifically validated evidence on effective practices.
2. Weak and inconsistent MRV systems (Monitoring, Reporting, Verification)	Non-standardized methods for measuring soil carbon, inconsistencies in C sequestration measurement methodologies, high complexity and cost of monitoring, and low confidence in the reliability of carbon credit accounting.
3. Limited access to appropriate technology and machinery	Shortage of equipment adapted to conservation practices, limited availability of appropriate technological resources, limited access to precision and digital agriculture tools, and constraints in accessing key inputs such as organic amendments, constrain implementation at the farm level.
4. Agronomic and system-level challenges	Transition-related yield risks, slow soil carbon accumulation (particularly in Mediterranean conditions due also to higher temperatures), management difficulties (weeds, nutrients, residues, soil compaction), and challenges integrating multiple practices, compounded by high variability across local conditions and lack of standardized technical solutions, increasing uncertainty about the effectiveness and scalability of CFPs.
Opportunities	
1. Knowledge, advisory support and innovation	Strengthening technical advisory services, farmer training, the role of Living Labs in knowledge exchange and on-farm experimentation to support the adoption of locally adapted CFPs.
2. Soil health and system resilience	Improving soil fertility, organic matter, and resilience to climate change through regenerative practices, alongside better nutrient and manure management. Key opportunities: such as cover crops, reduced tillage, and diversified crop rotations, improve soil structure while enhancing resilience to drought, extreme rainfall, and other climate-related stresses.
3. Digitalisation and technological development	Expanding the use of affordable carbon measurement methods, precision agriculture technologies, digital tools, and improved monitoring systems to increase efficiency and support carbon accounting.
4. Scientific evidence and collaboration	Developing robust metrics, validated practices, improved field data collection, and collaborative research to build confidence in C farming and support informed decision-making.

Economic and market	
Barriers	
1. Economic uncertainty and profitability	High upfront investment costs (machinery, advisory), uncertain returns during the transition period, and delayed economic benefits (long-term) reduce the attractiveness of C farming.
2. Carbon market uncertainty	Low and unstable carbon prices (and credits), insufficient remuneration for C sequestration, unreliable quantification methods, and evolving policies and certification frameworks reduce confidence in C farming profitability and make investment decisions more risky.
3. Limited financial support and incentives	Insufficient grants, funding mechanisms, and compensation for transition risks or yield losses constrain farmers' capacity to adopt new practices. In addition, economic vulnerability in the agricultural sector, combined with market volatility, weather-related risks, geopolitical uncertainty, further reduces farmers' willingness and capacity to adopt new practices.
4. Market and value-chain constraints	Limited market demand and price premiums for sustainable products, inconsistent markets for diversified crops, and a lack of mechanisms to reward ecosystem services beyond C sequestration (improvements in soil health, biodiversity, and water regulation) reduce the economic viability of C farming.
Opportunities	
1. Improved farm profitability and resilience	Enhancing soil health to increase productivity, reduce external input, lower production risks, and strengthen long-term farm competitiveness.
2. New financial incentives and revenue streams	Expanding opportunities through carbon credits, payments for ecosystem services, dedicated funding programmes, and innovative financing mechanisms to support the transition to C farming. However, stakeholders stressed that these mechanisms should provide meaningful and reliable economic incentives that support farmers throughout the transition.
3. Sustainable markets and value chains	Creating added value through certified sustainable products, climate-friendly production systems, sustainability branding, and access to premium and export markets. Integration of C farming into existing certification and quality schemes as ways to improve market differentiation and strengthen direct links between farmers and consumers.
4. Standardisation and collaborative business models	Developing common metrics, valuation methods for ecosystem services to quantify environmental and nutritional benefits, and collaborative farming networks to improve market recognition, establishing robust methods attract investment, and support the long-term viability of C farming.

Socio-cultural	
Barriers	
1. Knowledge and skills gaps	Limited awareness, training, and practical expertise among farmers, advisors, and farm workers hinder the adoption and effective implementation of CFPs. Participants highlighted the need for more training, practical education, and greater exposure to C farming concepts.
2. Resistance to change	Traditional farming practices, cultural attitudes, and uncertainty about the environmental and economic benefits of carbon farming reduce willingness to adopt regenerative approaches. Highlighted that many farmers remain unconvinced of the environmental and long-term economic benefits of C farming.
3. Weak collaboration and knowledge exchange	Limited interaction and trust among farmers, researchers, advisors, and policymakers, together with insufficient peer-to-peer learning, slow the transfer of knowledge and innovation, and weakens the adoption.
4. Low public awareness and recognition, structural constraints	Limited consumer awareness and weak recognition of sustainable products reduce social support for C farming. Skilled labour shortages, changing land ownership patterns, and reduced decision-making power among producers limit the capacity to implement CFPs.
Opportunities	
1. Knowledge exchange and collaboration	Strengthening Living Labs, demonstration farms, farmer networks, and peer-to-peer learning to promote knowledge sharing, innovation, and farmer engagement. Participants also highlighted the importance of communicating C farming in ways that address farmers' real needs and practical concerns
2. Growing societal support	Increasing public awareness of climate change, biodiversity conservation, and sustainable agriculture to enhance recognition of carbon farming and farmers' environmental contributions. Better communication of agriculture's contribution to climate mitigation.
3. Attracting new generations	Positioning C farming as an innovative and environmentally responsible approach to make agriculture more attractive, particularly to younger farmers. An agriculture supported by training, scientific evidence, and stronger links between agriculture, environmental stewardship, and human health.
4. Multi-actor cooperation	Enhancing collaboration among farmers, researchers, advisors, policymakers, and supply chain actors to support innovation, social acceptance, and the wider adoption of carbon farming practices. Strengthening local identity, shared learning and collective initiatives was considered essential for fostering social acceptance and accelerating the adoption of carbon farming practices.

Administrative/policy/regulatory	
Barriers	
1. Regulatory uncertainty	Lack of clear, stable, and harmonised regulatory frameworks, including uncertainty regarding certification, carbon credit ownership, permanence, and governance. This regulatory uncertainty reduces confidence and discourages long-term investment.
2. Administrative complexity	Burdensome certification, monitoring, and reporting requirements, together with the slow development of carbon registries and certification schemes, increase transaction costs and discourage participation. These administrative demands increase transaction costs and reduce the attractiveness of participating in C farming schemes.
3. Limited policy and institutional support	Existing policies are often poorly aligned with farmers' needs, offering insufficient economic incentives, advisory services, and extension support. In addition, weak coordination between key stakeholders together with the lack of a clear institutional contact point and knowledge-sharing mechanisms, was seen as limiting.
4. Rigid and incomplete policy frameworks	Limited recognition of early adopters, inflexible regulations, and insufficient recognition of ecosystem services beyond C sequestration hinder the wider adoption of C farming.
Opportunities	
1. Clear and harmonised regulatory frameworks	Developing common European rules, standardised methodologies, and transparent certification and carbon registry systems to increase confidence and support carbon market development.
2. Stronger policy integration and incentives	Incorporating C farming into the Common Agricultural Policy (CAP) and Rural Development Programmes through dedicated funding, result-based payments, and incentives that reward both adoption and long-term maintenance of sustainable practices.
3. Simplified administration and institutional support	Reducing administrative burdens, improving coordination across governance levels, and promoting regional collaboration and collective initiatives to facilitate farmer participation.
4. Recognition of ecosystem services	Expanding policies to reward the broader environmental benefits of C farming beyond carbon sequestration, while fostering long-term investment, innovation, and supply chain collaboration.

The co-creation workshops revealed broad convergence across the five Living Labs, despite the diversity of contexts represented in the first WP2 cycle. This diversity is reflected in the workshop evidence base: 228 stakeholders participated across the five Living Labs, with participation ranging from 30 stakeholders in SOFRALL to 69 in SHARE, and including farmers, researchers, policy representatives, agri-food industry actors, technical advisors and NGOs. It is also reflected in the different CFP profiles addressed by each Living Lab, ranging from more soil- and nutrient-management-oriented combinations in GRECFL² and SOFRALL to broader combinations including agroforestry, livestock, grazing and grassland management in IBERSOILL. Against this diverse background, similar priority issues emerged across the four macro-environmental

dimensions. This suggests that many challenges to carbon farming are systemic and cannot be solved only through farm-level technical recommendations.

From a technical perspective, stakeholders repeatedly highlighted the need for stronger knowledge exchange, trusted advisory support, practical training, suitable machinery and technologies, and affordable tools to monitor and verify carbon-related outcomes. Several participants stressed that adopting regenerative and carbon farming practices involves a transition phase in which yields, labour organisation, weed control, nutrient management and field operations may become more uncertain or complex.

Economic concerns centered mainly on uncertainty. Stakeholders identified high upfront investment costs, uncertain carbon markets, low or unstable carbon prices, insufficient financial incentives and the absence of reliable long-term business models as major constraints. The workshops also showed that farmers need incentives that reward not only carbon sequestration, but also broader ecosystem services such as soil health, water regulation, biodiversity and climate resilience.

Socio-cultural barriers highlighted the role of human and social capital. Limited awareness, resistance to change, weak collaboration among farmers, advisors, researchers and policymakers, and insufficient peer-to-peer learning can slow down adoption. Conversely, Living Labs, demonstration farms, farmer networks and practical knowledge exchange were repeatedly identified as key opportunities to build trust and accelerate learning.

Administrative, policy and regulatory barriers reflected the need for a more enabling institutional framework. Unclear rules, complex certification and reporting procedures, fragmented institutional support and limited recognition of ecosystem services create uncertainty and may discourage participation in carbon farming schemes. Stakeholders therefore identified harmonised regulatory frameworks, simplified procedures, stronger policy integration and better recognition of ecosystem services as major opportunities.

Overall, these findings show that stakeholders perceive carbon farming as promising and will depend on the following four interrelated enabling conditions:

- Strengthening knowledge exchange, collaboration, peer learning, training, and independent advisory services.
- Developing credible, standardised, and affordable MRV and certification systems.
- Providing stable economic incentives and viable business models.
- Establishing clear, coherent, and supportive policy frameworks.

5.2 Practical challenges and co-developed solutions for CFP implementation

The co-creation activities carried out across the Living Labs showed that CFP implementation is constrained by a combination of technical, economic, organisational and knowledge-related factors. Although the specific challenges varied according to farming systems and local environmental conditions, several common implementation issues emerged across the five Living Labs.

The most recurrent challenges concerned field operability, soil and water constraints, access to machinery and specialised services, technical knowledge, economic risk, market uncertainty, governance complexity and MRV requirements. At the same time, the co-creation process enabled stakeholders to identify practical and context-specific responses. These solutions focused mainly on adaptive management, collaborative learning, advisory support, shared access to machinery, decision-support tools and more operational monitoring systems, rather than on standardised prescriptions.

The synthesis presented in Table 9 summarises the main cross-cutting implementation challenges and the corresponding co-developed solutions emerging from the Task 2.2 reporting tables and the Living Lab-specific analyses.

Table 9. Cross-cutting practical challenges and co-developed solutions for CFP implementation.

Focus area	Practical challenges and constraints	Co-developed solutions and strategies
Soil, water and field operability	Reduced or no-tillage systems may increase risks of compaction, crusting, water stagnation and difficult field access, especially on clay or silty soils. Cover crops may compete with vines, orchards or main crops for water in dry periods. Delayed autumn rainfall can make rainfed cover crop establishment unpredictable. Operational windows for sowing, harvesting and termination are often narrow and strongly weather-dependent.	Use adaptive and targeted interventions, including compaction mapping, localised subsoiling where needed, adaptive grazing and context-specific cover crop management. Combine practices such as cover crops, reduced tillage and organic amendments into locally adapted soil-building strategies rather than applying them as isolated measures.
Machinery and investment barriers	Specialised machinery such as direct seeders, roller crimpers, manure spreaders, GPS-guided equipment or digital grazing tools can be costly and difficult to access. Some equipment is used only occasionally, making individual farm investment difficult to justify. In several areas, specialised contractors or service providers are not sufficiently available.	Promote cooperative approaches such as shared ownership, leasing systems, machinery rings, or equipment management associations. Encourage specialised contractor services and collective solutions for plant residue management, composting and organic amendment logistics.
Knowledge and decision support	Farmers and advisors reported uncertainty about cover crop species, establishment and termination, reduced tillage effects, soil analysis interpretation, residue management, nutrient planning and organic input use. Generic carbon farming recommendations are often insufficient because farmers need guidance adapted to local soils, climates and farming systems.	Strengthen continuous advisory support, demonstration farms, field days, farmer discussion groups and peer-to-peer learning. Use Living Labs as trusted interfaces between research, farmers, advisors, policy actors and value-chain stakeholders. Develop simple, localised decision-support tools that translate monitoring results into practical management decisions.
Economic risk and market uncertainty	Low or uncertain carbon credit values may not compensate for new machinery, additional labour, monitoring costs or yield risks during the transition phase. Market systems may not reward rotation crops or broader ecosystem services, limiting the economic feasibility of diversification and soil-building strategies.	Move from single-practice incentives towards incentives for integrated soil-building systems. Combine carbon-related payments with support for ecosystem services, input optimisation, value-chain agreements and transition-risk compensation. Recognise early adopters who already maintain good practices, not only newly generated carbon gains.
Governance, bureaucracy and MRV	Carbon farming schemes may interact with existing policies in complex ways. Certification, monitoring and reporting requirements can be difficult to understand and costly to implement. MRV systems may focus narrowly on carbon while overlooking indicators that farmers	Design practical MRV frameworks that combine soil organic carbon with soil health, nutrient status, compaction, water retention, biological activity and productivity indicators. Use monitoring not only for certification, but also as a farm management tool. Establish

	consider relevant, such as soil fertility, water retention, compaction, pasture yield and crop performance.	long-term observation periods to validate slow-acting practices such as compost application, reduced tillage and diversified rotations.
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The co-developed solutions identified by the Living Labs suggest that successful CFP implementation depends on flexible combinations of practices adapted to local soil and climatic conditions, cropping systems and farm organisation. Rather than producing uniform protocols, the first co-creation cycle highlighted the need for adaptive implementation pathways supported by training, advisory services, field demonstration and credible monitoring.

5.3 Common needs for training, advisory support and MRV

A set of common needs related to training, advisory support and Monitoring, Reporting and Verification (MRV) were identified from the co-creation activities across the five Mediterranean Living Labs (SHARE, IBERSOILL, GRECFL², RAGILL and SOFRALL). These needs are summarised below. The overall need was for practical, locally adapted, and continuous support rather than generic technical recommendations.

Training needs:

- Practical implementation of CFPs - hands-on training on reduced tillage, no-till transition, cover crop establishment and termination, manure and digestate management, crop rotation, grazing management, agroforestry and the use of organic amendments. These needs were identified across SHARE, GRECFL², IBERSOILL, SOFRALL and RAGILL.
- Machinery use and adjustment - training on the selection, operation, calibration and adjustment of machinery. Specific needs included direct seeders/planters, precision agriculture equipment, roller crimpers, slurry spreaders, drones, GPS-guided subsoilers, track-laying tractors, digital grazing tools, machinery calibrations and operations under variable soil moisture conditions. These needs were particularly evident in IBERSOILL, SHARE and GRECFL².
- Soil and nutrient management - the interpretation of soil analyses, nutrient planning, fertiliser timing, organic matter management, humic balance assessment, compost quality evaluation and soil structure assessment. They were identified in GRECFL², SOFRALL, RAGILL and SHARE.
- Peer learning and demonstration - farmer-to-farmer exchanges, demonstration farms, Living Lab experimentation, field visits, webinars and communication networks. These approaches were particularly relevant in SHARE, RAGILL, SOFRALL and IBERSOILL, where stakeholders emphasised the value of learning from locally relevant experiences and observed results.
- Decision-support tools and digital technologies - capacities for using yield maps, digital Decision Support Systems (DSS), precision agriculture technologies and monitoring data into farm management. These needs were highlighted in IBERSOILL and GRECFL².

Advisory support needs:

- Locally adapted recommendations - site-specific advice considering soil characteristics, climate, cropping system and operational constraints. This need was identified across all Living Labs.
- Continuous technical support - throughout the implementation process rather than one-off technical recommendations particularly during the transition. This need was highlighted in SHARE, RAGILL and SOFRALL.

- Knowledge translation - improve the translation of scientific knowledge, monitoring results and technical information into practical farm management decisions through advisors and Living Labs acting as knowledge-brokers. This role was particularly emphasised in RAGILL, GRECFL² and SHARE.
- Integrated farm planning - support for combining several CFPs (cover crops, improved rotations, reduced tillage, nutrient management, organic inputs and grazing management). This systems-based approach was highlighted in GRECFL², SHARE and IBERSOILL.
- Economic and administrative guidance - advice on cost-benefit assessment, machinery investment, cooperative approaches, carbon markets, certification and regulatory compliance. These needs were particularly identified in SHARE, IBERSOILL and RAGILL.

MRV needs:

- Monitoring beyond soil organic carbon – inclusion of soil health and management indicators in addition to soil carbon (soil structure, biological activity, organic matter, nutrient-use efficiency, biomass production, soil cover, trafficability, weed pressure and crop performance). This broader approach was identified across all Living Labs.
- MRV as a decision-support function - monitoring used to guide farm management, supporting nutrient planning, evaluating changes in soil condition and adapting CFP implementation, and not only for carbon certification. This was identified across all Living Labs.
- Simple and operational indicators – practical, accessible indicators that can be applied under routine farm conditions rather than complex scientific measurements. These needs were highlighted in SHARE, SOFRALL, GRECFL² and RAGILL.
- Long-term monitoring - repeated observations over several growing seasons or years to distinguish management effects from seasonal variability. This need was particularly emphasised in RAGILL, SOFRALL and SHARE.
- Interpretation and advisory support - advisory support capable of connecting monitoring results with management decisions. This requirement was particularly highlighted in SOFRALL, GRECFL², SHARE and RAGILL.

Overall, the synthesis indicates that successful carbon farming implementation requires three complementary support pillars:

1. practice-oriented training, centred on hands-on learning, machinery operation, soil management, digital tools and peer learning;
2. continuous advisory support, providing locally adapted and system-based guidance throughout the transition;
3. operational MRV systems, designed not only for carbon accounting but also as practical farm management tools integrating soil health, productivity and nutrient-efficiency indicators.

5.4 Key similarities and differences across Living Labs

When comparing the five Living Labs, SHARE (Italy), IBERSOILL (Spain/Portugal), GRECFL² (Greece), RAGILL (Israel) and SOFRALL (France), carbon farming practices (CFPs) are generally recognised as technically relevant and capable of generating benefits beyond carbon sequestration, including improved soil health, nutrient-use efficiency, erosion control, water management, biodiversity, resilience and, in some cases, improved farm productivity. In this first co-creation cycle, results also demonstrate that the implementation of CFPs is constrained by a combination of economic, technical, operational, institutional and knowledge-related factors.

Similarities across Living Labs:

1. Adoption is primarily constrained by implementation conditions

The most recurrent practices were cover crops, improved nutrient management, organic matter and manure management, improved rotations, and reduced or no soil disturbance. The way these practices were prioritised and the barriers associated with them differed according to farming systems, climatic conditions, institutional contexts and the maturity of existing advisory and technical support structures. This common focus indicates that carbon farming is being understood primarily as a systems-based approach rather than as a single-practice intervention. The co-creation results suggest that the effectiveness and feasibility of individual CFPs are strongly dependent on their interaction with other farm management decisions.

This was particularly explicit in GRECFL², where stakeholders emphasised that combinations of cover crops, reduced tillage, nutrient management, organic inputs and rotations may provide more robust benefits than isolated measures. Similar conclusions emerged from IBERSOILL, where stakeholders argued for flexible combinations adapted to different production systems, and from RAGILL, where the management of service crops, grazing, organic inputs and reduced soil disturbance was considered highly context-dependent.

2. Technical knowledge and advisory support are general needs

Across all LLs, stakeholders identified gaps in knowledge concerning the selection, timing and management of CFPs. These gaps concerned, among other issues, cover crop species selection, termination timing, nutrient planning, interpretation of soil analyses, management of organic inputs, reduced-tillage systems and the integration of livestock into carbon-oriented management. This common need was particularly clear in the Task 2.2 results. GRECFL² and SOFRALL highlighted difficulties in interpreting soil and nutrient data, while RAGILL stressed the need for accessible and trusted professional knowledge. IBERSOILL identified training needs related to machinery operation, crop rotations, direct sowing, grazing management, soil compaction mapping and organic fertiliser management. SHARE similarly emphasised targeted technical advice, machinery demonstrations and peer-to-peer learning.

The results therefore point to a common need for advisory systems that combine scientific knowledge with practical farm experience. Peer-to-peer learning, demonstrations, farmer experimentation and long-term field observation were repeatedly identified as effective mechanisms for reducing uncertainty.

3. Machinery and operational capacity are major bottlenecks

Machinery access and operational feasibility are major barriers to CFP implementation. Access to appropriate machinery was one of the strongest common themes. Although many practices are technically viable, adoption is often constrained by the limited availability and high cost of suitable machinery and specialised contractors. This was particularly prominent in IBERSOILL, where many of the practical solutions proposed involved machinery sharing, renting, cooperation among farmers, or the development of specialised agricultural service providers. Similar concerns were raised in SHARE, GRECFL² and SOFRALL in relation to reduced tillage, soil trafficability, compaction and field access.

4. Cover crops are widely recognised as promising but highly context-dependent

Cover crops were discussed in almost all Living Labs and represent one of the clearest areas of convergence. Their potential benefits include soil protection, organic matter accumulation, erosion control, improved nutrient cycling and resilience. However, their implementation was consistently associated with significant management complexity. The specific constraints differ by context. In Mediterranean systems, water

availability and dry autumn conditions were particularly important. In woody crops, late-season competition for water and difficulties accessing fields with machinery were prominent. In more humid systems, trafficability and wet soils created different constraints. The common conclusion is that cover crops should not be applied according to a uniform protocol, but that species selection, establishment, management and termination must be adapted to local pedoclimatic and production conditions.

5. Soil management practices are interconnected

Another important similarity is that stakeholders rarely considered individual CFPs in isolation. Reduced tillage was linked to weed management, soil compaction, machinery access, crop rotations and organic matter management. Nutrient management was linked to soil diagnosis, manure and compost quality, crop residues and precision agriculture. Cover crops were linked to rotations, grazing, soil moisture and nutrient cycling.

GRECFL² emphasised that combinations of practices may produce more robust benefits than isolated interventions. The same principle is evident in SHARE, where conservation practices, nutrient management, manure use and rotations were discussed as interconnected elements of broader soil-health strategies. IBERSOILL also highlighted combinations of crop, livestock and agroforestry practices, while RAGILL considered the integration of organic inputs with cover or service crops.

6. MRV remains uncertain

All Living Labs identified some form of need for improved monitoring, reporting and verification. The specific concerns varied, such as uncertainty about how to quantify carbon outcomes, difficulties in translating soil measurements into practical decisions, high costs of soil and microbiological analyses, and insufficient clarity regarding the indicators to monitor.

SHARE placed particular emphasis on MRV protocols that capture carbon together with soil fertility and nutrient-related outcomes. GRECFL² stressed the need for practical MRV approaches linked to locally adapted practice combinations. RAGILL highlighted MRV as a mechanism for building trust between farmers, researchers, markets and policy actors. SOFRALL emphasised the need for farm-level tools that are understandable and usable by farmers. IBERSOILL showed that farmers are also interested in quantifying less conventional benefits, such as the effects of wool application on soil fertility, soil microbiology and moisture retention.

Differences across Living Labs:

1. The dominant constraints differ according to the farming system and regional context

One of the most important differences is the farming-system diversity. SHARE, GRECFL² and SOFRALL are comparatively more strongly oriented towards arable and soil-management issues, although livestock and pasture systems are also present to varying degrees. IBERSOILL covers the widest range of systems, while RAGILL combines arable, orchard, vineyard and livestock contexts under highly specific climatic and market conditions.

This diversity explains why similar CFPs create different implementation challenges. Cover crops, for example, are common across all Living Labs, but the principal concerns differ. In arable systems, the main issues relate to establishment, termination timing, weed control and competition with the main crop. In woody crops, the challenge is often controlling vegetation while avoiding competition for water and maintaining access to the plantation. In livestock systems, grazing can support management but requires control of overgrazing and compaction, while RAGILL also faces fire risks, pests, machinery maintenance and religious or local considerations.

2. The diversity of production systems is most pronounced in IBERSOILL

IBERSOILL differs from the other LLs because its co-creation process encompasses a particularly broad range of production systems, including arable, livestock, sheep, woody crop and agroforestry systems. This diversity creates distinct challenges.

For arable systems, the focus is on precision fertilisation, direct sowing, and cover crop management. Livestock and sheep systems focus on manure and grazing management, labour and permanent pastures, while woody crops face additional challenges related to cover crops, wet-field access, invasive species, residue management. Agroforestry systems introduce additional complexity concerning crop rotation, grazing control, direct sowing, residue management and decision-making across spatially heterogeneous systems.

3. Climate and water constraints shape the implementation of Mediterranean CFPs

GRECFL², RAGILL and parts of IBERSOILL illustrate how water availability and climatic variability influence the feasibility of CFPs. Cover crops can provide soil and carbon benefits but can also compete with crops for scarce water, making sowing timing and the selection of species critical.

In RAGILL and IBERSOILL, climate interacts with production systems and market conditions, creating additional challenges such as fire risk, pest management, crop establishment, grazing interactions, and the economic value of practices. In contrast, SHARE and SOFRALL, face constraints related to wet soils, low bearing capacity, compaction and trafficability. Thus, the same CFP, such as cover crops or reduced tillage, may face very different implementation barriers depending on local climate and soil conditions.

4. Institutional and regulatory barriers are more prominent in some Living Labs

SHARE and RAGILL placed greater emphasis on policy, regulatory and market uncertainty. SHARE highlighted uncertainty regarding the interaction between carbon farming schemes and existing policies, while RAGILL focused on carbon-credit mechanisms, market demand and regulatory conditions. In IBERSOILL, regulatory challenges were more directly linked to farm-level administrative burdens. By contrast, GRECFL² and SOFRALL focused more on technical and agronomic constraints.

These differences suggest that policy barriers may vary by context, with some Living Labs prioritising policy clarification and others requiring practical support and cost reduction.

5. The contribution of Living Lab capacities is different

The Living Labs differ in the assets they can mobilise to support adoption.

SHARE benefits from long-term field experience, existing conservation agriculture practices, research infrastructure and established links with advisors and agri-food actors. Its main challenge is translating this knowledge into scalable, economically viable and policy-compatible implementation.

IBERSOILL is characterised by diverse farming systems and opportunities to connect field-level practices with livestock, agroforestry and landscape management. Its challenge is organising this diversity into coherent and transferable practice combinations.

GRECFL² has strong potential to integrate soil data, digital tools and agronomic experimentation, provided these remain accessible and decision oriented.

RAGILL can act as a knowledge-translation interface connecting farmers, researchers, advisors, industry, policy actors and civil society. Trust-building and demonstration are therefore central to its added value.

SOFRALL can connect soil diagnosis, field observation, technical advice and monitoring tools, with the main challenge being to ensure that these tools remain simple and actionable for farmers.

6. Implications for the next project activities

The results of the first WP2 co-creation cycle provide direct inputs for the next phases of LILAS4SOILS. The Living Labs have identified a common set of priority CFPs, recurrent barriers and opportunities, practical implementation needs, and expectations regarding training, advisory support and MRV. These results should now be used to guide cross-fertilisation between Living Labs, support CFP implementation at demo-site level, and improve the design of the next co-creation cycle.

The main implication is that future activities should move from broad discussion of carbon farming towards more targeted, practical, and implementation-oriented work. Stakeholders have already provided substantial evidence on perceptions, barriers, and opportunities. The next step is therefore to use this evidence to refine CFP implementation pathways, test solutions under real farm conditions, and monitor whether the proposed practices are technically feasible, economically meaningful and compatible with emerging certification and policy requirements.

6.1 Implications for cross-fertilisation between Living Labs

The first co-creation cycle identified several common topics that can support cross-fertilisation between Living Labs. These include cover crop management, reduced soil disturbance, nutrient and manure management, machinery adaptation, field operability, farmer advisory systems, economic incentives, and MRV. Although these issues emerged in different forms across the Living Labs, their recurrence indicates strong potential for structured exchange.

Cross-fertilisation should therefore be organised around practical themes rather than only around general presentations of Living Lab activities. For example, cover crops and reduced tillage could be discussed across Living Labs by comparing establishment methods, termination strategies, water competition, weed management, machinery needs, and soil trafficability constraints. Similarly, nutrient and manure management could be addressed by comparing slurry incorporation, compost quality, nutrient planning, fertilisation timing, and links with soil health indicators.

Each Living Lab can contribute specific knowledge to this process. SHARE can provide experience on conservation agriculture, long-term field trials, manure and slurry management, and links with agri-food value chains. IBERSOILL can contribute knowledge on diversified farming systems, agroforestry, grazing management, and the integration of crop and livestock systems. GRECF² can contribute to the discussion on integrated practice combinations, soil and nutrient data, and the use of digital tools. RAGILL can provide insights on knowledge translation, farmer confidence, innovation systems and adaptation to dry and highly specific farming contexts. SOFRALL can contribute experience on soil diagnosis, cover crop management, pasture management, and practical field-based assessment.

Future cross-fertilisation activities should therefore prioritise peer-to-peer learning, technical exchanges, field visits, machinery demonstrations, and thematic workshops. These formats are more likely to respond to stakeholder needs than broad dissemination events. They would also allow Living Labs to compare not only which CFPs are implemented, but how they are adapted to different soils, climates, production systems, market conditions, and policy contexts.

A further implication is that cross-fertilisation should include both successful and problematic experiences. Stakeholders repeatedly highlighted the importance of understanding failures, trade-offs and transition risks. Sharing difficulties related to cover crop establishment, machinery access, reduced tillage transition, monitoring costs or market uncertainty may be as useful as sharing successful examples, because it can help other Living Labs anticipate and manage similar challenges.

6.2 Implications for CFP implementation and monitoring

The co-creation results confirm that CFP implementation should not be based on uniform protocols applied across all Living Labs. The same CFP may require different technical adaptations depending on soil type, climate, cropping system, livestock integration, machinery availability, labour organisation and farm economic conditions. Future implementation activities should therefore translate the common CFP framework into locally adapted implementation pathways.

At demo-site level, the results of Task 2.2 should be used to refine practical protocols and follow-up actions. This includes clarifying the specific problem addressed by each CFP, the proposed solution, the operational steps required, the machinery and advisory needs, the expected benefits, the potential risks, and the indicators to be monitored. The completed reporting tables in Annex 5 provide the basis for this work and should be used as operational references for the next implementation phase.

The results also suggest that CFPs should be implemented as combinations of practices rather than isolated interventions. Cover crops, reduced tillage, nutrient management, organic inputs, manure incorporation, crop rotations, grazing management, and agroforestry often interact with each other. For this reason, implementation protocols should describe how different CFPs are combined at farm level and how trade-offs are managed. This is particularly important for practices that may create short-term challenges, such as cover crop competition for water, weed management under reduced tillage, or yield uncertainty during the transition period.

Monitoring should also reflect this integrated approach. Stakeholders repeatedly indicated that MRV should not focus only on soil organic carbon. Carbon accounting remains important, but farmers and advisors also need indicators that are useful for farm management. These include soil organic matter, soil structure, compaction, water retention, nutrient status, biological activity, biomass production, crop performance, weed pressure, pasture productivity, and input use efficiency. Including these indicators would make monitoring more useful for both certification and decision-making.

These results also highlight the need for close alignment between WP2 and the monitoring activities developed under WP3 and WP4. The practical constraints, farmer-relevant indicators and MRV needs identified through the WP2 co-creation process should inform the development of monitoring plans at demo-site level. In particular, the information collected through the Living Labs and transition plans should be used to identify monitoring approaches that are scientifically robust, feasible under real farm conditions, and meaningful for farmers, advisors and project partners.

The development of EU certification rules under the CRCF Regulation makes this issue particularly relevant. The new certification framework and related methodologies are expected to increase the importance of robust, transparent, and verifiable monitoring. However, the co-creation results show that MRV systems must also remain understandable, affordable, and feasible for farmers. Future project activities should therefore assess whether the CFP implementation pathways developed in the Living Labs are compatible with emerging certification requirements, while preserving the locally adapted and participatory character of the Living Lab approach.

This reassessment should focus on practical questions: which data are already available at demo-site level, which additional measurements are needed, who is responsible for data collection, how monitoring costs can be reduced, which indicators are meaningful for farmers, and how results can be translated into management decisions. In this way, MRV can become both a certification tool and a learning tool supporting adaptive management.

6.3 Recommendations for the next co-creation cycle

The next co-creation cycle should build on the evidence already collected during the first WP2 cycle. Since the questionnaires and workshops have provided substantial information on stakeholder perceptions, barriers, opportunities and practical needs, a full repetition of the same broad questionnaire approach may not be necessary. Instead, future consultation should be more targeted and focused on the issues that require updating, validation or further operational detail.

A key improvement for the second co-creation cycle should concern the standardisation of pre-workshop data collection. The first cycle confirmed the usefulness of preparatory questionnaires, but also showed that differences in implementation, stakeholder categorisation, response coding and reporting formats can make cross-Living Lab comparison more difficult. Future questionnaires or pre-workshop surveys should therefore be shorter, more targeted and more standardised across Living Labs, with common core questions, harmonised stakeholder categories, clearer response options and shared guidance for data extraction and reporting. Local adaptations should remain possible, but they should be limited to specific CFPs or context-specific questions, while preserving a comparable common structure.

A short and targeted consultation may still be useful where relevant changes have occurred, for example in relation to CRCF certification methodologies, carbon market rules, monitoring requirements, or new local implementation constraints. Such consultation should not aim to repeat the first cycle, but to check whether the co-developed CFP pathways remain feasible, relevant and aligned with policy and market developments.

The second cycle should also aim to increase stakeholder engagement, both in terms of the number of participants and the balance among stakeholder categories. Farmers and technical advisors should remain central, but greater effort should be made to involve value-chain actors, public authorities, certification bodies, financial actors, consumer organisations and other stakeholders whose role is relevant for scaling carbon farming beyond the demo-site level. This would strengthen the multi-actor character of the Living Labs and improve the robustness of the co-creation outputs.

To support this improvement, the involvement of social scientists from UNICATT should be considered in the design and implementation of the next pre-workshop survey and co-creation activities. Their contribution could help improve questionnaire design, stakeholder segmentation, facilitation methods, qualitative coding, comparability of results and interpretation of social, behavioural and organisational barriers. This would also support a more robust analysis of stakeholder engagement, adoption drivers and resistance to change across Living Labs.

Future workshops should be more practical and thematic. Several Living Labs reported that discussions would benefit from longer sessions, smaller focus groups and more time dedicated to specific practices or implementation challenges. Dedicated sessions could be organised on cover crops, reduced tillage, nutrient and manure management, grazing management, agroforestry, MRV, carbon quantification, economic feasibility and certification requirements.

Field-based learning should also be strengthened. Demonstration visits, machinery demonstrations, soil profile observations, farmer-to-farmer exchanges and discussions directly connected to demo-sites should become central components of the next co-creation cycle. These formats respond directly to the stakeholder demand for practical evidence, local examples and operational guidance.

The next cycle should also strengthen the link between co-creation and implementation. Workshop discussions should be connected to concrete follow-up actions, including responsibilities, timing, demo-site activities, monitoring needs and feedback mechanisms. This would avoid treating workshops as isolated events and would reinforce the role of Living Labs as continuous learning processes.

Finally, reporting tools should remain harmonised but should be further simplified and standardised. The first cycle showed the value of common templates, but also the need to make outputs easier to compare across Living Labs. Future reporting should focus on a limited set of key information: priority CFPs, stakeholder categories, main implementation barriers, co-developed solutions, MRV indicators, training needs, advisory needs, follow-up actions and changes compared with the previous cycle. A clearer and more standardised structure for questionnaire outputs and workshop reporting would strengthen the analytical value of the second co-creation cycle and make cross-Living Lab synthesis more robust.

To make these recommendations more operational, the main actions proposed for the second co-creation cycle are summarised in Table 10. The table links each action to the main responsible actors, indicative timing, expected outputs and possible indicators of progress. This is intended to support discussion within WP2 and with the other relevant work packages, particularly WP3 and WP4.

Table 10. Recommended actions for the second WP2 co-creation cycle, including responsible actors, indicative timing, expected outputs and possible progress indicators.

Action	Main responsible actor(s)	Timing	Expected output	Possible indicator
Standardise the next pre-workshop survey	WP2 leader, Living Lab leaders, with support from UNICATT social scientists	Before the second co-creation cycle	Improve data consistency with shorter and harmonised questionnaire template with common core questions, shared stakeholder categories and standardised response options	Common questionnaire template approved and used by all Living Labs
Increase stakeholder engagement	Living Lab leaders, with support from WP2 leader	Before and during the second co-creation cycle	Broader and more balanced stakeholder participation, including farmers, advisors, value-chain actors, public authorities, certification-related actors and civil society	Number of stakeholders involved; balance among stakeholder categories
Organise more practical and thematic workshops	Living Lab leaders, WP2 leader, technical partners	During the second co-creation cycle	Workshops focused on specific implementation issues such as cover crops, reduced tillage, nutrient and manure management, machinery, MRV and economic feasibility	Number of thematic sessions organised; number of CFP-specific issues addressed
Strengthen field-based learning	Living Lab leaders, demo-site managers, farmers and advisors	During the second co-creation cycle and field season	Field visits, machinery demonstrations, soil profile observations and farmer-to-farmer exchanges connected to demo-site activities	Number of field-based activities organised; participants feedback
Link co-creation outputs with demo-site implementation	Living Lab leaders, demo-site managers, WP2 and WP3 teams	During and after the second co-creation cycle	Updated CFP implementation pathways including practical protocols, follow-up actions, responsibilities and monitoring needs	Number of demo-sites with updated implementation pathways
Align WP2 outputs with WP3/WP4 monitoring planning	WP2 leader, WP3/WP4 teams, Living Lab leaders	Before the General Assembly and during monitoring plan development	Monitoring plans informed by stakeholder needs, practical constraints and farmer-relevant indicators identified through co-creation	Evidence of WP2 inputs integrated into WP3/WP4 monitoring plans
Improve MRV usability for farmers and advisors	WP3/WP4 teams, WP2 leader, Living Lab leaders, advisors	During monitoring plan development and implementation	MRV approach combining soil organic carbon with soil health, productivity, nutrient-use efficiency and management indicators	Set of farmer-relevant MRV indicators defined and tested

Strengthen advisory and peer-learning mechanisms	Living Lab leaders, advisors, farmer networks, technical partners	Throughout the second co-creation cycle	Continuous advisory support, peer-to-peer learning and knowledge translation adapted to local farming systems	Number of advisory/peer-learning activities; stakeholder satisfaction
Improve reporting tools for cross-Living Lab comparison	WP2 leader, Living Lab leaders	Before and after the second co-creation cycle	Simplified and standardised reporting templates for questionnaire and workshop outputs	Reporting template completed consistently by all Living Labs
Prepare cross-Living Lab learning inputs for the GA and subsequent project activities	WP2 leader, Living Lab leaders, WP3/WP4 teams	Before and during the General Assembly	Shared discussion points on lessons learned, standardisation, stakeholder engagement, monitoring needs and practical implementation	GA session held; agreed follow-up actions documented

The actions listed in Table 10 translate the main lessons learned from the first co-creation cycle into practical steps for the next phase. They highlight the need to combine stronger methodological standardisation with more practical, field-based and locally adapted co-creation. They also underline the importance of aligning WP2 outputs with WP3/WP4 monitoring activities, so that stakeholder needs, demo-site constraints and farmer-relevant indicators are considered in the development of monitoring plans.

In summary, the next co-creation cycle should be less presentation-heavy and more focused on thematic, practical and field-based co-creation. It should validate and refine the solutions already identified, improve the standardisation and comparability of pre-workshop data collection, increase stakeholder engagement, support demo-site implementation, and strengthen the connection between farmer needs, advisory support, MRV, WP3/WP4 monitoring activities and emerging policy and market frameworks.

7. Conclusions

D2.1 reports the outcomes of the first WP2 co-creation cycle carried out across the five LILAS4SOILS Living Labs. This cycle combined preparatory questionnaires, local co-creation workshops and harmonised reporting tools to identify barriers, opportunities, practical implementation challenges and co-developed solutions for Carbon Farming Practices.

The results show that stakeholders perceive carbon farming as a promising approach, but not as a simple or automatic solution. Across the Living Labs, CFPs were associated with potential benefits for soil health, nutrient efficiency, water regulation, erosion control, biodiversity, climate resilience, and farm productivity. At the same time, stakeholders emphasised that adoption depends on the ability to manage technical complexity, economic risk, policy uncertainty, and monitoring requirements.

A common core of CFPs emerged across the Living Labs, especially cover crops, reduced soil disturbance, improved rotations, nutrient management, manure or organic matter management, grassland management and agroforestry-related practices. However, the co-creation process also confirmed that these practices must be adapted to local conditions. The same CFP may face different constraints depending on soil type, climate, water availability, cropping system, livestock integration, machinery access, and market context.

The main barriers identified were systemic. They included technical knowledge gaps, limited advisory support, machinery and investment constraints, uncertain carbon market returns, insufficient or unstable incentives, administrative complexity, regulatory uncertainty and difficulties related to MRV. These barriers cannot be solved only through farm-level technical recommendations. They require coordinated action involving farmers, advisors, researchers, value-chain actors, policymakers, certification bodies, and other stakeholders.

The Living Labs also identified clear opportunities. These include strengthening advisory services, peer-to-peer exchange, farmer training, field demonstrations, digital and decision-support tools, improved MRV systems, supply-chain agreements, payments for ecosystem services, and policy mechanisms that reward both carbon sequestration and wider environmental benefits. The results therefore show that Living Labs can act as important interfaces between research, practice, policy and markets.

One of the strongest messages from the first cycle is that carbon payments alone are unlikely to drive large-scale adoption unless the economic framework becomes sufficiently attractive, predictable and accessible. Future carbon farming initiatives should therefore consider wider agronomic and economic benefits,

including improved soil fertility, reduced input needs, better water management, greater resilience to climatic stress and more stable productivity. Economic models should also consider the value generated across the whole agri-food chain and the contribution of farmers to ecosystem services.

The results of D2.1 provide a basis for the next project activities. They will support cross-fertilisation between Living Labs, the refinement of CFP implementation pathways at demo-site level, the development of practical and farmer-oriented MRV approaches, and the design of the following co-creation cycles. Future work should now focus on translating the co-developed insights into operational protocols, testing them under real farming conditions, and monitoring their technical, economic and environmental performance over time.

Overall, the first WP2 co-creation cycle confirmed the value of the Living Lab approach for carbon farming. It allowed LILAS4SOILS to move beyond generic discussion and to identify concrete barriers, opportunities and implementation needs across different territories. The next challenge will be to transform this shared understanding into locally adapted, credible and scalable carbon farming pathways.

8. References

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9. Annexes

Annex 1. Preparatory questionnaire template

A1.1 Purpose of the questionnaire templates

This annex reports the three preparatory questionnaire templates used during the first WP2 co-creation cycle. The questionnaires were designed to collect preliminary stakeholder inputs before the Living Lab co-creation workshops and to stimulate early reflection on Carbon Farming Practices (CFPs), soil health, barriers and opportunities for adoption, incentives, carbon markets, and the expected role of the Living Labs.

Three questionnaire versions were prepared to address different stakeholder macro-categories:

1. farmers and technical advisors;
2. agri-food industry and civil society;
3. research, schools, public authorities and foundations.

The templates shared a common purpose and structure, but the wording and focus of the questions were adapted to the role, expertise and expected contribution of each stakeholder group. Living Lab leaders could translate and locally adapt the templates where necessary, while preserving the common structure needed for cross-Living Lab comparison.

In the templates reported below, references to the local Living Lab are indicated as **[Living Lab name]**.

A1.2 Questionnaire for farmers and technical advisors

Introduction

This questionnaire is part of the LILAS4SOILS project and aims to collect inputs to prepare for the upcoming co-creation workshop and to stimulate early reflection on key themes related to Carbon Farming Practices (CFPs) and soil health. The feedback from all the stakeholders involved will help identify priorities, opportunities and challenges for developing practical and effective solutions within the Living Lab.

Initial profiling

You are responding as:

- Farm business, only if primary activity
- Technical consultant
- Other:

If a farm business, please indicate:

- Geographic location, region/province
- Main production system, e.g. cereals, forage crops, vegetables, livestock
- Farm size, hectares/livestock units

If a technical consultant, please indicate:

- Geographic area of activity

- Type of services offered, e.g. agronomic, livestock, environmental, management advice

1. Carbon Farming Practices

Carbon Farming Practices are those that aim at increasing CO₂ sequestration and/or reducing greenhouse gas emissions in agricultural and agroforestry systems. In the LILAS4SOILS Living Labs, these practices are mostly focused on nutrient management and on maintaining or increasing soil carbon in cultivated land.

1a. Which of the following practices do you consider most effective for sustainably increasing soil organic carbon? Select the 3 practices you consider the most effective.

- Optimising nitrogen fertilisation, organic/mineral
- Using nitrification inhibitors and/or biostimulants
- Introducing cover crops in rotations
- Improving crop rotations
- Reintroducing permanent multi-species grasslands
- Reducing tillage, minimum/strip tillage
- No-tillage farming
- Organic farming
- Agroforestry
- Other:

1b. Which Carbon Farming Practices do you already apply?

Open answer.

2. Enabling factors and barriers

The adoption of CFPs requires management changes and new costs, and it could entail certain risks, mainly related to investments and yields over the first few years after their application.

2a. Which factors do you consider most important to promote the uptake of CFPs? Maximum 3 answers.

- Professional technical advisory services
- Easy access to suitable inputs, machinery, contractors, seeds, crop protection products, etc.
- Frequent exchange of experiences with other farmers/technicians
- Financial incentives and/or economic support for buying new equipment
- Premium price for products
- Other:

2b. Which factors represent structural barriers that are difficult to overcome? Maximum 3 answers.

- Investment in machinery/equipment
- Inadequate farm size
- Unsuitable cropping system
- Limited flexibility in farm organisation/labour

- Lack of technical knowledge during the transition period
- Inclination to tradition vs innovation
- Absence of risk protection systems, consulting, insurance, contractors, etc.
- Lack of community sense or farmers' networks, isolation, limited collective action
- Unfavourable cost-benefit ratio
- Other:

3. Benefits of soil organic matter

Soil organic matter is essential for soil fertility and provides multiple co-benefits.

3a. Which benefits do you consider most relevant from soils rich in organic matter? Maximum 3 answers.

- Better water regulation and resilience to climate stress
- Reduced water and wind erosion
- Improved soil structure and workability
- Lower need for fertilisers/amendments
- Increased soil biodiversity and biological activity
- Higher yields and production stability
- Other:

3b. Do you consider the adoption of CFPs justified?

- Only with adequate financial incentives
- Yes, in any case, even without incentives
- It depends on the CFP: only the less demanding ones without incentives
- Yes, but gradually and with an adequate technical support network
- No, benefits do not outweigh costs/risks

3c. Which type of financial incentive would you prefer?

- Subsidies for adopting CFPs, e.g. RDP measures
- Payment for results, carbon credits
- Hybrid system, adoption support + credits generated
- Premium price for products grown with CFPs

4. Carbon credit market

EU Regulation 2024/3012 introduces certification of agricultural carbon credits, but the development of a real market will depend on ETS, supply-chain agreements and incentive measures.

4a. ETS in agriculture, carbon tax: would you consider it an interesting/desirable solution?

- Yes
- No

- Don't know

4b. RDP measures to promote supply-chain agreements between agribusiness and farmers: should this be pursued?

- Yes
- No
- Don't know

4c. Voluntary commercial agreements between agribusiness and farmers, even without EU regulation: are they preferable?

- Yes
- No
- Don't know

5. [Living Lab name] Living Lab

The [Living Lab name] Living Lab involves farmers, technicians, researchers, industry, public authorities and institutions to co-create and disseminate innovation.

5a. Which aspects should be strengthened to make a Living Lab more useful? Maximum 3 answers.

- Demonstration visits on farms applying CFPs
- Peer-to-peer exchanges among farmers
- Participation in conferences/fairs
- Training and refresher courses
- Exchanges with other Living Labs focused on similar issues, in the same country or in Europe
- Online library/resource centre, technical materials
- Targeted meetings with experts on specific topics
- Joint projects, RDP, national, EU
- Social groups/chats for experience sharing
- Other:

5b. Preference level for the following organisational options of the Living Lab. 1 = low; 5 = high.

- Coordination by a research institute
- Coordination by a public technical body or extension service
- Coordination by farmers' organisations
- Presence of an experimental site on CFPs
- One annual in-person meeting
- Thematic meetings on request, in-person/online
- Technical secretariat for information/contacts

- Creation of a Living Lab website
- Expansion of the Living Lab to national level
- Inclusion of farms with different production systems

A1.3 Questionnaire for agri-food industry and civil society

Introduction

This questionnaire is part of the LILAS4SOILS project and aims to collect inputs to prepare for the upcoming co-creation workshop and to stimulate early reflection on key themes related to Carbon Farming Practices (CFPs) and soil health. The feedback from all the stakeholders involved will help identify priorities, opportunities and challenges for developing practical and effective solutions within the Living Lab.

1. Role of carbon farming

Carbon Farming Practices are those that sequester CO₂ in soils and reduce greenhouse gas emissions, while contributing to environmental and climate adaptation benefits.

Question: How much do you think agriculture, through the implementation of CFPs, can contribute to tackling climate change?

- Little, the contribution will be marginal
- Partly, but not decisive
- A lot, it can play an important role
- Very much, it can be a pillar of climate mitigation strategies
- Other:

2. Technological innovation

Technologies, including genetic, digital, mechanical and chemical innovations, are often considered essential to improve the sustainability and resilience of agricultural systems.

Question: What is your assessment of their role in carbon farming?

- Not essential, management of tillage and carbon inputs are more important
- Useful, but not sufficient on their own
- They can strongly boost the adoption of CFPs
- Digital tools for precision management and monitoring
- Machinery for reduced tillage and cover crop management
- Biostimulants or inhibitors improving nutrient efficiency
- They are fundamental for the agro-ecological transition
- Genetic and biological innovations supporting diversity and resilience
- Integrated systems for nutrient recycling and soil health monitoring
- Digital platforms enabling knowledge sharing and co-design
- Other:

3. Limits and risks of carbon farming

Despite the benefits, carbon farming also involves risks, including high costs, uncertainties in carbon sequestration and lack of solid certification systems.

Question: Which aspect do you consider most critical?

- Uncertainty about carbon sequestration levels and stability of soil carbon stocks
- Uncertainty about crop yield and productivity of farms
- High project implementation costs
- Lack of investment in research and advisory services
- Absence of credible public certification systems
- Other:

4. Carbon credit market

EU Regulation 2024/3012 aims to develop a market for agricultural carbon credits, but appropriate tools and incentives are needed to make it work.

Question: Which measure do you consider most useful to support the development of such market?

- Introduce an ETS, Emission Trading Scheme, in agriculture
- Encourage supply-chain agreements between agribusiness and farmers
- Promote existing voluntary and commercial agreements
- Include dedicated measures in RDPs or national policies
- Introduce a premium price for products produced with Carbon Farming Practices
- Other:

5. Business opportunities and market risks

The development of a credit market may create opportunities for farmers, but also risks, such as low carbon credit prices, limited farmer benefits or delays in achieving direct emission reductions.

Question: In your opinion, what should be the priority?

- Reduce project implementation costs
- Ensure strict criteria for additionality and transparency
- Avoid credits replacing direct emission reductions
- Support insetting mechanisms, within supply chains, that provide clear incentives and financial security for farmers
- Establish public institutions to support certification and registries
- Other:

6. [Living Lab name] Living Lab

Living Labs are spaces for co-creation between farmers, industry, research and civil society to disseminate innovation.

Question: Which activities do you consider most important for the [Living Lab name] Living Lab?

- Demonstration visits and peer-to-peer exchanges
- Thematic meetings and workshops, in-person or online
- Collaboration with other Living Labs in the same country and in Europe
- Creation of a website and digital sharing tools
- Other:

A1.4 Questionnaire for research, schools, public authorities and foundations

Introduction

This questionnaire is part of the LILAS4SOILS project and aims to collect inputs to prepare for the upcoming co-creation workshop and to stimulate early reflection on key themes related to Carbon Farming Practices (CFPs) and soil health. The feedback from all the stakeholders involved will help identify priorities, opportunities and challenges for developing practical and effective solutions within the Living Lab.

1. Carbon Farming Practices

Carbon farming is based on the implementation of agricultural and forestry practices that contribute to carbon sequestration in soils and the reduction of greenhouse gas emissions.

Question: Which Carbon Farming Practices do you consider most effective or promising for sustainably increasing soil organic carbon in cultivated land?

- Optimising fertilisation, organic/mineral
- Introducing cover crops and crop rotations
- Reducing or eliminating tillage
- Organic farming
- Mulching
- Other:

2. Combination of practices

CFPs can be applied individually or in combination. Some studies suggest that the best results are achieved when multiple practices are integrated and applied together.

Question: In your opinion, which approach is most effective?

- A single practice may be sufficient
- Preferable to combine more than one
- Essential to combine more than one
- Depends on the cropping and farm context
- Other:

3. Digital technologies and Agriculture 4.0

Digital technologies, including precision farming, sensors and Decision Support Systems, are often considered key tools for the spread of CFPs.

Question: How important do you think they are for implementing carbon farming?

- Not essential, it can also be done without them
- Useful, but agronomic expertise matters more
- Very important to improve efficiency and outcomes
- Absolutely necessary to implement CFPs
- Other:

4. Research and experimentation

Supporting the adoption of CFPs requires investment in research and innovation.

Question: In which areas should research be strengthened?

- Selection and management of cover crops
- Crop rotations
- Organic farming
- Sensors and soil health indicators
- Long-term experiments
- On-farm application trials
- Other:

5. Opportunities and limits of carbon farming

Carbon farming refers both to the practices and to the related business model. This model can generate environmental and economic benefits, but also presents uncertainties, including market risks and implementation costs.

Question: Which aspect do you consider most critical for developing this model?

- Uncertainty about carbon sequestration and stability of the carbon stocks
- Implementation costs are too high
- Lack of experienced advisors
- Lack of solid certification systems
- Risk that the credit market delays direct emission reductions
- Other:

6. Carbon credit market

EU Regulation 2024/3012 aims to create a market for carbon credits from CFPs, but concrete tools and actors are needed to make it work.

Question: Which solution do you consider most useful to develop such market?

- Introduce an ETS, carbon tax, in agriculture

- Promote supply-chain agreements between agribusiness and farmers
- Support existing voluntary and commercial agreements
- Include dedicated measures in RDPs and national policies
- Other:

7. [Living Lab name] Living Lab

Living Labs are spaces for co-creation between farmers, researchers, institutions and businesses to foster the spread of innovation.

Question: Which activities do you consider most important for the [Living Lab name] Living Lab?

- Demonstration visits on farms and trial sites
- Peer-to-peer exchanges and training courses
- Thematic meetings and workshops, in-person or online
- Collaboration with other Living Labs in the same country and in Europe
- Other:

Annex 2. Summary of questionnaire responses by Living Lab

A2.1 Purpose and scope of the annex

This annex provides a summary of the preparatory questionnaire responses collected during the first WP2 co-creation cycle. The questionnaires were used as pre-workshop tools to collect stakeholder perceptions, identify priority Carbon Farming Practices (CFPs), and support the organisation of the co-creation workshops in the five LILAS4SOILS Living Labs.

The annex does not report the full question-by-question results of each questionnaire. Instead, it provides a harmonised summary of the response base, stakeholder macro-categories, Living Lab distribution and main messages emerging from the questionnaire phase. The detailed questionnaire templates are reported in Annex 1, while the workshop outputs informed by the questionnaire results are included in Annex 5.

A2.2 Overview of responses

Overall, the preparatory questionnaire phase collected 256 responses across the five Living Labs. Responses were grouped into three stakeholder macro-categories, corresponding to the three questionnaire versions used during the preparatory phase: farmers and technical advisors; agri-food industry and civil society; and research, schools, public authorities and foundations.

Table A2.1. Questionnaire responses by stakeholder macro-category.

Stakeholder macro-category	Number of responses	Share of total responses
Farming sector, including farmers and technical advisors	162	63%
Agri-food industry and civil society	38	15%
Research, schools, public authorities and foundations	56	22%
Total	256	100%

The largest respondent group was the farming sector, including farmers and technical advisors. This reflects the operational focus of WP2, which requires direct input from actors involved in the implementation of CFPs at farm and demo-site level. At the same time, the involvement of agri-food actors, civil society, researchers, public authorities, schools and foundations ensured that the questionnaire phase retained the multi-actor perspective of the Living Lab approach.

A2.3 Responses by Living Lab

The number of responses varied across Living Labs, reflecting differences in stakeholder networks, dissemination strategies, local engagement processes and questionnaire implementation. SHARE collected the largest number of responses, followed by IBERSOILL, SOFRALL, RAGILL and GRECF².

Table A2.2. Questionnaire responses by Living Lab and stakeholder macro-category.

Living Lab	Farming sector, including farmers and technical advisors	Agri-food industry and civil society	Research, schools, public authorities and foundations	Total responses
SHARE – Italy	76	11	17	104
IBERSOILL – Spain/Portugal	48	8	15	71
SOFRALL – France	23	12	5	40
RAGILL – Israel	15	7	9	31
GRECFL ² – Greece	0	0	10	10
Total	162	38	56	256

Table A2.3. Distribution of questionnaire responses by Living Lab.

Living Lab	Total responses	Share of total responses
SHARE – Italy	104	41%
IBERSOILL – Spain/Portugal	71	28%
SOFRALL – France	40	16%
RAGILL – Israel	31	12%
GRECFL ² – Greece	10	4%
Total	256	100%

These figures should be interpreted as a harmonised synthesis of the questionnaire materials made available by each Living Lab. In some cases, local stakeholder categories or response files required aggregation into the three common macro-categories used in D2.1. For example, technical consultants and advisors were grouped within the farming sector, while public authorities, schools, foundations and research organisations were grouped within the institutional and research macro-category.

A2.4 Main messages emerging from the questionnaires

The questionnaires confirmed a generally positive perception of carbon farming, while also highlighting several uncertainties and implementation barriers. Across stakeholder categories and Living Labs, respondents recognised the potential contribution of CFPs to climate action, but also linked carbon farming to broader agronomic and environmental benefits, including soil health, soil organic matter, nutrient efficiency, erosion control, water regulation, biodiversity and resilience.

The practices most frequently perceived as relevant were cover crops, reduced or no-tillage, improved crop rotations and fertilisation optimisation. These practices were also among the most frequently discussed during the subsequent workshops. However, the questionnaire results also suggested an adoption gap: some practices were recognised as effective but were not always widely implemented, indicating constraints related to costs, knowledge, machinery, labour organisation, risk perception or farm structure.

The main enabling factors identified by respondents were access to technical advisory services, exchange of experiences with other farmers and advisors, financial support, and access to suitable inputs or machinery. These results indicate that carbon farming adoption depends on a combination of technical support, peer learning and economic instruments.

The main barriers identified through the questionnaires concerned machinery and equipment investment, lack of technical knowledge during the transition phase, uncertainty about cost-benefit ratios, persistence of conventional practices, and limited confidence in carbon market mechanisms. Respondents also highlighted uncertainty regarding carbon sequestration measurement, permanence of soil carbon, certification procedures, project costs and the availability of qualified advisors.

The carbon credit market emerged as a potential opportunity, but also as an area of considerable uncertainty. Respondents generally showed interest in economic incentives, but expressed concerns about low or unstable carbon prices, additionality, transparency, certification, registry systems and the risk that carbon credits may not adequately reward farmers' efforts. Support through public policies, supply-chain agreements, payments for ecosystem services and hybrid incentive mechanisms was therefore considered particularly relevant.

Finally, the questionnaires confirmed the expected role of Living Labs as spaces for practical learning and exchange. Demonstration visits, peer-to-peer exchanges, thematic meetings, training activities, field visits and collaboration with other Living Labs were repeatedly identified as priority activities. These results directly informed the design of the co-creation workshops and the discussion of practical implementation needs.

Table A2.4. Main questionnaire messages and implications for WP2.

Topic	Main message emerging from questionnaires	Implication for WP2
Climate and soil health	Carbon farming was recognised as relevant for climate action, but also for soil health, productivity and resilience.	CFPs should be framed not only as carbon measures, but also as agronomic and soil-health strategies.
Priority CFPs	Cover crops, reduced tillage, crop rotations and fertilisation optimisation emerged as priority practices.	These practices should remain central in Living Lab discussions and cross-fertilisation activities.
Adoption gap	Some practices were perceived as effective but were not always widely applied.	WP2 should investigate practical barriers preventing implementation.
Enabling factors	Advisory services, peer exchange, financial support and access to equipment were repeatedly identified.	Future activities should combine technical, social and economic support.
Research needs	On-farm trials, long-term experiments and soil health indicators were considered important.	Research should support practical evidence generation and farmer-oriented monitoring.
Main barriers	Machinery costs, knowledge gaps, transition risks and uncertain profitability were recurrent constraints.	CFP implementation requires risk reduction, technical support and clearer economic models.

Carbon market	Carbon credits were seen as an opportunity, but also as uncertain and potentially insufficient.	Carbon farming should be linked to broader incentives and ecosystem service recognition.
Role of Living Labs	Demonstration, training, peer learning and collaboration were priority expectations.	Living Labs should act as continuous learning and knowledge-exchange platforms.

A2.5 Living Lab-specific questionnaire summaries

SHARE – Italy

SHARE collected 104 questionnaire responses, with a strong representation of the farming sector, including farmers and technical advisors. The responses reflected the operational orientation of the Italian Living Lab and its focus on arable systems, conservation agriculture, manure and slurry management, nutrient efficiency, cover crops, reduced tillage, no-tillage, rice systems and crop diversification.

The main messages from SHARE concerned the need to connect CFPs with practical farm management and economic feasibility. Respondents recognised the value of soil organic matter and soil health, but also highlighted barriers related to machinery, transition risks, technical knowledge, regulatory complexity and carbon market uncertainty. Advisory support, peer-to-peer learning, field demonstrations and clearer economic scenarios were identified as important conditions for adoption.

IBERSOILL – Spain/Portugal

IBERSOILL collected 71 questionnaire responses, covering a broad range of farming systems and stakeholder types. The Living Lab includes arable crops, livestock systems, sheep farming, woody crops and agroforestry, and this diversity was reflected in the questionnaire results.

The responses highlighted the relevance of CFPs such as agroforestry, grazing management, manure use, nutrient planning, cover crops, improved rotations, grassland management and reduced soil disturbance. Main barriers concerned technical knowledge, machinery access, labour constraints, cost-benefit uncertainty and weak farmer networks. Opportunities were linked to peer learning, field demonstration, livestock integration, agroforestry systems and the possibility of connecting carbon farming with drought resilience, erosion control, biodiversity and pasture productivity.

SOFRALL – France

SOFRALL collected 40 questionnaire responses, with contributions from farmers, agri-food and civil society actors, and research or institutional stakeholders. The questionnaire results were closely linked to the Living Lab focus on fertilisation, cover crops, tillage reduction and pasture management.

Respondents highlighted the importance of improving soil organic matter, soil structure, erosion control and nutrient management. At the same time, they identified barriers related to cover crop complexity, uncertainty about agronomic benefits, weed control, soil diagnosis, economic risks and carbon quantification. The results suggest a strong need for practical advisory support, soil assessment tools, field-based demonstrations and MRV approaches that are understandable and useful at farm level.

RAGILL – Israel

RAGILL collected 31 questionnaire responses, involving farmers and technical actors, agri-food and civil society stakeholders, and research, policy or institutional actors. The responses reflected the specific climatic, agronomic and market conditions of the Israeli Living Lab.

Relevant CFPs included manure and compost management, nutrient planning, cover and service crops, reduced or no tillage, crop rotations and pruning residue management. Respondents highlighted uncertainty about yield effects, economic returns, advisory capacity, regulatory conditions, market demand and MRV. The questionnaire results also confirmed the importance of trusted knowledge translation, demonstration activities, professional support and data collection as tools for building confidence among farmers and stakeholders.

GRECFL² – Greece

GRECFL² collected 10 questionnaire responses, mainly from research, institutional or knowledge-related stakeholders. The smaller and more specialised response base should therefore be interpreted with caution and should not be considered fully representative of all stakeholder categories in the Greek Living Lab.

The responses nevertheless provided useful inputs for the workshop discussion. The main CFPs addressed included cover crops, reduced soil disturbance, nutrient management, organic inputs and crop rotations. The main issues concerned soil structure, compaction, nutrient management, interpretation of soil data, limited diversification and uncertainty about carbon outcomes. The results pointed to the need for locally adapted combinations of practices, practical decision-support tools, farmer-oriented experimentation and MRV approaches connected to soil health and nutrient management.

A2.6 Lessons learned for future questionnaire standardisation

The first questionnaire phase was useful for stimulating stakeholder reflection, identifying priority topics and supporting the design of the co-creation workshops. However, the process also highlighted the need for stronger standardisation in future pre-workshop data collection.

Although all Living Labs worked within a common methodological framework, differences in questionnaire implementation, stakeholder categorisation, response coding, local adaptations and reporting formats made cross-Living Lab comparison more complex. For this reason, future questionnaires or pre-workshop surveys should be more standardised, while still allowing limited local adaptation.

The second co-creation cycle should therefore use a shorter and more targeted questionnaire structure, built around a common core of questions applied by all Living Labs. This common core should include harmonised stakeholder categories, standard response options, clear definitions of CFPs, consistent questions on barriers and opportunities, and a shared template for data export and reporting. Local Living Lab-specific questions could still be added, but should be clearly separated from the common section.

Improved standardisation would make it easier to compare results across Living Labs, assess changes over time, identify common priorities, and support the cross-Living Lab synthesis required in future WP2 deliverables. It would also reduce the risk of inconsistent classification and would improve the robustness of the evidence base used for co-creation, implementation planning and monitoring.

At the same time, standardisation should not reduce the flexibility of the Living Lab approach. The objective should be to combine a common comparable structure with sufficient space for local priorities, context-specific CFPs and stakeholder-specific issues. In this way, future pre-workshop surveys can better support both local co-creation and project-level analysis.

Annex 3. Co-creation workshop agendas and dates

  Funded by the European Union		
PROGRAMA		
	29 JANEIRO 2026	29 ENERO 2026
10:30	Receção e registo	Recepción y registro
11:00	Sessão de abertura	Mensaje de bienvenida
11:15	LILAS4SOILS & IBERSOILL: onde estamos e o que vem a seguir <i>Laura Birrento, F4S & Eduardo Velasquez, ITACyL</i>	LILAS4SOILS & IBERSOILL: Dónde estamos y hacia dónde vamos <i>Laura Birrento, F4S & Eduardo Velasquez, ITACyL</i>
11:30	Apresentações dos agricultores	Presentaciones de los agricultores
12:00	1ª sessão de cocriação: Barreiras e oportunidades na adoção das práticas agrícolas de carbono	1ª sesión de co-creación: Barreras y oportunidades en la adopción de las Prácticas de Agricultura del Carbono
13:30	Almoço & Networking	Comida & Networking
15:00	Palestra: O Mercado Voluntário de Carbono em Portugal: o que é e como funciona <i>Tiago Domingos, Instituto Superior Técnico, Univ. Lisboa</i>	Presentación: El mercado voluntario de carbono en Portugal: qué es y cómo funciona <i>Tiago Domingos, Instituto Superior Técnico, Univ. Lisboa</i>
15:30	Palestra: Perspectivas da agricultura de carbono no quadro regulamentar da UE <i>Inmaculada Carceller García, Ministerio de Agricultura, Pesca y Alimentación</i>	Presentación: Perspectivas de la agricultura de carbono en el marco regulatorio de la UE <i>Inmaculada Carceller García, Ministerio de Agricultura, Pesca y Alimentación</i>
16:00	Coffee break	Coffee break
16:15	2ª sessão de cocriação: Co-desenvolvimento de práticas agrícolas de carbono para cada local de demonstração	2ª sesión de co-creación: Co-desarrollo de las prácticas de agricultura de carbono para cada sitio demostrativo
20:00	Jantar Convívio IBERSOILL	Cena IBERSOILL
	30 JANEIRO 2026	30 ENERO 2026
9:00	Visita a demo-site / Visita el sitio de demostración IBERSOILL - Real Idanha, Idanha-a-Velha	
11:15	Visita a demo-site / Visita el sitio de demostración IBERSOILL - Monte Silveira Bio, Ladoeiro	
		

Figure A3.1. IBERSOILL, PT-SP workshop agenda



LILAS4SOILS
 CARBON FARMING



RAGILL
 REGENING ISRAEL
 LIVING LAB



Funded by
 the European Union

התכנסות 9:30-10:00

חלק ראשון 10:00-12:30

עדכון על פרויקט LILAS4SOILS
 סטטוס פרויקט, קולות קוראים ושיתופי פעולה
 עידן קופלר ואריק בן מאיר, צוות ליבה מעבדת RAGILL

מה למדנו עד כה על ה-Living Lab
 כמסגרת להעברת ידע ופיתוח משותף קדימה
 אורי בן הרצל, מנכ"ל מיגל

מגמות גלובליות בעולם תעודות הכחם
 בפרויקטים חקלאיים
 מירי קולניק COO NIBBANA Israel
 (הזרוע הסביבתית של קבוצת גרנות)

משולחן היחידה הסביבתית:
 פרויקטים אזוריים לקידום חקלאות ידידותית לסביבה, לתושבים ולאקלים
 רונן פלר, ד"ר הילה שגיא, יחידה סביבתית מ.א. הגליל העליון

שולחנות עגולים
 חסמים והזדמנויות לחקלאות פחמנית

12:30-13:15 – הפסקה – ארוחת צהריים

13:15-15:30 – **חלק שני**

הצגת קמפיין דיגום קרקע בחלקות הפרויקט
 פרופ' איגי לטאור, מיגל

פרקטיקות חקלאות פחמנית
 בפרויקט LILAS4SOILS
 אריק בן מאיר, צוות ליבה מעבדת RAGILL

שולחנות עגולים
 דיון עומק בנושא הפרקטיקות המיושמות בשטח

סיכום

סדנת עבודה משותפת של RAGILL

המעבדה הישראלית ליישום פרקטיקות חקלאות פחמנית וחקלאות מחדשת במסגרת פרויקט LILAS4SOILS+



יום חמישי

19.2.2026

09:30-15:30

מארג מבואות החרמון

צומת כוח







Figure A3.2. RAGILL, Israel workshop agenda




Funded by
the European Union






SHARE
UNA VIA PER IL
CARBON FARMING

Mercoledì 25 febbraio 2026, ore 09:30
 Università Cattolica del Sacro Cuore
 Strada Anselma, 9 - 29122 Piacenza
 Centro congressi - "Il Fienile - Residenza Gasparini" ([Google maps](#))

IL CONTESTO
 Con l'obiettivo della neutralità climatica dell'UE entro il 2050, la Commissione ha emanato il Regolamento (UE) 2024/3012 che delinea anche per l'agricoltura le strategie da adottare per contrastare il cambiamento climatico (Carbon Farming). In questo contesto, la Soil Mission dell'UE definisce i Living Lab come ecosistemi di ricerca e innovazione transdisciplinare, incentrati sull'utente e basati sul territorio per progettare, testare, monitorare e valutare congiuntamente soluzioni per migliorare la salute del suolo.

LILAS4SOILS
 Finanziato dall'UE, il progetto riunisce agricoltori, ricercatori, industrie e autorità pubbliche per sviluppare sistemi agricoli sostenibili attraverso i Living Lab. Con 24 partner e oltre 80 agricoltori, testa pratiche innovative su numerosi siti, affrontando salute del suolo, agroecologia, sequestro di CO₂ e uso responsabile delle risorse.

SHARE Innovation Lab
 Tra i primi Living Lab italiani, include 20 siti nella Pianura Padana. Le aziende coinvolte spaziano da cerealicole e zootecniche a impianti di biogas, sperimentando varietà di soluzioni per un'agricoltura resiliente, efficiente, sostenibile.

OBIETTIVO DELL'INCONTRO
 Confronto con gli stakeholders sulle barriere e opportunità per l'adozione del Carbon Farming come sistema lungo le principali filiere agro-alimentari.

PROGRAMMA

09:30 Registrazione dei partecipanti

10:00 Apertura dei lavori
Andrea Fiorini – Università Cattolica del Sacro Cuore

10:10 Aggiornamenti sulla CRCF Regulation
Valeria Forlin – Commissione Europea (DG CLIMA)

10:20 Come funziona un progetto di Carbon Farming?
Andrea Ferrarini – Università Cattolica del Sacro Cuore

10:30 Cosa pensano gli stakeholders del Carbon Farming?
Nicolaj Franceschi – Università Cattolica del Sacro Cuore

10:45 Prima sessione di confronto: il Carbon Farming come sistema
Moderano:
Vincenzo Tabaglio – Università Cattolica del Sacro Cuore
Stefano Brenna – Ricercatore indipendente

13:00 Pranzo a buffet

14:30 Seconda sessione di confronto: le pratiche di Carbon Farming
Moderano:
Andrea Fiorini – Università Cattolica del Sacro Cuore
Vincenzo Tabaglio – Università Cattolica del Sacro Cuore

16:30 Conclusione dei lavori

PARTNERS






La partecipazione in presenza è aperta, previa registrazione. Iscriviti utilizzando il [link](#) oppure scansiona il QR-code dedicato.
 Aggiungi l'evento alla tua agenda ([link](#))



Segreteria:
 SHARE Innovation lab (share.innovationlab@gmail.com)
 Tel. 0523 599202

Funded by the European Union
 (Grant no. 101157414)

Figure A3.3. SHARE, Italy (IT) workshop agenda

Bonjour à tous,

Voilà les informations concernant l'atelier du 11 décembre 2025 à Montpellier. Merci de lire ce mail attentivement.

Date : 11 décembre 2025

Horaires : 9h30 - 16h30

Lieu : Halle de l'Innovation,

10 place Françoise Héritier,

34000 Montpellier

Parking :

- Parking *Odysseum* (puis accès par tram/navette) : [point GPS](#)
- Parking de la *gare Sud de France* (5 minutes à pied) : [point GPS](#)

Ces parkings sont **payants**.

Covoiturage :

Cette [Feuille Excel](#) vous offre la possibilité de proposer ou de rechercher une place dans une voiture, parmi les participants de l'atelier.

Programme :

9h30-10h : introduction, résultats des questionnaires, update du projet, du LL français et des autres LL

10h-10h45 : présentation des sites de démonstration

10h45-11h : pause café

11h-12h30 : discussions thématiques

- Fertilisation
- Couverts végétaux
- Réduction du travail du sol
- Gestion des prairies

12h30-13h30 : pause repas

13h30-14h : trajet

14h-16h : Visite de la SCEA de la Pommeraie

16h-16h30 : Conclusions, attentes pour la suite

Figure A3.4. SOFRALL, France (FR) invitation email

Annex 4. Reporting tables used for Task 2.1 and Task 2.2

In this annex are provided the templates given by WP2 for reporting the results from co-creation sessions 1 (Task 2.1) and session 2 (Task 2.2).

Instructions for Task 2.1: Identification of macro-environmental barriers and opportunities for implementation of Carbon Farming Practices (CFPs)

Aim of the task: To assess regional cultural, gender, regulatory, economic, and market barriers affecting carbon farming adoption. It will also identify key challenges and opportunities for its effective implementation.

Objective of the morning sessions: 1. Align stakeholders on key concepts and project objectives, and 2. Identify macro-environmental barriers, opportunities associated with Carbon Farming

Guidelines for reporting:

1. Fill in the information regarding your LL, working group reference, number of stakeholders by category (columns A-D)
2. Provide the external barriers to Carbon Farming for each category (columns E-H)
3. Provide the external opportunities to Carbon Farming for each category (columns J-M)
4. Score (Drop-down list) between 5 (Highly important), 4 (Important), 3 (Neutral), 2 (Less important), 1 (Not important)
5. Additional comments can be provided (columns I and N)

Categories of barriers and opportunities:

- A. Technical: Monitoring tools, innovation, remote and proximal sensing tools, time-scale of soil carbon sequestration
- B. Economic/Market: Market volatility, investment costs, capacity building
- C. Socio-cultural: Community engagement, cultural resistance, training needs
- D. Admin/policy/regulation - Compliance, Certification, regulatory frameworks, incentives (EU Green Deal), ISO standards compliance

Table A4.1. Table for reporting co-creation session 1 from Task 2.1

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)								What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
				A. Technical	Score	B. Economic /market	Score	C. Socio-cultural	Score	D. Admin/policy /regulation	Score	A. Technical	Score	B. Economic /market	Score	C. Socio-cultural	Score	D. Admin/policy /regulation	Score

Instructions for Task 2.2: Evaluation and co-development of practical carbon farming solutions

Aim of the task: To identify operational challenges, define practical solutions, and produce concrete outputs that support the implementation, monitoring, and improvement of CFPs in each demo-site.

Objective of the afternoon sessions - Co-Creation Workshop

1. Work with farmers, technicians, and innovation actors to refine CFPs at demo-site level
2. Identify practical problems, co-develop solutions, clarify MRV requirements, and define next-step actions
3. Produce homogeneous and comparable outputs across all Living Labs to feed Deliverable D2.1, WP2 synthesis activities, and inputs to WP3/WP4

Table A4.2. Guidelines for reporting co-creation session 2 from Task 2.2

1. Fill in the general information for each demo-site Indicate: - Living Lab name - Demo-site name - Working group reference (e.g. farm type, agroecosystem) - Facilitator name - Participants involved (farmers, technicians, advisors/pioneers)	2. Complete the “Problem Summary” section Identify the main operational barriers affecting the implementation of the CFP in this demo-site. Examples: management constraints, technical limitations, soil-related issues, equipment, labour, coordination, MRV difficulties. Keep entries short and specific.	3. Complete the “Solution Summary” section For each problem, summarise the practical and feasible solutions co-developed during the session. This may include changes in practice, new tools, improved coordination, or support needs.	4. Provide the “Practical Protocol” information Describe or adapt a simple operational protocol for implementing the CFP in this demo-site. Include: - Key steps - Required tools/equipment - Timing (when performed) - Any local adaptations needed If a protocol already exists, indicate modifications or confirmations.	5. Fill in the “MRV Requirements” section Specify what needs to be monitored to implement/validate the CFP, including: - Type of data - Frequency of data collection - Responsibility (who collects it) - Tools/methods (if discussed) Keep the focus on what is feasible at demo-site level.	6. Provide the list of “Training Needs” Indicate skills or knowledge farmers/technicians need to implement or monitor the CFP effectively, e.g.: - Machinery use - Sampling methods - Digital tools - Agronomic training Mention who could provide the training (if known).	7. Complete the “Follow-Up Actions” section This is essential for continuity. Specify: - Concrete actions to be taken after the workshop - Person(s) responsible - Deadlines / indicative timing This sheet will be used to track progress in WP2.
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Table A4.3. Table for reporting co-creation session 2 from Task 2.2

Name of LL	Demo-site	Problem Summary	Solution Summary	Practical Protocol (draft/adapted)	MRV Requirements	Training Needs	Follow-up Actions (Who / What / When)
(Name)	(Name/code)	Main barriers affecting implementation	Proposed solutions	Key steps, tools, timing	Data needed, frequency, roles	Skills needed, training sources	Actions, responsibilities, deadlines

Annex 5. Completed reporting tables by Living Lab

This annex provides the reporting tables on the macro-environmental barriers and opportunities for the implementation of Carbon Farming Practices (CFPs), as identified in Task 2.1. It also includes the tables presenting the evaluation and co-development of practical carbon farming solutions under Task 2.2, based on the outcomes of the co-creation workshops. In addition, the tables report the importance scores assigned to the identified barriers and opportunities using a five-point scale: Highly important (5), Important (4), Neutral (3), Less important (2), and Not important (1). The tables were provided by all LLs and contain information as reported to WP2.

Table A5.1. Table from SHARE, Italy (IT) for reporting the co-creation session 1 in Task 2.1, on macro-environmental barriers for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
SHARE Innovation lab				Agronomic and field management challenges during the transition phase, including higher weed pressure, temporary yield variability, soil compaction or waterlogging issues, and more complex residue and nutrient management.	5	Insufficient economic return from carbon credits compared to the costs of implementing carbon farming practices, particularly in the short term.	5	Lack of technical knowledge and practical skills among farmers, advisors and farm workers to correctly implement and manage new practices and technologies.	5	Regulatory uncertainty regarding permanence, liability and ownership of carbon credits, particularly in cases of farm management changes over time.	5
SHARE Innovation lab				Difficulty in integrating multiple practices into a coherent system (e.g. rotations, cover crops, reduced tillage and manure management), especially in livestock or mixed systems where operational constraints can create trade-offs between practices.	5	High initial investment costs for machinery, advisory services and organizational changes required to shift towards regenerative or conservation agriculture systems.	5	Limited availability of trained personnel able to operate advanced machinery, digital tools and precision agriculture systems.	4	Lack of alignment between national and regional authorities on rules and implementation of carbon farming schemes.	5
SHARE Innovation lab				Lack of standardized and scalable technical solutions that work across different soil types, climatic conditions and farm structures, making it difficult to provide clear and replicable recommendations.	5	Uncertainty about the long-term profitability of carbon farming due to unstable credit prices and evolving policy frameworks.	5	Cultural resistance to change from conventional farming approaches to regenerative or conservation-based management systems.	4	High administrative burden and complexity of certification and reporting procedures, which can discourage participation.	5
SHARE Innovation lab				Complexity and cost of monitoring and verifying carbon sequestration (MRV), including soil sampling, data management and reporting requirements for certification schemes.	4	Limited or inconsistent markets for crops needed in diversified rotations (e.g. legumes or cover crop seeds), which can discourage agronomic diversification.	4	Limited awareness and understanding of carbon farming among citizens and consumers, reducing social support for these practices.	3	Limited recognition of early adopters ("early movers") who have already implemented sustainable practices before the introduction of carbon farming schemes.	4
SHARE Innovation lab				Limited availability or adaptability of machinery suitable for conservation agriculture practices (e.g. strip-till, precision seeding), particularly on heavy or silty soils.	4	Low willingness of consumers or buyers to pay a premium price for products derived from carbon farming or sustainable practices.	3	Negative public perception of certain agricultural sectors (e.g. livestock farming), which can undermine trust and recognition of sustainability efforts.	3	Rigid regulatory constraints affecting farm operations (e.g. fixed manure spreading windows), which may conflict with optimal agronomic management.	4
SHARE Innovation lab				High variability of agronomic results depending on local conditions, which increases uncertainty about the expected performance of carbon farming practices.	3	Lack of clear mechanisms to reward ecosystem services other than carbon sequestration, such as soil fertility, biodiversity or water regulation.	4	Difficulty in communicating the environmental benefits of existing good practices that farmers are already applying.	3	Slow development or unclear functioning of official carbon registries and certification infrastructures.	4
SHARE Innovation lab				Operational constraints in manure and digestate management, including timing, soil trafficability and compatibility with reduced tillage systems.	4	Economic vulnerability of some agricultural sectors (e.g. livestock or arable commodities), reducing the capacity to invest in new practices.	4	Limited opportunities for peer-to-peer learning, demonstration and exchange of practical experience among farmers.	3	Fragmentation of policies across agriculture, climate and environmental sectors, creating uncertainty for farmers and supply chains.	3
SHARE Innovation lab				Limited usability or interoperability of digital tools and decision support systems, especially for small and medium-sized farms.	2	Temporary yield reductions or additional operational costs during the transition period, which can create short-term financial risks.	3	Perception of carbon farming as complex, risky or bureaucratic, especially among smaller farms.	3	Limited long-term policy stability, reducing confidence in the continuity of support measures.	3

Table A5.2. Table from SHARE, Italy (IT) for reporting the co-creation session 1 in Task 2.1, on macro-environmental opportunities for implementation of Carbon Farming Practices (CFPs)

Name of the LL	What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
	A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
SHARE Innovation lab	Improvement of soil fertility, structure and organic matter content through regenerative practices such as cover crops, reduced tillage and diversified rotations.	5	Creation of added value through certified sustainable products and climate-friendly production systems recognized by consumers and supply chains.	5	Strong interest and openness to innovation among younger farmers and new entrants to agriculture.	5	Development of a clear European regulatory framework for carbon farming, providing common rules and increasing confidence in the system.	5
SHARE Innovation lab	Increased resilience of farming systems to climate variability, including drought and extreme rainfall events.	5	Strengthening supply chain stability and reducing dependence on imports by maintaining soil productivity and long-term yield levels.	5	Creation of Living Labs and demonstration farms that provide real-world examples of carbon farming practices.	5	Establishment of official carbon registries and certification systems to ensure transparency and credibility of carbon credits.	5
SHARE Innovation lab	Better management and valorization of manure and digestate, transforming waste streams into valuable soil amendments and nutrient sources.	5	Diversification of farm income through payments for ecosystem services, carbon credits or sustainability incentives.	4	Development of farmer networks and knowledge-sharing platforms that support peer learning and collaboration.	4	Integration of carbon farming into CAP instruments and Rural Development Programs, including dedicated funding schemes.	5
SHARE Innovation lab	Adoption of precision agriculture technologies (e.g. sensors, drones, variable-rate applications) supporting more efficient resource use.	4	Development of differentiated value chains and sustainability branding strategies.	4	Improved communication of the environmental role of agriculture and its contribution to climate mitigation.	4	Alignment of regional and national policies supporting climate-smart agriculture and soil management.	4
SHARE Innovation lab	Integration of digital tools and farm management systems for monitoring soil health, inputs and environmental performance.	4	Integration of carbon farming practices into existing certification schemes or quality labels.	4	Recognition of farmers as providers of ecosystem services beneficial to society.	4	Availability of financial incentives and public support measures for adopting sustainable practices.	4
SHARE Innovation lab	Innovation in nutrient management, including the use of inhibitors and targeted fertilization strategies.	4	Access to new markets, including export markets with higher demand for sustainable products.	4	Strengthening collaboration between farmers, researchers, advisors and supply chain actors.	4	Simplification of administrative procedures and reporting requirements.	5
SHARE Innovation lab	Development of locally adapted technical solutions through experimentation in Living Labs and demonstration farms.	5	Improved farm competitiveness through increased productivity and reduced production risks.	4	Increased attractiveness of agriculture as a modern and innovative sector.	4	Support for collective projects and supply chain initiatives promoting carbon farming.	4
SHARE Innovation lab	Increased efficiency in the use of inputs such as fertilizers, water and energy.	4	Long-term reduction of production costs through improved soil health and input efficiency.	3	Greater public awareness of sustainable agriculture and climate-smart practices.	3	Recognition of ecosystem services within agricultural and environmental policies.	4

Table A5.3. Table from SHARE, Italy (IT) for reporting the co-creation session 2 in Task 2.2, on the evaluation and co-development of practical carbon farming solutions

Name of LL (Name)	Name of DS (Name)	Demo-site (Code)	Problem Summary Main barriers affecting implementation	Solution Summary Proposed solutions	Practical Protocol (draft/adapted) Key steps, tools, timing	MRV Requirements Data needed, frequency, rules	Training Needs Skills needed, training sources	Follow-up Actions (Who / What / Actions, responsibilities, deadlines
SHARE Innovation lab	Massimo Della Bona	IT_04	Regulatory constraint on slurry spreading due to the 90-day ban period, combined with the risk of soil compaction when entering the field under wet conditions and the need to maintain soil structure under reduced tillage conditions.	Adapt timing and method of slurry application to field conditions, using flexible equipment options (umbilical or tanker) and applying slurry when soil bearing capacity is adequate.	Apply slurry after forage harvest when soil conditions allow field traffic. Choose distribution system based on soil moisture. Use shallow or localized incorporation compatible with reduced tillage. Avoid operations under wet conditions.	Periodic analysis of slurry nutrient content (mainly N, optionally P) to support better nutrient management decisions.	Practical training on machinery adjustment and timing of slurry application under different soil moisture conditions.	Record field conditions and operational choices during slurry spreading and discuss results at the end of the season.
SHARE Innovation lab	Matteo Ruggeri	IT_20	Low soil bearing capacity in reclaimed silty soils limits machinery operations and increases weed management challenges under conservation agriculture systems.	Introduce a temporary forage phase (e.g. alfalfa or similar crop) within the rotation to improve soil structure and maintain continuous soil cover.	Overseed forage crop into cereal crop during the growing season. Maintain forage cover for at least one season. Manage mowing and residues to maintain soil cover. Return to arable crops once soil trafficability improves.	Simple field observation of soil structure, soil cover and biomass production of the forage phase.	Guidance on selecting suitable cover crops or forage species for local soil and climate conditions.	Evaluate soil trafficability and weed pressure at the end of the rotation phase.
SHARE Innovation lab	Mauro Grandi	IT_01	Transition to no-till on clay soils can lead to compaction and water stagnation in the first years, especially when machinery is not adapted to reduced tillage systems.	Use a multi-year forage or cover crop phase to stabilize soil structure before fully implementing continuous no-till.	Maintain forage crop for multiple seasons. Avoid deep tillage during the forage phase. Gradually introduce no-till sowing once soil structure improves. Adjust seeding equipment progressively.	Periodic observation of soil structure and organic matter trends using available farm data.	Practical training on transition management to no-till systems and residue management.	Share experience with other farmers through field visits or group discussion within the Living Lab.
SHARE Innovation lab	Michèle Conle	IT_11	Limited crop rotation options in rice systems increase pest pressure and reduce soil resilience, particularly where continuous rice cultivation is practiced.	Introduce cover crops during fallow periods to improve soil health and reduce pest pressure while maintaining soil cover.	Establish cover crop after rice harvest or before the next crop cycle. Select species suited to local conditions and management constraints. Terminate cover crop before field preparation for rice. Adjust sowing method depending on soil conditions.	Visual monitoring of cover crop establishment and soil cover during the fallow period.	Technical support on the selection and management of cover crops in rice-based systems.	Assess the feasibility of maintaining cover crops in the rotation and document practical constraints encountered.
SHARE Innovation lab	Marco Aurelio Pasti	IT_14	Operational difficulties in strip-till systems on silty soils, particularly in wet years, combined with challenges in machinery adjustment and field traffic management.	Adapt soil operations and digestate application strategies according to seasonal conditions and field accessibility.	Adjust tillage depth and timing depending on soil moisture. Apply digestate when soil conditions allow safe field traffic. Maintain flexibility in operation timing. Avoid repeated passes under wet conditions.	Observation of soil surface condition and presence of ruts after field operations.	Practical training on machinery setup and adjustment in variable soil conditions.	Continue applying adaptive management strategies and review operational outcomes at the end of the season.
SHARE Innovation lab	Paolo Caprioli	IT_16	Limited slurry availability on light soils requires efficient nutrient use and integration with crop rotation strategies to maintain soil fertility.	Combine crop rotation, cover crops and targeted slurry application to maximize nutrient efficiency and maintain continuous soil cover.	Maintain diversified crop rotation including cover crops where feasible. Apply slurry at key crop stages. Adjust application rates according to crop needs. Maintain soil cover whenever possible.	Basic monitoring of crop performance and soil cover during the season.	Guidance on efficient slurry use and nutrient management under reduced tillage systems.	Compare crop performance under strip-till and conventional management and discuss results within the Living Lab.
SHARE Innovation lab	Anna Trettenaro	IT_08	Systemic barriers to continuous no-till adoption, including limited technical knowledge, difficulty in accessing suitable machinery and lack of stable markets for rotation crops.	Strengthen collaboration and knowledge exchange among farmers to support practical implementation of conservation agriculture systems.	Continue applying no-till combined with diversified rotations and cover crops. Share practical experiences and solutions with other farmers. Adapt practices progressively based on field conditions.	Observation of soil cover, crop performance and operational feasibility of the rotation system.	Specific agronomic training on residue management, machinery use and crop rotation planning.	Participate in knowledge exchange activities and identify practical improvements for the next cropping season.
SHARE Innovation lab	Fabrizio Ruozzi	IT_07	Management of solid manure and slurry under continuous no-till conditions, combined with strong pressure from rhizomatous weeds that are difficult to control without soil disturbance.	Introduce forage or cover crops within the rotation to improve soil cover and compete with problematic weeds.	Maintain diversified rotation including forage or cover crops. Apply manure on the soil surface or with minimal disturbance. Monitor weed pressure and adjust management strategies accordingly.	Observation of weed presence and soil cover during the season.	Training on alternative weed management strategies compatible with no-till systems.	Evaluate weed pressure and effectiveness of rotation strategy at the end of the season.
SHARE Innovation lab	Mattia Spagnolo	IT_10	Difficulty in implementing continuous no-till on silty soils due to soil structure limitations and operational constraints during wet periods.	Gradual adaptation of soil management practices to local soil conditions, maintaining flexibility in tillage and crop rotation strategies.	Apply reduced tillage or no-till where soil conditions allow. Avoid field operations under wet conditions. Maintain crop rotation and soil cover whenever feasible.	Observation of soil condition and trafficability during key operations.	Practical guidance on adapting no-till systems to silty soils.	Review field performance and identify adjustments needed for the following season.
SHARE Innovation lab	Emanuele Migliorali	IT_17	Continuous maize cultivation without regular organic matter inputs has led to low soil fertility and limited soil structure stability. This condition reduces the soil's capacity to self-structure and makes the transition to reduced tillage systems more difficult and risky in terms of crop establishment and yield stability.	Introduce external organic matter sources (e.g. compost purchase or agreements with nearby biogas/biomethane plants for digestate supply) to gradually increase soil organic matter and improve soil structure, creating the conditions for progressive adoption of reduced tillage practices.	Identify available sources of organic amendments (compost or digestate) within a reasonable transport distance. Apply organic material periodically (e.g. before maize sowing or after harvest) according to field accessibility and crop needs. Combine organic inputs with crop residue retention and simplified tillage practices. Evaluate the feasibility of gradually reducing tillage intensity over time.	Record quantities and type of organic amendments applied and observe changes in soil workability, crop establishment and yield performance over time.	Practical guidance on the agronomic use of compost and digestate, including timing, application methods and integration with mineral fertilization.	Monitor crop performance and soil condition after the introduction of organic amendments and review the feasibility of reduced tillage adoption in subsequent seasons.

Table 5.4. Table from IBERSOILL, Portugal-Spain (PT-SP) for reporting the co-creation session 1 in Task 2.1, on macro-environmental barriers for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
Ibersoill	Group 1 Arable Crops	10	Farmers (2), Technical (2), Policy (1), Research (2), Facilitators (Carmen Asensio and Nádía Castanheira)	Lack of impartial technical support		Cost of machinery		Policy training (if the farmers had more advice do not need technical support)	5	What is the relation of carbon farming and PAC?	
				Monitor to access carbon credits	4	Time of a carbon project (10-15 years)	4	Land ownership is getting far away from the farmers (renting)	4	Carbon volunteer market already exists but based on balance	
				Possibility of increase carbon without the practices		Carbon offsets		Change in consumers mindset	4	More important the balance than the carbon capture	4
				A lot of sensors, necessary to have models		For anual cultures the certification is payed by the farmers				Difficult to have a common normative in different cultivation systems	5
				Horticultural cultivation more demanding technically		Pressure element for farmers				Annual crop farmers might not enter in the carbon market	
Ibersoill	Group 2 Livestock farmers	8	Farmers (3), Academy (2), Industry (1), Facilitators (Laura Birrento and Eduardo Velázquez)	Machinery (not only the lack of machinery but also the lack of adequate machinery)	4	Initial investment (mainly in machinery if the farmer does not have available)	4	Lack of community and organization (for example one farmer does not have possibility to buy an equipment but if the community or association organizes can be possible to have one equipment that all farmers can use)		Policy promotes individual farmers and oblige to have machinery per farm; to have some benefits/subsidies the farmer needs to have the conditions (e.g. machinery) even if the neighbour or family has	4
				Climate conditions		Banks are not open to give loans for agricultural activities		Different mindsets (mostly generational)		Subsidies do not take in account factors as type of culture, practices and local conditions	
				Lack of technical advise		It is not possible to observe an immediat return, practices with a long-term economical benefit	4	Agricultural cooperatives do not shape to farmers conditions (for example, a cooperative that for many years collected a certain culture in a certain period, but nowadays it cannot be shaped to the farmers reality or conditions)			
Ibersoill	Group 3 Sheep farmers	8	Farmers (2), Research (2), Policy (1), Other (1), Facilitators (Regina Menino and José María Santos)	More time to get results		Lack of quantification	4	Lack of awareness		Lack of regulation and transfer	4
				Machinery/technology		Credits cost (who pays?)		Systemic and ecosystemic vision in the environment	5	Evaluation system	
				Lack of knowledge and technical advisory	4	Limitation to carbon only	4	Distrust in policy, carbon market and in the others		Burocracy	
				Transfer		Lack of support during the transition		Producer's decision-making power	4	Incompetence of exporter market	
				Decreasing yield curve		Incentives development and lack of knowledge about them				Ineffectiveness of policy	4
										No benefits for the ones that make well the practices neither penalizations for the ones that make wrong	
Ibersoill	Group 4 Woody crops	6	Farmers (2), Research (1), Technical (1), Facilitators (Ana Marta Paz and Ana de Coca)	Measure and quantification	4	Lack of financial management of the farm		Lack of incentive due to short term systems (for example land rent)		Measurement and quantification not only of the carbon but also of the benefits	
				Organic matter accumulation in mediterranean climate is slow	5	Does the carbon increase in Mediterranean climate have the same value in colder/humid climate? How much for the kg?	4	Lack of agronomical and climatic knowledge		Incentives creation	
						Carbon practices valorization		Prejudgement about the Greenwashing			
Ibersoill	Group 5 Agroforestry	8	Farmers (2), Research (3), Academia (1), Facilitators (Pedro Varão and Margarida Palma)	Lack of knowledge	4	Market instability		Mindsets and costumes change		Difficult in certification	4
				Lack of equipment		Crop diversity poses a problem for sales		Lack of knowledge transfer		Unclear market	4
				Lack of clear methodologies of monitorization	5	Financial instability	5	Lack of long-term thought		Diversity poses a bureaucracy problem	
						Initial investment in machinery and equipment				Lack of knowledge of the institutions involved	

Table A5.5. Table from IBERSOILL, Portugal-Spain (PT-SP) for reporting the co-creation session 1 in Task 2.1, on macro-environmental opportunities for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
Ibersoill	Group 1 Arable Crops	10	Farmers (2), Technical (2), Policy (1), Research (2), Facilitators (Carmen Asensio and Nidia Castanheira)	Soil regeneration (improves soil fertility and production; this can be technical and also economic opportunity)	4	Nutritional density for meat, milk and olive products (higher)		Social demand to be climate neutral	4	Contributes to climatic and policy goals of UE	
				Living labs support and knowledge transfer	5	Carbon practices improve soil health and increase the productivity	5	Regenerative agriculture			
				LL Community to exchange knowledge		Decrease in the production costs		Exchange community (lighthouse)			
						Financial instruments to improve soil natural capital	4				
Ibersoill	Group 2 Livestock farmers	8	Farmers (3), Academy (2), Industry (1), Facilitators (Laura Birrento and Eduardo Velázquez)	Climate conditions (application of the CFPs and different cultures)		Some banks have lower fees to farms that show sustainable practices		Demo-sites and results explanation can change mindsets		Possibility to create subsidies according to outcomes and results visualization	5
				Demo-sites implementation to show results		Carbon agriculture do not increase the product value but can allow the reduction of inputs	4	Climate changes mitigation can add a social benefit	4		
				Carbon agriculture improve the climate	4						
Ibersoill	Group 3 Sheep farmers	8	Farmers (2), Research (2), Policy (1), Other (1), Facilitators (Regina Menino and José María Santos)	Availability of measurement and methodology (cheaper)	5	Knowledge of soil and techniques make profitable		Environmental benefits (biodiversity, food and nutrition)	4	Favorable policies	
				Practical and teorical knowledge	4	Financial incentives for the markets (the ones that exist and the new ones)	4	Society sensibilization		Participation of policy makers in projects as Lilas4Soils	
				Opportunity of careful, knowledge of soil measure and biodiversity		Obligation general of carbon markets				Payment per practice and adapted for each one	5
						Economical benefit for all the food chain				Specific policies like the ones for eco-schemes in PAC	
Ibersoill	Group 4 Woody crops	6	Farmers (2), Research (1), Technical (1), Facilitators (Ana Marta Paz and Ana de Coca)	Soil health benefits that can support the production		Savings with inputs (fertilizer, water, diseases)		Nature, territory, land abandonment, cohesion, environment, fires, etc.	5		
Ibersoill	Group 5 Agroforestry	8	Farmers (2), Research (3), Academia (1), Facilitators (Pedro Varão and Margarida Palma)	System resilience	4	Lower inputs, higher savings		Valorization of more sustainable products	5	Carbon agriculture has the opportunity to push the industry Regulation of European carbon market	
				Less pests and diseases		Carbon credits assume opportunity	5	Attraction for agriculture			
				Application of new technologies and innovation	4			Attraction for younger farmers			
				Recovery of methodologies already done							

Table A5.6. Table from IBERSOILL, Portugal-Spain (PT-SP) for reporting the co-creation 2 in Task 2.2, on the evaluation and co-development of practical carbon farming solutions

Name of LL	Demo-site	Problem Summary	Solution Summary	Practical Protocol (draft/adapted)	MRV Requirements	Training Needs	Follow-up Actions (Who / What / When)
(Name)	(Name/code)	Main barriers affecting implementation	Proposed solutions	Key steps, tools, timing	Data needed, frequency, roles	Skills needed, training sources	Actions, responsibilities, deadlines
IBERSOILL	G1: ARABLE LANDS: SP-04 (Félix del Villar, FV), SP-11 (Raúl San Juan, RJ). Facilitator/s: Carmen Asensio and Nádia Castanheira.	<u>CFP-14: TECHNICAL LIMITATIONS:</u> Fertilisers with nitrification inhibitors are very expensive (595 €/T) for a cereal/legume rainfed rotation. To increase the fertilizer efficiency, now FV applies it during sowing in the row with a conventional seeder. RJ has tried to deal with that problem through improving timing and application of fertilizers (CFP-13). In horticultural crops, reduction of fertilizers is challenging	<u>New tools/equipment:</u> Use of precision agriculture machinery able to apply mineral fertilisers on those areas of the cropland in which they are needed according to yield maps. Precision agriculture machinery (seeders) whose cost raises up to 40.000 euros. Difficult to apply in horticultural crops	<u>Required tools/equipment:</u> Precision agriculture machinery able to apply mineral fertilisers in those area sin which yields were lower.	NA	<u>Agronomic training:</u> on the interpretation of yield maps. <u>Machinery use:</u> training on the use of precision agriculture machinery able to apply fertilisers using yield maps.	NA
IBERSOILL	G1: ARABLE LANDS: SP-04 (Félix del Villar, FV), SP-11 (Raúl San Juan, RJ). Facilitator/s: Carmen Asensio and Nádia Castanheira.	<u>CFP-15: MANAGEMENT CONSTRAINTS:</u> Lack of knowledge to manage the cover crop in extensive crops, in terms of timing of killing it and how to do it.	<u>New tools/equipment:</u> Use the roller crimper, which flattens and crushes, without cutting the cover crop. Roller crimper not available	<u>Required tools/equipment:</u> Roller crimper.	NA	<u>Machinery use:</u> training on the use of roller crimper. <u>Experimental crops:</u> more trials must be done to determine the best moment to kill the cover crop and use the better strategy to do it, depending of the weather, the type of cover crops and the cash crop (specially small seeded horticultural crops)	NA
IBERSOILL	G1: ARABLE LANDS: SP-04 (Félix del Villar, FV), SP-11 (Raúl San Juan, RJ). Facilitator/s: Carmen Asensio and Nádia Castanheira.	<u>CFP-16: TECHNICAL LIMITATIONS:</u> There is a lack of new and improved varieties of Leguminous species, more productive and stable without regard of climatic and edaphic conditions.	<u>Information:</u> results of official trials to make decisions about varieties of different crops.	NA	NA	<u>Agronomic training:</u> on the use of more productive varieties of Leguminous species.	NA

IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-11: <u>TECHNICAL LIMITATIONS</u> : One farmer (Eva Tocino) refers to the lack of adequate machinery to spread manure. Spreaders are very expensive and she cannot afford buying one. Until now, she has spreaded the manure using the spade of the tractor, but the result has not been satisfactory.	New tools/equipment: Buying or renting an spreader. If there were a cooperative or farmer's association it could be bought amongst all of them, as well as other equipment of occasional use.	Required equipment: Spreader.	NA	NA	NA
IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-13: <u>LABOUR</u> : One farmer (Diogo Pinho) mentions that climatic conditions are an obstacle to carry out an appropriate application of fertilisers. Those years in which rains are abundant, it is very difficult to introduce machinery into the estates. This problem can be solved: (1) applying basal fertilisation with... and nitrification inhibitors, but they are very expensive. Another option is (2) placing the tractors around the estates and applying foliar nutrients with sprayers, or using drones.	New tools/equipment: Buying or renting track-laying tractors and/or drones. Buying slow-release fertilizers with nitrification inhibitors. <u>Changing practice</u> : Improving basal fertilisation with slow-release fertilisers with nitrification inhibitors.	Required equipment: track-laying tractors and/or drones, slow-release fertilisers with nitrification inhibitors. <u>Timing</u> : Improve basal fertilisation.	NA	<u>Machinery use</u> : training on the use of track-laying tractors or drones to spread foliar nutrients. <u>Agronomic training</u> : on the application of slow-release fertilisers with nitrification inhibitors.	NA
IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-13: <u>LABOUR</u> : One farmer (Eva Tocino) mentions that the lack of rains in early autumn makes the sowing of the cover crop at the appropriate moment very difficult. Another farmer (Diogo Pinho) says that they perform dry sowing, burying the seeds with a roller.	New tools/equipment: Direct sowing with a seeder adapted to this practice. <u>Changing practice</u> : To perform dry sowing.	Required equipment: Direct seeder	NA	<u>Machinery use</u> : training on the use of direct seeders. <u>Agronomic training</u> : on dry sowing	NA

IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-17: LABOUR: One farmer (Gonçalo Santos) speaks about the problem which entrains colonization of grasslands by woody plants particularly along the margins of the estates. This problem process forces some farmers to plough, which implies a loss of C to the atmosphere. According to Diogo Pinho, in Monte Silveira Bio, they perform rotational grazing on previously defined 2-ha estates through which they drive pigs, cows and sheep, and goats over 48 hours. The animals get back to the first estate over one year.	<u>Changing practice:</u> Driving the animals (particularly goats) to consume woody plants. To perform rotational grazing according to the amount of available biomass in the different areas of the estates.	<u>Timing:</u> Define the areas and times to drive the animals in the different areas of the estates in order to consume herbaceous and woody plants.	NA	<u>Agronomic training:</u> on rotational grazing performing appropriate estimations of the amount of available biomass on the different areas of the estates.	NA
IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-17: SOIL-RELATED ISSUES: The increase in soil compaction provokes a decrease in grasslands productivity and force the farmers to plough (Luís Ramos). To deal with this problem, they perform a low intensive tillage each five years, but it is not a desirable solution, as it implies a loss of C to the atmosphere.	<u>Changing practice:</u> In Monte Silveira Bio, they make maps of soil compaction and apply a subsoiler (up to 40 cm depth) in those areas in which soil compaction is higher.	<u>Required equipment:</u> Subsoiler equipped with GPS.	NA	<u>Machinery use:</u> training on the use Of GPS-equipped subsoilers. <u>Agronomic training:</u> on the development of soil compaction maps.	NA
IBERSOILL	G2: LIVESTOCK: PT-B (Diogo Pinho), PT-05 (Gonçalo Silva), PT-12 (Luís Ramos), SP-11 (Eva Tocino). Facilitator/s: Laura Birrento and Eduardo Velázquez.	CFP-19: MANAGEMENT CONSTRAINTS: Organic farming entrains an excess of bureaucracy.	<u>Improved coordination:</u> Farmers should associate themselves in order to cope with this and other management constraints.	NA	NA	<u>Training:</u> on the creation of agricultural cooperatives and associations.	NA
IBERSOILL	G3. SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	Old machinery	Economic / administrative support	NA	NA	NA	NA

IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	<u>CFP-8: EQUIPMENT/INPUTS:</u> The farmer (Ricardo Miranda) mentioned the difficulties on finding quality organic fodder to justify that the sheep are being feed according to organic farming standards. He has figured out with this problem by producing his own forage plants, but in some cases it is still necessary to buy fodder.	NA	NA	NA	NA	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	Lack of qualified workforce.	NA	NA	NA	NA	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	Lack of training	NA	NA	NA	More training opportunities	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	Farmers made trials on their own	Exchange of experiences among farmers. More sense of community (creation of cooperatives and associations)	NA	NA	NA	NA

IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	CFP-12: <u>TECHNICAL LIMITATIONS</u> : One farmer (Tiago Lourenço) said that he has been applying wool to tree gutters because there is currently no market for the wool that is sheared and it can increase soil fertility and water availability in such areas. He has observed such improvements, but he has not been able to quantify them analytically. He would like to calculate the gains from the wool's fertilising power, assess the improvements in soil microbiology and reduction in soil moisture loss, with benefits for crops, as well as reducing the soil's temperature range.	No-cost technical support (Scientific support)	NA	Data on soil fertility (physico-chemical analyses) and soil microbiology.	NA	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	CFP-20: <u>MANAGEMENT CONSTRAINTS</u> : The farmer (Ricardo Miranda) mentioned the lack of administrative support for those farmers that aim to develop permanent pastures.	<u>Support needs</u> : More administrative support to agricultural exploitations with permanent pastures.	NA	NA	NA	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	The farmer (Ricardo Miranda) assured that soil microbiology analyses are crucial to test soil health, but they have a very high price.	No-cost technical support (Scientific support)	NA	Soil microbiology data	NA	NA
IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	The farmer (Ricardo Miranda) referred to the lack of products (fertilisers, plant protection or animal health systems) able to be used in his exploitation in order to maintain the organic agriculture certification.	NA	<u>Required tools/equipment</u> : Biological products	NA	NA	NA

IBERSOILL	G3: SHEEP FARMERS: SP-06 (Ricardo Miranda), Tiago Lourenço (PTA-A). Facilitator/s: Regina Menino and José Maria Santos.	CFP-10: TECHNICAL LIMITATIONS: The farmer (Ricardo Miranda) referred to the lack of qualified workforce (shepperds) able to control sheep flocks when they are grazing. It is possible to use digital fences to remotely control the flocks, but they are expensive.	New tools: Digital fences to remotely control the flocks.	Required tools/equipment: Digital fences.	NA	NA	NA
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	CFP-21: SOIL RELATED ISSUES: It is very difficult to eliminate soil mobilisation completely. For instance, how can we eliminate the woody plants that colonize the estates without ploughing?	Changes in practice: Make precise maps of plantations.	NA	NA	NA	NA
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	CFP-5: LABOUR: One farmer (Jose Marques) comments that is very difficult to assure the survival of recently planted individuals (vines, strawberry and cork oak trees) in those areas that cannot be irrigated.	Changes in practice: Make use of the previous vegetation existing on the area to provide shadow and enhance the establishment of planted trees.	NA	NA	NA	NA
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	One farmer (Ángel García) refers to the difficulties in controlling the damage provoked by wildlife (wildboars, roe deers, birds) on his vineyard. He has used kites and audible warnings among other solutions, but it is not enough.	NA	NA	NA	NA	NA
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	CFP-15: LABOUR: Several farmers mention the difficulties on managing the cover crops to reduce the competition with the woody crop (e.g. vines) at the end of spring or the beginning of summer, when the cover crop has reached its maximum vegetative development and soil water	New machinery: Such as track-laying tractors adapted to vineyards with narrow rows.	Required tools/equipment: Track-laying tractors.	NA	Machinery use: Training on the use of track-laying tractors.	NA

	Marta Paz and Ana de Coca.	availability starts to decrease. They have solved this problem by means of: (1) sowing species of low vegetative development (mainly grasses), (2) cutting down the cover crop. In the last case, the problem is that in many cases they cannot get into the estate because the terrain is very wet. They do it lowering the pressure of the tyres, but it makes the labour slower and more expensive. They might do it with adapted machinery such as track-laying tractors adapted to vineyards with narrow rows, but they are very expensive and it is necessary to move them to the estate with a trailer.					
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	CFP-12/13: <u>SOIL-RELATED ISSUES</u> : Uncertainty on the increase of soil fertility after the application of organic fertilisers. Some farmers have tried to solve this problem by applying an excess of fertilisers, but it can be expensive and not convenient.	NA	NA	NA	<u>Agronomic training</u> : to improve nutrient planning as well as timing and application of organic fertilisers.	NA
IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	CFP-15: <u>LABOUR</u> : One farmer (Ángel García) mentions the difficulties on removing invasive weeds such as Bermuda grass (<i>Cynodon dactylon</i> L. (Pers.)) from the cover crop without using herbicides or moving the soil. He has extracted the plants and exposed them upside down on the ground in winter, when there are frosts, or in summer, when there is hot. Such a solution works to avoid the expansion of these plants, but not subsequent invasion processes.	NA	NA	NA	<u>Agronomic training</u> : to control invasive weeds on cover crops through organic agriculture means.	NA

IBERSOILL	G4: WOODY CROPS: SP-07 (Ángel García Bamala), PT-03 (Filipe Volante), PT-08 (Jose Marques). Facilitator/s: Ana Marta Paz and Ana de Coca.	<u>CFP-12: SOIL-RELATED ISSUES:</u> One farmer (Ángel García) referred to his positive experience with the incorporation of pruning residues into the soil, as he has observed that this particular CFP improves soil structure, reduces the amount of inputs (e.g. fertilisers). However, it also decreases the N content as the C:N relationship of such residues is very high.	NA	NA	NA	<u>Agronomic training:</u> On how to incorporate pruning residues into the soil appropriately.	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	<u>CFP-21: TECHNICAL LIMITATIONS:</u> One farmer mentioned that seeders to perform direct sowing are very expensive.	<u>New tools:</u> Direct sowing seeders or direct sowing using drones.	<u>Required tools/equipment:</u> Direct sowing seeders.	NA	<u>Agronomic training:</u> on how to conduct direct sowing using drones.	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	<u>CFP-21: COORDINATION:</u> There are few companies of agricultural services with expertise on direct sowing, and the few existing ones are not professionalized.	<u>Improved coordination:</u> More professionalized agricultural services companies with experience in direct sowing	NA	NA	<u>Agronomic training:</u> on direct sowing.	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	<u>CFP-10: LABOUR:</u> When managing grazing, it is very difficult to control the movement of the flocks all over the estates.	<u>Changes in practice:</u> Clearly separating grasslands from croplands dedicated to forage species.	<u>Required tools/equipment:</u> Intelligent collars to control the movement of the animals.	NA	<u>Agronomic training:</u> on the use of intelligent collars for grazing management.	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	<u>CFP-11: LABOUR:</u> Incorporation of organic matter into the soil is very expensive. The quality of the compost produced (and used) in certain agricultural exploitations is not good because they come from just a few types of plant residues.	<u>Improved coordination:</u> Farmers must manage agricultural residues they produce all together in order to obtain a better compost.	<u>Key steps:</u> (1) A better knowledge on the residues produced in the area, (2) collecting all residues together in a centralised management centre, (3) producing standardised and stable compost / organic fertilisers from such residues.	<u>Type of data:</u> quantification and monitoring of the agricultural residues produced in different exploitations.	<u>Agronomic training:</u> On the management of plant residues and compost production.	NA

IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	Difficulties in controlling pests and pathogens though methods compatible with organic farming certification.	<u>Change in practice:</u> Increase biodiversity to increase the resilience and the sustainability of the exploitations.	NA	NA	NA	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	CFP-16: <u>LABOUR</u> : It is not easy to plan crop rotations, particularly when performing no-till.	<u>Support needs:</u> Improve farmer's assessment on soil fertility and local climatic conditions.	<u>Required tools/equipment:</u> Decision Support Systems to better plan crop rotations. These DSS should be easy to use, particularly for old farmers, that are the majority. It would be also a good idea to reactivate Agricultural extension services in Portugal and Spain.	NA	<u>Agronomic training:</u> On the use of decision support systems to attain a better planification of crop rotations.	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	The use of mulching systems to avoid water retention in the surface soil provokes a increase in the abundance of fungi and in the C:N relationship.	NA	NA	NA	NA	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	The decision-making process based on available information is particularly difficult on agroforestry systems.	<u>Improved coordination:</u> Farmers need to take better advantage on the available data and to improve management to make decisions.	NA	NA	NA	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	CFP-8: <u>LABOUR</u> : The majority of forages are based on an unique species. The farmers have used mixed forages based on different species with good results on cattle production.	NA	NA	NA	NA	NA
IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	Controlling invasive species is difficult.	NA	NA	NA	NA	NA

IBERSOILL	G5: AGROFORESTRY SYSTEMS: PT-18 (Nuno Vitorino). Facilitator/s: Pedro Varão and Margarida Palma.	CFP-15: <u>LABOUR</u> : It is very difficult to decide which species you should use in cover crop. They should improve the performance of the cash crop, otherwise, it is not worthy to use a cover crop.	NA	NA	NA	NA	NA
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Table A5.7. Table from GRECFL2, Greece (GR) for reporting the co-creation session 1 in Task 2.1, on macro-environmental barriers for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
GRECFL ²		32	19 - farmers, 1- advisor, 9- researcher, 2- policy, 1- cert body	Limited availability of appropriate machinery and equipment for carbon farming practices restricts implementation at farm level.	4	High upfront investment costs for machinery and equipment discourage farmers from adopting carbon farming practices.	5	Low awareness and understanding of carbon farming concepts among farmers hinder adoption.	4	Lack of clear and stable regulatory frameworks for carbon farming creates uncertainty.	5
GRECFL ²				Lack of standardized and accessible MRV (Monitoring, Reporting, Verification) tools reduces confidence in measuring carbon outcomes.	5	Increased operational costs, including fuel, labour and water, reduce economic feasibility.	5	Resistance to change from traditional farming practices limits uptake of new approaches.	4	Complex administrative procedures discourage participation in schemes.	4
GRECFL ²				Uncertainty regarding the effectiveness of carbon farming practices compared to conventional fertilization limits adoption.	4	Uncertainty regarding economic returns and lack of stable carbon market mechanisms limit farmer engagement.	5	Limited collaboration and trust among stakeholders reduce knowledge sharing.	4	Limited alignment between policy measures and farmers' practical needs reduces effectiveness.	4
GRECFL ²				Limited access to digital tools and precision agriculture technologies constrains scaling potential.	3	Limited access to financial incentives and funding mechanisms slows down adoption.	4	Lack of skilled labour constrains implementation of more complex practices.	4	Insufficient advisory and extension services at institutional level limit support.	4
GRECFL ²				Insufficient technical advisory support for farmers reduces the correct implementation of practices.	4	Small farm size and fragmented land ownership reduce economies of scale.	4	Weak connection between research and farmers reduces the transfer of innovation.	3	Lack of standardized certification schemes for carbon farming reduces market development.	5

Table A5.8. Table from GRECFL2, Greece (GR) for reporting the co-creation session 1 in Task 2.1, on macro-environmental opportunities for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
GRECFL ²		32	19 - farmers, 1- advisor, 9- researcher, 2- policy, 1- cert body	Advances in precision agriculture and digital tools enable more efficient implementation of carbon farming practices.	4	Development of carbon markets can provide new income streams for farmers.	4	Increasing awareness of sustainable agriculture supports acceptance of carbon farming.	4	Alignment with EU Green Deal and CAP policies supports carbon farming adoption.	5
GRECFL ²				Improved monitoring technologies (e.g. EO, sensors) support scalable MRV systems.	5	Financial incentives and subsidies can support adoption of sustainable practices.	5	Knowledge exchange between regions and countries can accelerate adoption.	3	Ongoing LILAS4SOILS project provide structured support and knowledge.	5
GRECFL ²				Adoption of innovative farming techniques can improve productivity and soil health simultaneously.	4	Formation of clusters or cooperatives can reduce costs through shared resources.	4	Training and advisory services can enhance farmers' capacity.	4	Development of certification frameworks can create market trust.	4
GRECFL ²				Availability of new technologies can reduce input use (fertilizers, water).	4	Improved resource efficiency can lower operational costs.	4	Stronger collaboration among stakeholders can improve implementation.	4	Policy incentives can encourage sustainable land management.	5
GRECFL ²				Integration of data-driven decision-making enhances farm management.	3	Access to EU funding and innovation programs can accelerate implementation.	5	Younger farmers and new entrants are more open to adopting innovative practices.	3	Integration of carbon farming into national strategies can support scaling.	4

Table A5.9. Table from GRECFL2, Greece (GR) for reporting the co-creation session session 2 in Task 2.2, on the evaluation and co-development of practical carbon farming solutions

Name of LL (Name)	Implementation Groups	Demo-site (Name/code)	Problem Summary	Solution Summary	Practical Protocol (draft/adapted)	MRV Requirements	Training Needs	Follow-up Actions (Who / What / When)
			Main barriers affecting implementation	Proposed solutions	Key steps, tools, timing	Data needed, frequency, roles	Skills needed, training sources	Actions, responsibilities, deadlines
GRECFL ²	Soil structure	GR-5, 6, 12, 17, 19	Soil structure limitations, low bearing capacity and wet field conditions restrict machinery operations and increase compaction risks under reduced tillage systems.	Gradual adoption of reduced tillage with improved timing of field operations and adapted machinery use.	Avoid field operations under wet conditions; adjust machinery settings; progressively reduce tillage intensity; maintain soil cover to stabilize structure.	Soil structure condition (seasonal), trafficability, soil organic carbon (annual), crop establishment.	Soil structure assessment, machinery adjustment, timing of operations.	Test practices on selected fields; evaluate results; adjust before scaling.
GRECFL ²	Nutrient management	GR-5, 6, 8, 12, 14, 19	Inefficient nutrient management and difficulty in interpreting soil data lead to excessive inputs and reduced efficiency.	Improved nutrient planning, optimized application timing and use of nitrification inhibitors.	Base fertilization on soil analysis; adjust timing and rates; apply under suitable soil conditions; align with crop needs.	Nitrogen use efficiency, fertilizer records, soil organic carbon (annual).	Soil analysis interpretation, nutrient planning, fertilizer application.	Implement improved fertilization; monitor performance; update plans annually.
GRECFL ²	Cover crops	GR-5, 6, 8, 11, 13, 14, 18, 19	Challenges in establishing cover crops, variability in results and competition with the main crop limit adoption.	Use of locally adapted cover crops with improved establishment and termination management.	Establish after harvest or during fallow; select suitable species; adjust sowing method; manage termination to avoid competition.	Soil cover, biomass, establishment success, impact on main crop yield.	Cover crop selection, establishment and termination techniques.	Test cover crops; evaluate performance; adjust species and timing.
GRECFL ²	Organic inputs	GR-7, 9, 12, 16, 18	Low organic matter levels and challenges in managing manure and organic inputs limit soil fertility improvement.	Integration of manure and organic amendments with nutrient management.	Apply manure or compost at appropriate timing; adapt application method; combine with cover crops; monitor soil response.	Soil organic carbon, organic input records, soil fertility indicators.	Manure management, compost use, integration with fertilization.	Apply organic inputs; monitor soil improvement; adjust application rates.
GRECFL ²	Crop rotations	GR-6, 13, 14, 16, 18	Limited crop diversification and continuous monocropping reduce soil resilience and increase pest pressure.	Introduction of diversified crop rotations including legumes and cover crops.	Redesign rotations; introduce new crops; integrate cover crops; adjust fertilization and tillage accordingly.	Crop rotation records, pest pressure, yield stability, soil carbon.	Crop rotation planning and system management.	Implement rotations gradually; monitor results; refine strategy.

Table A5.10. Table from RAGILL, Israel (IL) for reporting the co-creation session 1 in Task 2.1, on macro-environmental barriers for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
RAGILL	Group 1	8	3 FARMERS 1 Research/Academia (MIGAL) 2 AgTech industries (Agmatix, Zemah laboratories) 2 NGO (RegenIL, Adama Haya)	Agro-technical difficulties and challenges	4	Economic safety net / compensation for crop loss	4	Ease of implementation	3	Lack of knowledge	4
				Ease of implementation	3	Lack of economical incentives/grants	4	Lack of knowledge	4	Lack of economical incentives/grants	4
				Lack of knowledge	5	Proper marketing and consumer recruitment	3				
				Lack of close, professional support and guidance	5	Bonus for agricultural improvement	3				
RAGILL	Group 2	8	3 FARMERS 4 Research/Academia (MIGAL, TEL-HAI) 1 Policy/Regulation	Lack of adequate machinery, equipment	4	Cost of new machinery	3	Lack of machinery pool/sharing	3	Exposing farmers to the issue	3
				Cost of new machinery	3	Uncertainty regarding the economics during the transition phase and after	4	Exposing farmers to the issue	4	Lack of knowledge and training to the farmer	4
				Lack of knowledge and training to the farmer	4			Lack of knowledge and training to the farmer	4		
RAGILL	Group 3	8	3 FARMERS 2 Research/Academia (MIGAL) 1 AgTech industries (Aviani) 2 Policy/Regulation	Lack of support and guidance	4			Lack of support and guidance	4	Lack of support and guidance	4
				EGO	4			Conservatism among food companies, farmers, research institutions and academia, and government	3	Conservatism among food companies, farmers, research institutions and academia, and government	4
								Lack of research institutions and academia, and government	4		
								EGO	4	Unsupportive regulation	4
RAGILL	Group 4	8	3 FARMERS 2 Research/Academia (MIGAL, Volcani) 1 AgTech industries (Rivula) 2 Policy/Regulation	Expansion or accessible professional knowledge (knowledge gathering, data analysis, and dissemination)	4	Financial backing – enabling the possibility of evaluation and field trials	4	Connecting agriculture and health	4	Connecting agriculture and health	4
						Connecting agriculture and health	4				
						“Branding” the initiative, understanding its long-term value	4	“Branding” the initiative, understanding its long-term value	4		
						Academic research in the field of carbon sequestration in Israel	4	Academic research in the field of carbon sequestration in Israel	3		
RAGILL	Group 5	9	3 FARMERS 3 Research/Academia (MIGAL) 1 AgTech industries (Agmatix) 2 Policy/Regulation	A clear practice that has been scientifically proven is lacking; scientific evidence is needed to show that it improves the microbiome	4	To translate the increase in awareness into practical implementation, support, and funding for farmers who manage to adopt it	4	Communication with other farmers is lacking	5	Greatly lacking state involvement	4
				A regional knowledge and data-sharing network	4	Exposure to and awareness of calls for proposals are lacking	4	Exposure to and awareness of calls for proposals are lacking	3	There is no clear point of contact that can bring forward information and data.	4
								Religious restrictions	5	Religious restrictions	5
								95% of farmers do not implement any of these practices and do not take responsibility for the environment or the farms around them, for example by spraying all year round	4	A regional knowledge and data-sharing network	4
RAGILL	Group 6	8	1 FARMERS 2 Research/Academia (MIGAL) 2 AgTech industries (Agmatix, Zemah laboratories) 2 NGO (Tad Hanadiv, RegAg Association) 1 Policy/Regulation	Making knowledge accessible	4	Lack of economical incentives	4	Education	5	Land ownership	4
				Technology to improve efficiency in physical work	3	Accountability mechanisms across the entire value chain	3			Mechanisms to increase certainty in the agricultural sector: geopolitics, weather, the market, and marketing gaps	4
						Mechanisms to increase certainty in the agricultural sector: geopolitics, weather, the market, and marketing gaps	4				
						Money in the sector – attractiveness to the younger generation	4				
RAGILL	Group 7	8	2 Policy/Regulation 2 Research/Academia (MIGAL) 3 AgTech industries (Nibbana Israel, Granot) 1 NGO (Slow Money)	There is a lack of understanding regarding which areas need to be addressed in order to improve precision and understand our capacity to improve and advance on the organizational level, with a focus on regenerative agriculture	4	The economic feasibility needs to be demonstrated	4			There is a lack of understanding regarding which areas need to be addressed in order to improve precision and understand our capacity to improve and advance on the organizational level, with a focus on regenerative agriculture	4
				Establishing an organized system for data collection from farmers	4	There is a lack of budget and local partnership bringing it down to the level of the individual farmer that the outside world is waiting for excellent agricultural produce. The farmer needs to better understand	4			Genuine adoption by the Ministry of Agriculture	5
							3				

Table A5.11. Table from RAGILL, Israel (IL) for reporting the co-creation session 1 in Task 2.1, on macro-environmental opportunities for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
RAGILL	Group 1	8	3 FARMERS 1 Research/Academia (MIGAL) 2 AgTech industries (Agmatix, Zemah laboratories) 2 NGO (RegenIL, Adama Haya)					To speak the farmers' language and bring forward the farmers' real problems	4		
RAGILL	Group 2	8	3 FARMERS 4 Research/Academia (MIGAL, TEL-HAI) 1 Policy/Regulation	To create a system for sharing cultivation tools	3	Establishing collaborative agriculture network	4	Establishing collaborative agriculture network To create a system for sharing cultivation tools	4 3		
RAGILL	Group 3	8	3 FARMERS 2 Research/Academia (MIGAL) 1 AgTech industries (Aviani) 2 Policy/Regulation	Opportunity to address flavor improvement	3	An opportunity to create measurement and compensation for nutritional value	4	Changing the approach – adopting a systemic approach: the farmer at the center	4		
				An opportunity to create metrics	4	An opportunity to create metrics	4				
RAGILL	Group 4	8	3 FARMERS 2 Research/Academia (MIGAL, Volcani) 1 AgTech industries (Rivulis) 2 Policy/Regulation			Carbon credit – as an opportunity to use financing for additional activities on	3				
				To raise the scientific bar — scientifically validated research is needed to demonstrate the success of the practices	4	Funding sources that were not previously available, such as philanthropic funding from Yad Hanadiv and Horizon, which demonstrate that the issue is important	4	To raise the scientific bar — scientifically validated research is needed to demonstrate the success of the practices	4	To create regional collaboration and support, for example through regional calls for proposals.	
RAGILL	Group 5	9	3 FARMERS 3 Research/Academia (MIGAL) 1 AgTech industries (Agmatix) 2 Policy/Regulation			To translate into monetary terms the environmental impact of conventional agricultural practices compared with regenerative agriculture	4	An opportunity to build a community that gathers and shares information about what is happening in other places	4		
RAGILL	Group 6	8	1 FARMERS 2 Research/Academia (MIGAL) 2 AgTech industries (Agmatix, Zemah laboratories) 2 NGO (Tad Hanadiv, RegAg Association) 1 Policy/Regulation			Direct farmer-to-consumer connection; attractiveness to the younger generation	4	Connecting agriculture and the environment; building a new and attractive profession (training)	3		
RAGILL	Group 7	8	2 Policy/Regulation 2 Research/Academia (MIGAL) 3 AgTech industries (Nissan Israel, Granot) 1 NGO (Slow Money)	Regulation for documenting field data by farmers	4	To leverage the local terroir as an economic tool.	4	To leverage the local terroir as an economic tool.	4	An opportunity to create standardization	4
						An opportunity to create standardization	3				
						An opportunity to engage farmers through an internal economic motivation that is meaningful for the farmer	4				

Table A5.12. Table from RAGILL, Israel (IL) for reporting the co-creation session session 2 in Task 2.2, on the evaluation and co-development of practical carbon farming solutions

Name of LL	Demo-site	Problem Summary	Solution Summary	Practical Protocol (draft/adapted)	MRV Requirements	Training Needs	Follow-up Actions (Who / What / When)
(Name)	(Name/code)	Main barriers affecting implementation	Proposed solutions	Key steps, tools, timing	Data needed, frequency, roles	Skills needed, training sources	Actions, responsibilities, deadlines
	IL-06 Granot Maanit Dairy farm; IL-13 Tzora Orchards; IL-17 Yiftah Cohen Farm; IL-19 Zandani Farms; IL-20 Tzivon Vineyards	CFP 11 - Manure incorporation into soil - Organic matter almost always needs to be added to the orchard or the field. We are feeding the soil, supplying nutrients and microelements. The quality of the compost must be improved. Compost quality depends on maturity, weed content, and pathogens. The timing of compost application is critical, as is whether, in the end, it is a cost-effective practice. The problem is that the response time of the soil and the plant is long — several growing seasons.	Integration of other organic materials Integration with service/cover crops		Establishing taste values and taste data as a quality indicator and a premium indicator.	Training and peer-learning	
	IL-05 Granot site Lehavot Haviva; IL-11 Ein Harod Orchards; IL-12 Hulata Carob Path	CFP 12 - Improving nutrient planning and fertilisation strategy CFP 13 - Improving timing and application of nutrients * Lack of sufficient knowledge * Difficulty in managing criticism * Lack of coordination among professionals	* Accessible professional knowledge * Professional safeguarding	Observation over at least three years, where the first year is merely anecdotal, the second year is mainly excitement, and the third year is the validation year	Continuous monitoring to create a learning curve		
	IL-09 Livestock farm Gilboa; IL-15 DALTON WINERY	CFP 15 - Cover cropping introduction or improvement - What works? Leaving natural vegetation; At times, localized treatment is needed to bring things into balance — and then allow local vegetation to grow; When there is grazing, it fertilizes the land — introducing sheep; to trample the vegetation; apply roller creemper; work with professional advisors prior to introduction. What are the barriers? Data; Pests; Religious constraints; A machine that works with flailing strings along the planting row. It cannot be used when there is pruned material on the ground, as this can cause wear and tear on the equipment; Fire risk due to high biomass; Machinery and maintenance costs (man power); Fear of snakes when there is high vegetation	* Laying down the vegetation * Spraying with a contact herbicide * It depends on how grazing is managed — there is a concern about over-compaction, so the plots need to be divided * The management approach should be adapted to the region * The service crop needs to be managed; it is critical for achieving the benefits		Data		

	IL-01 Mataim Exp Farm; IL-02 Gadash Yiron; IL-03 Gadash GADOT; IL-07 Granot Gadash Hefer; IL-14 Beresheet Agricultural Society Ltd.; IL-16 Havivian Farm; IL-18 Galilee Agriculture Company	CFP 16 - Improved crop rotations CFP 21 - Reduced soil disturbance (ranging from reduce/ minimum tillage to no-till in cropland) What works? Integrated tools that can carry out, in a single pass, everything from shallow tillage to pre-sowing preparation; We need to stop talking about reduced tillage and start talking about soil building; Crop rotation will increase only when there is strong market demand for a diversity of crops; What are the barriers? Economic backing to support farmers in choosing crop rotation; There is no sufficiently good solution for a skid box	Coordinating the procurement of diverse produce from each farmer				
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Table A5.13. Table from SOFRALL, France (FR) for reporting the co-creation session 1 in Task 2.1, on macro-environmental barriers for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external barriers to Carbon Farming for each category of external barriers (provide inputs considering that the same barrier may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
SOFRALL	Group 1	7	4 farmers 1 research (INRAE) 2 agrifood industries (Carbogest, Agrosolutions)	Measure of carbone sequestration varies from different methodologies (depth, ...) Carbon credifility	4	Value of carbon (uncertain/low price signal), insufficient remuneration	4	Raise farmers' awareness of carbon storage (sometimes, farmers don't know they are storing C)	3		
				Need training : cover crops, grassland management, reducing tillage	4						
SOFRALL	Group 2	6	3 farmers 2 NGO 1 Agri-Food industry (Maitre Prunille)	The size of the farm may not necessarily be suitable for carbon farming	2	Method for calculating the carbon footprint of livestock systems per kilogram of meat produced: more intensive = higher carbon payments	4	Consumers buy the cheapest option	2	different frameworks: a wide variety of carbon farming approaches	5
								Mental load for farmers, need some support at decision time	3		
SOFRALL	Group 3	5	3 farmers 2 agri food industry (Syngenta, Lidéa)	Availability of the resources needed (organic matter to improve soil fertility, machinery ...)	4	Market instability, making it very risky economically to try new things	4	Lack of time for farmers (need workforce at some critical period, exemple sowing summer-covercrops while harvesting cereals crops)	3	Bureaucratic red tape for farmers	5
				Modeling has its limitations; sometimes farmers store more than the model predicts	4			Carbon diagnosis takes a long time for farmers, who don't necessarily have the time			
SOFRALL	Group 4	6	4 farmers 2 Agrifood industry (Tarditab)	Climate change and water management : concurrence for water (cash crops VS cover crops), timing for field work shorter	3	Cost of the transition (machinery, seeds, workforce)	3	Confusion on which practices actually store carbon	3	A wide range of stakeholders and points of contact for farmers	4
				Farm size is not necessarily a factor in carbon farming	2						
SOFRALL	Group 5	6	3 farmers 1 research (Invenio) 2 agrifood industry (AA+, Vivalis)	Weed management, avoid compaction without tillage	3	Instability in the yield, making it very risky economically to try new things	4	Need more exchanges between peers, and returns on experiences (with economical data)	5	lack of benchmarks, comparisons that may not be reliable	4
				The diversity of production systems makes them difficult to model	3						

Table A5.14. Table from SOFRALL, France (FR) for reporting the co-creation session 1 in Task 2.1, on macro-environmental opportunities for implementation of Carbon Farming Practices (CFPs)

Name of the LL	Identify the working group reference	Number of members in the working group	Number of stakeholders by category	What are the external opportunities to Carbon Farming for each category of external opportunities (provide inputs considering that the same opportunity may fit into more than one category)							
				A. Technical	Score	B. Economic/market	Score	C. Socio-cultural	Score	D. Admin/policy/regulation	Score
SOFRALL	Group 1	7	4 farmers 1 research (INRAE) 2 agrifood industries (Carbogest, Agrosolutions)	Technical follow-up / advisory support	4	Pass value to consumers (pricing/labels)	3	Raise consumer awareness	3	Reward the maintenance of practices (Label bas carbone) and not only the increasing of practices)	5
										A farm could have a note regarding the SOC, and be remunerated on that note	3
SOFRALL	Group 2	6	3 farmers 2 NGO 1 Agri-Food industry (Maitre Prunille)	Highlight the practices already in place	5			share information with consumers	3	Lobbying : speak about soils at EU level	3
								work with research	3		
SOFRALL	Group 3	5	3 farmers 2 agri food industry (Syngenta, Lidea)	A lot of ressources already existing for training / learning (Ver de terre production, Centre national d'agroécologie ...)	3	try to involve large companies, despite the hierarchical and strategic challenges they face	3			establish a mandatory market	3
				reward the continuation of practices	5	network with local businesses	4				
SOFRALL	Group 4	6	4 farmers 2 Agrifood industry (Tarditab)	reward the continuation of practices	5	Communicating about local food systems	3				
SOFRALL	Group 5	6	3 farmers 1 research (Invenio) 2 agrifood industry (AA+, Vinovallie)	Integrate the various tasks on each plot and reward practices	4			discussions among farmers to improve farming practices	5		

Table A5.15. Table from SOFRALL, France (FR) for reporting the co-creation session session 2 in Task 2.2, on the evaluation and co-development of practical carbon farming solutions

Name of LL	Demo-site	CFP concerned	Problem Summary	Solution Summary	Practical Protocol (draft/adapted)	MRV Requirements	Training Needs	Follow-up Actions (Who / What / When)
{Name}	{Name/code}		Main barriers affecting implementation	Proposed solutions	Key steps, tools, timing	Data needed, frequency, roles	Skills needed, training sources	Actions, responsibilities, deadlines
SOFRALL		12,13	Low levels of organic matter, insufficient humic content	Exogenous organic matter inputs Soil cover	Organic Matter Application Plan Humic Substance Assessment	Soil analyses (Y0; Y2; Y3)	Humic balance calculation How to choose organic product	Webinars animated by Biospheres team
SOFRALL		12,13	Difficulty in making a diagnosis / interpreting test results	Establishing a methodology for soil diagnosis, identification of levers for carbon farming	Soil analyses (Y0; Y2; Y3) Spade test / Biological activity		Reading/interpretation analyses	Create a methodological guide (short-term) + webinars
SOFRALL		15	Technical complexity of establishing cover crops	A step-by-step approach	Communication network (WhatsApp / video calls) Group facilitation / peer-to-peer exchanges	NA	Species selection ITK planting/removal	
SOFRALL		15	Variability in success	Diverse Mixes Rethinking Species Selection				
SOFRALL		15	The economic risks associated with establishing cover crops		Technical and Economic Evaluation of the Technical Route	Yield data Cost of the production process (including labor)		
SOFRALL		15	Difficulty in assessing benefits	Clarify objectives (fertility, carbon, weeds)	Spade test / Biological activity after cover crop destruction	Biomass produced % ground cover		
SOFRALL		19,17	Organic weed management without tillage	Rotation redesign Permanent coverage				
SOFRALL		17	Crust formation / runoff / compaction	Permanent coverage				
SOFRALL		17	Carbon footprint difficult to measure Carbon sequestration difficult to quantify			Annual biomass organic matter Estimated carbon storage		
SOFRALL		15	Competition with the main crop		Choosing the right species mix	Yields		
SOFRALL			Capital expenditures and labor hours		Introduction of Permanent Cover			

Annex 6. Additional workshop material and visual documentation

This annex presents examples of the additional materials used in the co-creation workshop, namely the tables used for collecting information from participating stakeholders, photographs from the workshops and field visits.



Figure A6.1. Plenary phase from Session 1 of the SHARE (Italy) Co-Creation Workshop: Barriers and Opportunities for Carbon Farming



Figure A6.2. Working Group activity from Session 2 of the SHARE (Italy) Co-Creation Workshop: carbon farming practices problems, solutions, technical needs from farmers

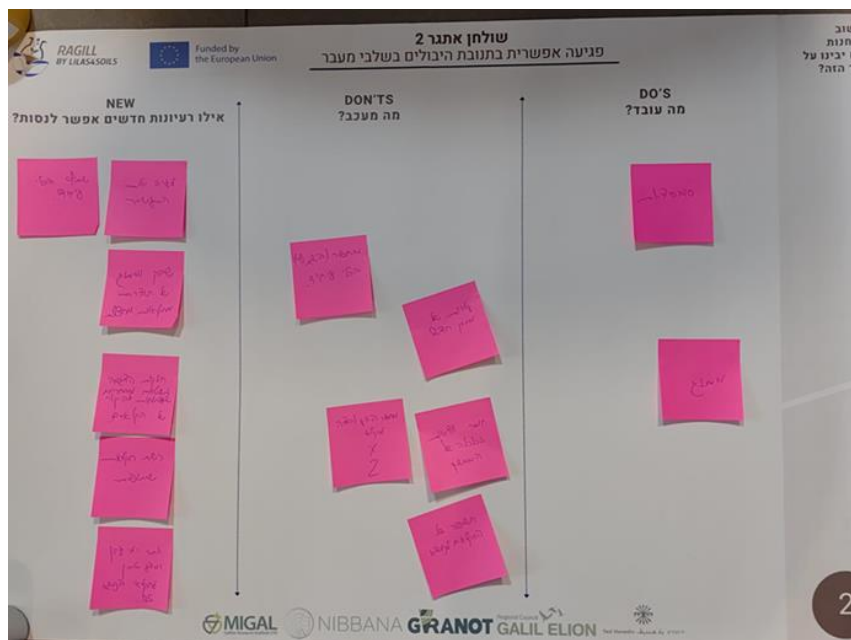


Figure A6.3. Working Group Table from Session 1 of the RAGILL (Israel) Co-Creation Workshop: Barriers and Opportunities for Carbon Farming

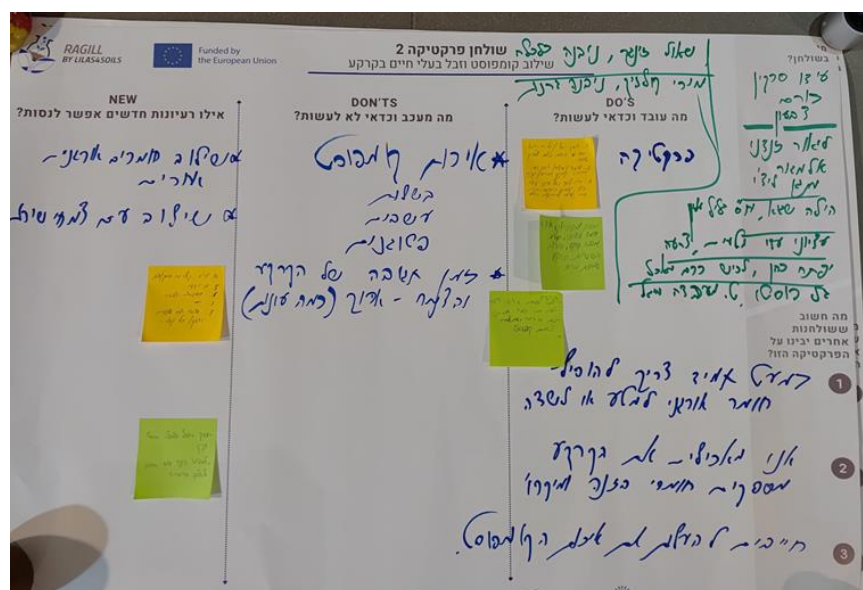


Figure A6.4. Working Group Table from Session 2 of the RAGILL (Israel) Co-Creation Workshop: carbon farming practices problems, solutions, technical needs from farmers



Figure A6.5. Field visit from RAGILL (Israel)

SESSION 1 - CARBON FARMING: REGIONAL BARRIERS AND PRIORITIES **ARABLE CROPS GROUP: 1**

REGIONAL CONTEXT
 What is the "Story Here" that defines Carbon Farming for this group?
 Fertilidade do solo, orgânica, Sujeito Resiliência

PRIORITY BARRIERS AND OPPORTUNITIES
 From the identified external barriers and opportunities select the most voted one of each.
 Main Barrier: _____ Main Opportunity: _____

EXTERNAL BARRIERS (THE "WHY NOT?")
 What stops the average farmer in our region?

TECHNICAL	ECONOMIC
<ul style="list-style-type: none"> • Apoio técnico + acompanhamento (ag) visando cultivo tradicional mas surgindo em áreas (Café) • Manutenção para crescer nos créditos C (Café) • Possíveis aumentos de C q tem aplicado técnicas CF (F) • Muitos sensores, modelos E reabastecimento • Técnicas + CF o caminho futuro pode ser a Europa (F) 	<ul style="list-style-type: none"> • Magnumaria (adaptación) (F) • Cultivos com frutos das E conversão (F) • Transição de 1 projeto de C (10-15 anos) - 100% • Investimento - infraestrutura de produção/valorização - não é simples • Carbon affects • Para culturas atuais a conversão, o preço para agricultores (F) • elemento de pressão para os agricult. (simul)

EXTERNAL OPPORTUNITIES (THE "WHAT IF?")
 What are the beneficiaries for our region?

TECHNICAL	ECONOMIC
<ul style="list-style-type: none"> • Processo CF - caminho técnico - parte seca (resumo) • Regeneração solo (F) • Apoio gestão LL - organização centralizada (F) • comunidade para discussões, conhecimento (F) 	<ul style="list-style-type: none"> • densidade numérica de produtores/campos, área, preço de venda → 100% • Práticas CF melhoram o feedback solo (F) • o mais produtivo!! (F) • custos de produção (capital) • Instrumentos financeiros (F) (para o capital natural solo (F))

SOCIO-CULTURAL **ADMIN/POLICY**

CRITICAL ENABLERS
 What would help overcome the identified barriers?
 Apoio técnico independente (sf) interesse comercial
 Estabilidade das políticas - Normativas para fazer conversão
 O objetivo do CF é serem as técnicas aplicadas ou são o resultado de C no solo?

Figure A6.6. Working Group Table from Session 1 of the IBERSOILL (Portugal/Spain) Co-Creation Workshop: Barriers and Opportunities for Carbon Farming. IBERSOILL created templates for the moderators of the working groups collect information needed to report to Task 2.1.



SESSION 2 - CARBON FARMING PRACTICAL SOLUTIONS IN DIFFERENT SYSTEMS LIVESTOCK/GADO GROUP: 2			
PROBLEMS	SOLUTIONS	TECHNICAL NEEDS	POSITIVE & NEGATIVE EXPERIENCES
<p>CFP-15) Cultivo rubicundo Clima: muito húmido e há bastante água toda (concentrada)</p> <p>CFP-17) Manutenção dos pastagens sem fumeiro → a pastagem consome a diminuir a produtividade devido à compactação do solo. Se houvesse um maquinário adequado como um cisel. Inversão do solo também necessita da lavagem.</p> <p>CFP13) melhoria do calendário e da aplicação de nutrientes O clima é um condicionante. Pode ter tudo planeado e pronto, mas p.ex. o excesso de chuva impede a aplicação.</p> <p>CFP19) agro cultura biológica. Diversidade burocrática</p> <p>CFP11) Incorporação de esterco No se dispõe de la maquinaria adequada (se base em la pila del tractor, no con un espartador)</p>	<p>CFP15 Semestral em p.s. Aplicação no solo seco até às primeiras chuvas. Enterrar com um solo. Dependendo do conteúdo. Pode ser com alguma cultura (ex. gr. branco ou preto-verde)</p> <p>CFP17 Animais nos terrenos, consomem o mato. Lavagem pouco intensiva ao 1º e 2º anos. Alfafa + subsoladora (entre a 40 cm no solo, seguindo as curvas de nível) Pecuária, vacas, cavalos e estercos. Pólo não rotacionar. Voltam ao mesmo ponto passando um ano. Parcelas de 2 ha. Depende do estágio do mato, da quantidade de biomassa.</p> <p>CFP13 Normalmente Aplicação de nutrientes foliares com pulverização desde o tractor e quando chover, com árvores. Aplicação + cedo com adubos de fundo, de libertação lenta (crimibolares)</p> <p>CFP19 Associações em vez de falar em nome individual.</p> <p>CFP11 Espalhador estreme o o baldes do tractor em vez do espalhador.</p>	<p>CFP15 Sealadora de sulcos directo. Permite fazer a aplicação dum só vez. GPS ou marcador Avaliação da compactação do solo p.ex. em solos argilosos. Permite p.ex. usar o subsolador se</p> <p>CFP17 Análise topográfica p/ saber as curvas de nível. Não saber dimensionar a pastagem disponível, conforme os animais</p> <p>CFP13 Drones Tractores com lagartas Avaliação da fertilidade do solo e das necessidades das plantas.</p> <p>CFP19 Organização. Às vezes há autoridades que podem ser dadas a mais que um agricultor de cada vez.</p>	<p>+</p> <p>Melhoria do solo Redução dos inputs Redução da mobilização do solo, especialmente nos olivais Rotina de análises de solo e das plantas (a folha de sobraço) Combinação das práticas permitiu melhorar a MO, principalmente c/ os animais. (arvores + 150% ; culturas permanentes + 150%)</p> <p>-</p> <p>Controlo das ervas infestantes Parte burocrática x2 Perda de culturas por não poder utilizar certos produtos</p>

Figure A6.7. Working Group Table from Session 2 of the IBERSOILL (Portugal/Spain) Co-Creation Workshop: Carbon farming practices problems, solutions, technical needs and positive and negative experiences from stakeholders. IBERSOILL created templates for the moderators of the working groups collect information needed to report to Task 2.2.



Figure A6.8. IBERSOILL co-creation workshop with the five working groups (top) and the field visit to Monte Silveira Bio to discuss the roller crimper machine uses (bottom)

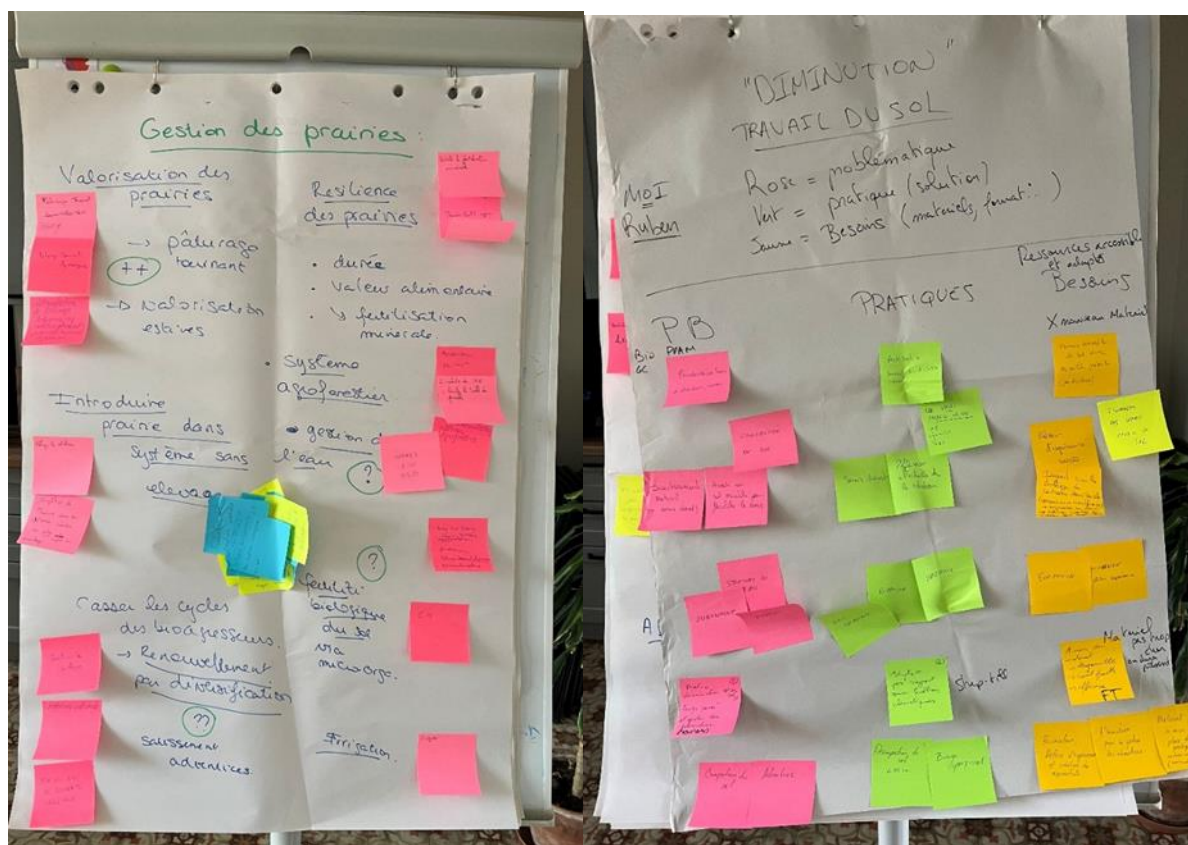


Figure A6.9. Working Group Table from two of the four thematic sessions of the SOFRALL (France) Co-Creation Workshop: Barriers and Opportunities for grassland management (left) and for soil cultivation (right). SOFRALL co-creation workshop did four thematic sessions on fertility diagnosis, plant cover, grassland management, and soil cultivation



Figure A6.10. Working Group on soil management from one of the thematic sessions of the SOFRALL (France) Co-Creation Workshop on soil cultivation (left) and field visit (right)