EU CAP NETWORK

Research needs from practice 2023

Funded by the European Union

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1. Why collect research needs from practice?

Many research findings are often slow to translate into practical applications, if they do so at all. Conversely, professionals such as farmers and foresters frequently feel that research does not sufficiently address their needs. Identifying 'research needs from practice' can help resolve this issue by facilitating dialogue between researchers and practitioners who can utilise research outcomes efficiently.

In agriculture, the gap between research and practical application poses a significant barrier to innovation and advancement. Bridging this gap is crucial, and one of the most effective methods is to gather research needs from practitioners directly. This approach ensures that research remains relevant and applicable to the challenges faced by farmers, foresters, and other practitioners.

There are several key reasons why gathering research needs from practice is important:

1. **Insight into Emerging Issues**: Practitioners often encounter new problems and challenges in agriculture first-hand. Engaging directly with them allows researchers to gain insights into the most urgent issues requiring attention.
2. **Understanding Practical Realities**: Practitioners possess deep insights into the practical aspects of agriculture and the factors influencing decision-making. Their input is essential to ensure that research findings are translated into effective and feasible solutions.
3. **Efficient Resource Allocation**: By focusing on practitioners' needs, researchers can avoid wasting time and resources on projects that do not address pressing challenges. This leads to a more efficient and effective use of public funds.
4. **Building Trust and Collaboration**: Gathering research needs from practice helps build trust between researchers and practitioners. When practitioners see that their concerns are being addressed, they are more likely to support and collaborate with researchers, fostering a collaborative and productive research environment.

2. How is it done?

This report follows the latest update in the October 2022 Methodological Approach document, which defines a 'research need from practice' as:

a) A challenge that professionals from the farming and forestry sectors (such as farmers, foresters and advisers) and other relevant rural actors encounter in their daily work, for which multi-actor research or innovative projects of EIP-AGRI OGs may provide solutions.

b) A potential solution for a problem or constraint, or new method identified in practice by a farmer, forester or adviser, or other relevant rural actor, including those in agribusiness, which requires further development, research or methodology for broader implementation.

c) New knowledge and/or an invention for an innovative solution discovered by a farmer, forester, adviser, or any other relevant rural actor, including those in agribusiness or non-food sectors, which could benefit from research or innovative projects to improve, commercialise, or adapt it for broader application.

The Support Facility for 'Innovation & knowledge exchange | EIP-AGRI collects research needs from practice during workshops, seminars, Focus Group meetings, and other networking activities.

The collected research needs are published and can be searched on the EU CAP Network website. Making these research needs visible allows others, including researchers and practitioners, to review them and provide solutions. They can also choose to address the issue by setting up innovative projects with other partners.

These research needs will also become visible to national and regional policymakers and authorities, who may incorporate specific topics into their calls for innovative projects. This information also feeds into the programming of the European Research and Innovation programmes.

3. Scope of this summary report

This draft report follows the previous 'Research Needs from Practice' report published on September 7, 2023, which covered 122 research needs from practice. It was prepared by the Support Facility for Innovation & Knowledge Exchange | EIP-AGRI.

The current draft report presents 82 research needs from practice as the outcome of three EU CAP Network Focus Groups (FG), three workshops, and one seminar that took place between November 2022 and June 2023, including:

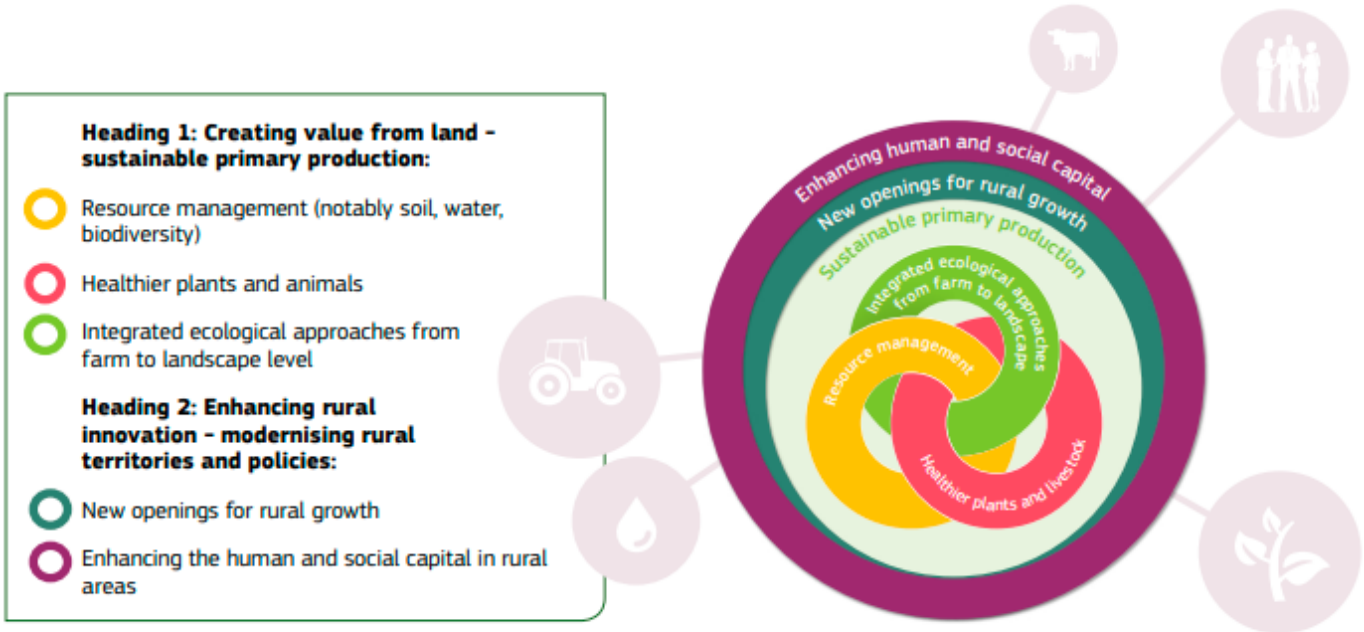
- FG 47 on 'Enhancing the biodiversity on farmland through high-diversity landscape features' (final report)
- FG 48 on 'Social farming and innovations' (final report)
- FG 49 on 'Recovery of abandoned agricultural lands' (final report)
- EU CAP Network seminar Smart circular farming to address high energy and fertiliser prices (final report)
- EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation' (final report)
- EU CAP Network Workshop Innovative arable crop protection – using pesticides sustainably (final report)
- EU CAP Network Workshop Animal Welfare and Innovation (final report)

The Excel table dated December 2023, included with this draft report, lists all 82 research needs from practice. It outlines the relevance of each research need to DG AGRI's Strategic Priorities, DG AGRI's Key Research Areas, and CAP objectives. All the entries have been cross-checked [1] for accuracy.

4. Analysis per DG AGRI strategic priorities and key research areas

Following DG AGRI's recommendation, the research needs below have been clustered according to its Strategic Priorities and Key Research Areas.

Figure 1. DG AGRI strategic research priorities

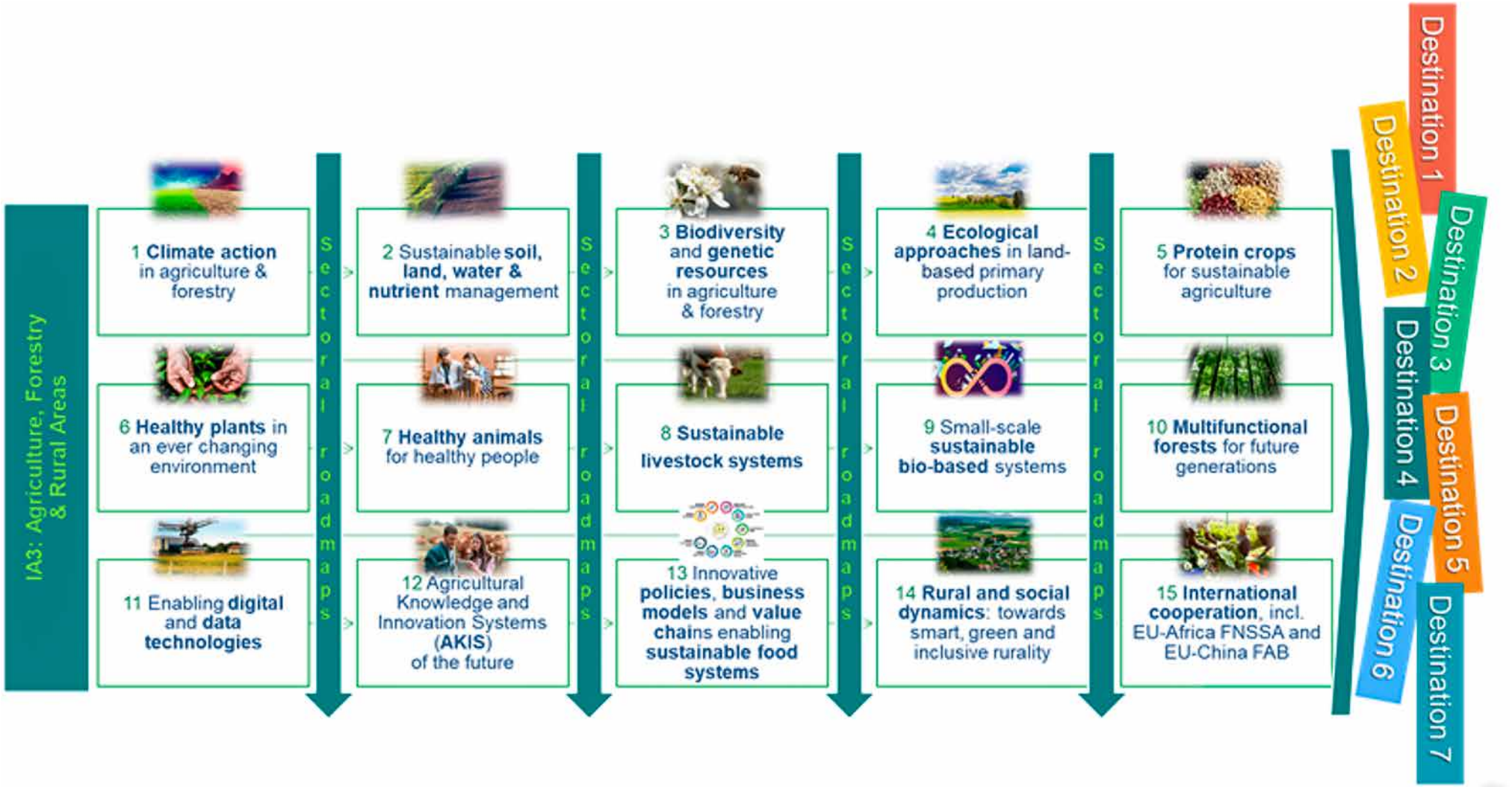


6 A STRATEGIC APPROACH TO EU AGRICULTURAL RESEARCH & INNOVATION I FINAL PAPER

Source: European Commission

1 The identified research needs have been validated through cross-checking by participants from all focus groups, workshops and seminars. This process ensures that each research need is relevant for farmers, foresters, agribusiness and other rural stakeholders, preferably across multiple geographical areas in Europe. In some network activities, cross-checking is an integral part of the process.

Figure 2. DG AGRI key research areas



Source: European Commission

For this purpose, the key research areas have been grouped per strategic priority as follows (Table 1):

Table 1. Key research areas by strategic priorities

DG AGRI strategic research priority	Key research areas
Creating value from land – sustainable primary production	
Resource management	2. Sustainable soil, land, water and nutrient management
	3. Biodiversity and genetic resources in agriculture and forestry
	5. Protein crops for sustainable agriculture
	10. Multi-functional forests for future generations
Healthier plants and animals	6. Healthy plants in an ever-changing environment
	7. Healthy animals for healthy people
Integrated ecological approaches, from farm to landscape level	4. Ecological approaches in land-based primary production
	1. Climate action in agriculture and forestry
	8. Sustainable livestock systems
Enhancing rural innovation – modernising rural territories and policies	
New openings for rural growth	9. Small-scale, sustainable bio-based systems
	11. Enabling digital and data technologies
Enhancing the human and social capital in rural areas	12. Agricultural Knowledge and Innovation Systems (AKIS) of the future
	13. Innovative policies, business models and value chains enabling sustainable food systems
	14. Rural and social dynamics: towards smart, green and inclusive rurality

DG AGRI's research priority 15 on international cooperation outside Europe has not been included in the table above and will not be considered in the clustering, as it falls outside the scope of EIP-AGRI.

The research needs from practice are presented per key research area in Annex I of this report. Table 2 summarises the total number of research needs identified per key research area.

It is important to note that many research needs appear under multiple key research areas, resulting in a total of 248 instances when the 82 research needs are considered across all research areas. On average, each research need appears 3.02 times.

Table 2. Number of research needs cases by key research area

DG AGRI strategic research priority	
Key research area	**Number of cases**
Creating value from land – sustainable primary production	
Resource management (Total: 65)	
2. Sustainable soil, water and nutrient management	29
3. Biodiversity and genetic resources in agriculture and forestry	34
5. Protein crops for sustainable agriculture	0
10. Multi-functional forests for future generations	2
Healthier plants and animals (Total: 24)	
6. Healthy plants in an ever-changing environment	16
7. Healthy animals for healthy people	8
Integrated ecological approaches, from farm to landscape level (Total: 58)	
4. Ecological approaches in land-based primary production	28
1. Climate Action in Agriculture and Forestry	19
8. Sustainable livestock systems	11
Enhancing rural innovation – modernising rural territories and policies	
New openings for rural growth (Total: 29)	
9. Small-scale sustainable biobased systems	15
11. Enabling digital and data technologies	14
Enhancing the human and social capital in rural areas (Total: 72)	
12. Agricultural Knowledge and Innovation Systems (AKIS) of the future	30
13. Innovative policies, business models and value chains enabling sustainable food systems	23
14. Rural and social dynamics: towards smart, green and inclusive rurality	19
Total number of cases	**248**

All the research needs have been grouped according to the corresponding DG AGRI strategic priorities. Annex I presents these research needs per related DG AGRI research priority. Since most research needs are relevant to multiple research priorities, they will appear multiple times across different table sections. For each research need from practice, the source is cited, with a hyperlink to the corresponding web page.

The total number of cases across all key research areas is 248. In principle, the networking events in the annual work program largely reflect the key research areas outlined by DG AGRI. However, it is evident that the number and distribution of cases are not evenly spread across these areas.

For the 'Resource Management' strategic priority, some areas, such as 'Biodiversity and Genetic Resources in Agriculture and Forestry' (34 cases) and 'Sustainable Soil, Water, and Nutrient Management' (29 cases), have a higher number of cases, indicating a potentially greater focus or significance. In contrast, areas such as 'Protein Crops for Sustainable Agriculture' have no reported relevant cases.

Under the 'Healthier Plants and Animals' strategic priority, both research areas have a moderate number of relevant research needs. However, the 'Healthy plants in an ever-changing environment' research area has double the relevant research needs (16 cases) compared to 'Healthy animals for healthy people' (8 cases).

In the 'Integrated Ecological Approaches, from Farm to Landscape Level' strategic priority, all three research areas have been covered by relevant research needs. The 'Ecological approaches in land-based primary production' research area (28 cases) is the most covered, compared to 'Climate Action in Agriculture and Forestry' (19 cases) and 'Sustainable livestock systems' (11 cases).

For the 'New openings for rural growth' strategic priority, the two research areas, 'Small-Scale Sustainable Biobased Systems' (15 cases) and 'Enabling digital and data technologies' (14 cases), are almost evenly covered by relevant research needs.

In the strategic priority of 'Enhancing the human and social capital in rural areas' the research area on 'Agricultural Knowledge and Innovation Systems (AKIS) of the future' features the most relevant research needs (30 cases) compared with the two other research areas: 'Innovative policies, business models and value chains enabling sustainable food systems' (23 cases) and 'Rural and Social Dynamics: Towards Smart, Green and Inclusive Rurality' (19 cases). Notably, this strategic research priority has the highest number of relevant research needs (72 cases) compared to the other four strategic priorities.

While the scope of different networking events in the annual work program aligns with the key research areas, the uneven distribution of cases suggests variations in emphasis or priorities. Achieving a more balanced distribution could be beneficial for a comprehensive approach to DG AGRI's strategic research priorities. This insight can guide future planning and resource allocation for a more inclusive and holistic work programme.

5. Analysis per CAP objective

According to the preliminary assessment conducted by the Support Facility for Innovation & Knowledge Exchange EIP-AGRI, many of the identified research needs from practice address multiple CAP objectives, including the nine specific objectives and the cross-cutting objectives.

In the Excel table, all research needs from practice were categorised under three CAP objectives, ranked from 1 to 3 based on their relevance, with 1 indicating the most pertinent CAP objective.

Table 3 presents the distribution of the 82 research needs from practice based on the most relevant (ranked 1) CAP objective. Annex II provides a detailed categorisation of research needs related to the most relevant CAP objectives.

Table 3. The division of research needs from practice by CAP objectives

CAP Objective	Nº of the most relevant (number 1) research needs from practice
CCO - Building up a well-functioning AKIS, including digitalisation	8
CCO - Modernising the sector by fostering and sharing knowledge, innovation and digitalisation in agriculture and rural areas, and encouraging their uptake	11
SO1 - Support viable farm income and resilience across the EU territory to enhance food security	19
SO2 - Enhance market orientation and increase competitiveness including greater focus on research, technology and digitalisation	1
SO3 - Improve farmers' position in the value chain	0
SO4 - Contribute to climate change mitigation and adaptation, as well as sustainable energy	4
SO5 - Foster sustainable development and efficient management of natural resources such as water, soil, and air	2
SO6 - Contribute to the protection of biodiversity, enhance ecosystem services, and preserve habitats and landscapes	25
SO7 - Attract young farmers and facilitate business development in rural areas	1
SO8 - Promote employment, growth, social inclusion and local development in rural areas, including bioeconomy and sustainable forestry	2
SO9 - Improve the response of EU agriculture to societal demands on food and health, including safe, nutritious and sustainable food, food waste, as well as animal welfare	9
Total	**82**

From the data presented in the above table, it is evident that some CAP objectives are addressed more than others. This distribution is determined by the choice of topics covered annually through Focus Groups and other networking events, such as Seminars and Workshops, which are correlated to specific CAP priorities. Over multiple years, as a broader range of topics is covered, the distribution is expected to become more even.

Annex I. The research needs from practice per key research area

Key research areas	Research needs from practice	Source
Creating value from land – sustainable primary production		
Resource management		
2. Sustainable soil, land, water and nutrient management (29)	**Economic assessment and valuation of High-Diversity Landscape Features.** The economic assessment of the costs and benefits related to High-Diversity Landscape Features (HDLF) at the landscape level is currently lacking. Specifically, there is a need to gain a better understanding of the mismatches between economic and ecological outcomes across farm and landscape scales. This includes identifying the optimal number and size of HDLF for different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effects of HDLF on water retention and microclimate. The effects of different HDLF on water, soil, and microclimate are not all well-known or thoroughly explored. The correlations between HDLF and microclimate are not yet fully understood. For instance, in extremely dry conditions, establishing initial woody features can be very challenging. However, these features can influence water conditions, making subsequent steps towards enhancing HDLF easier. Some research findings may not be widely known among farmers. The challenge for a scientific team is to identify knowledge gaps and conduct further interdisciplinary research. The results can then be effectively communicated to farmers using appropriate methods, as outlined in the Mini Paper on knowledge transfer. This approach would ensure that farmers are aware of the potential positive effects from the outset. This research is particularly relevant to production farms that face issues related to water scarcity, soil degradation, and drought.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the understanding of enablers and barriers to the adoption of HDLF. Farmers typically seek information on issues that directly affect their farms or provide concrete solutions. Biodiversity is not always a primary concern for them, meaning significant effort is required to stimulate interest in HDLF. To address this challenge, research is needed on the social and environmental factors that enable farmers (e.g., social norms) and those that prevent them (e.g., workload, financial compensation, political factors) from maintaining or creating HDLF.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research into knowledge exchange between different actors. Ecologists, scientists, and policymakers think differently from farmers, as they belong to distinct thought collectives. This means they have different interests (goals), ways of knowing, working contexts, and languages. To overcome these challenges, research is needed to explore the factors (e.g. importance of context, choice of language, motivating factors, personal exchange, self-study) that favour the exchange of knowledge between these different thought collectives, and how these can be aligned to benefit both biodiversity and farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on how biodiversity advice is organised across different European countries. Advisory services in Europe are highly diverse, with variations in financing models and organisations involved. One major distinction is the provision of advisory services through NGOs versus official authorities. Other differences include the scope of the advisory service, the independence of advisory organisations, the qualification of advisors, financial aspects such as funding possibilities for measurements, whether advisory services are free advisory or come with costs, and more. As a result, the effects, quality, and acceptance of biodiversity advice may vary significantly. The term 'advisory' is used very broadly and can carry different meanings. Experts (e.g. in Focus Groups) may have entirely different perceptions of advisory systems due to the variety of approaches in European countries. It would be beneficial to compile an overview of existing advisory systems and their relationship to biodiversity. Understanding the advantages and disadvantages of different systems can help guide the establishment of new advisory services. Moreover, the research could examine the correlations between advisory services and the establishment of HDLF.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Locate the most relevant sites for HDLF setup. Advising farmers to implement HDLF requires a detailed identification of agricultural areas that should be prioritised for landscape restoration. This includes determining the necessary increase in habitat amount and complexity. To achieve this, evidence-based results and spatially-explicit tools are needed to assess the contribution of individual farms. These tools help in producing spatial patterns of ecological importance at the landscape level for diverse taxa.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Develop indicators for optimal HDLF setup and management. The development of indicators that are robustly validated by science is crucial to provide guidance on the appropriate setup and management of HDLF. These indicators are needed to assess the quality of HDLF both a priori and a posteriori regarding the services expected. These services include those benefiting society at large, which can help provide incentives for farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Exploring interactions between above ground and below ground biodiversity. How the health and effective functioning of soil organisms is affected by the presence and status of above-ground biodiversity is still in need of further research. To fill this gap, research on the influence of above-ground biodiversity on the ecological benefits provided by below-ground biodiversity is needed.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Assess the costs and economic benefits associated with HDLF at the farm level. There is a significant gap in the economic assessment of the costs and benefits associated with HDLF at the farm level. A deeper understanding of the trade-offs between economic and ecological performances is needed, including the identification of economic and ecological optima regarding the number and size of HDLF on different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into co-benefits of pollinator conservation actions. Farmers often perceive risk in managing parts of their farm for High-Diversity Landscape Features (HDLF) due to concerns of losing productive land, requiring additional time and money, and incurring additional management costs. Despite these concerns, managing farmland for pollinators through HDLF can provide numerous co-benefits to farmers. To overcome these challenges, evidence-based research is necessary to support farmers through knowledge exchange and training. This research will help demonstrate the co-benefits of pollinator conservation actions, enabling farmers to make informed decisions about managing their land. Furthermore, the research should also consider circumstances where the co-benefits do not exceed the costs and explore potential compensation measures or contract solutions.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the effects of tillage management practices and regenerative and conservation agriculture on pollinators including direct drilling, min-tilling, and ploughing. The benefits of practices such as direct drilling and min-tilling, particularly regarding soil structure and organic matter content, are increasingly recognised. However, the impacts of these practices on pollinators and broader biodiversity remain less understood. Research in this area could uncover additional incentives for adopting these practices. This research should also examine the advantages and disadvantages associated with of the use of herbicides and the implementation of catch, companion, and cover crops in place of traditional ploughing. To overcome this challenge, evidence-based research is needed to document the scientific linkage between tilling practices and pollinators. This could provide another incentive for farmers to adopt these practices.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the advantages or disadvantages of natural wildflower regeneration instead of seed sowing on plant and pollinator diversity. Seed sowing is cost-intensive but can provide resources for pollinators. Despite sowing a diversity of seeds, certain species often dominate over time. Conversely, natural regeneration may initially result in species dominance, but diversity tends to increase over time. A recent study suggests that tolerating the injurious weed species within agricultural environments may benefit flower-visiting insects more than the sowing of 'wildflower mixes'. The challenge lies in maintaining flowering resources for pollinators and other species with cost-effective measures. To address this challenge, a combination of on-farm research and monitoring of plant communities, with a focus on floral resources and pollinator diversity, is necessary.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research into the perception of different HDLF by various stakeholder groups (farmers, tourists, citizens, ag-science students, etc.) and their contribution to maintenance and restoration, such as through place-based actions. This research could explore how to develop and implement place-based actions aimed at maintaining, restoring, or enhancing HDLF. These actions should deliver socio-cultural benefits at the community level, social cohesion, and integration of different groups. Additionally, the research should assess how different types of HDLF fit into perceptions of landscapes and whether these types provide social and cultural benefits.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the development of theoretical and practical tools aimed at promoting, protecting and enhancing the social and cultural benefits of HDLF. This research should shift the focus from individual farmers to shared practices and routine activities that farmers engage in, targeting the social and institutional context that shape social norms, shared meanings, understandings, and material conditions. The research should aim to understand how certain conventions are established, how they evolve, what opportunities exist for change, and which practical tools can support this shift. This implies a focus on the societal-level system characteristics and the practices that system promotes or facilitates. A key inquiry could explore the social and cultural norms that shape which HDLF are preferred by farmers and/or by society, and whether these norms are related to how HDLF are maintained, enhanced, or created.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the creation of indicators for measuring and monitoring the social and cultural benefits of HDLF. These indicators should relate to a wide range of common HDLF and be applicable across different contexts. Additionally, the research outputs can also be used to inform the development of educational and experiential materials to communicate the many social benefits of HDLF to various groups (e.g. related to their habitat value, functions and roles in microclimate provisioning) The indicators should cover HDLF identified in relevant literature and be applicable across different socio-cultural contexts. Furthermore, these indicators can be used to develop educational material for farmer training, primary and secondary schooling, and continuing education opportunities for different professions involved in HDLF maintenance, restoration, or enhancement including community involvement.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	A need for demonstration sites/examples/good practices. A critical challenge for future research in HDLF is the lack of evidence regarding their long-term benefits to ecosystem services. There is a need for demonstration sites/examples/good practices to address this gap. Establishing an 'HDFL best practices'' network or an 'Innovation path of future HDLF' could facilitate the study of new and existing HDLF. The research study of future HDLF must focus on assessing different benefits for farmers, including yields, resilience, water balance, soil/below-ground benefits, and impact on microclimate. There are estimations on ecosystem benefits, but mainly for past scenarios, not really for future scenarios in the context of climate change. Therefore, models are needed to predict these future scenarios accurately. This research is especially acute in intensively managed landscapes, with a low proportion of HDLF, e.g., lowland areas with highly productive farmland.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research and an innovative idea for the integration of HDLF in existing production systems. The integration of individual or combinations of HDLF, including agroforestry elements, in existing production systems can potentially have positive effects regarding climate change adaptation, such as higher water holding capacity, erosion reduction, shading, and a reduction in heat. However, there are also trade-offs to be considered, such as competition for nutrients or effects on plant health. Farmers face challenges regarding mechanisation possibilities, rising workloads, and costs, without reliable data on economic benefits. Further research is needed to provide information on practical implementation, including, e.g., suitable varieties for treelines or hedges, options to maintain mechanisation, effects on nutrient management and economic viability. For permanent crops, the analysis of the long-term effects of agroforestry on product quality is also an important topic. The need for research is especially relevant for crops with specific production systems, such as permanent crops and vegetables.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Characterise the specificity of the land abandonment process across different geographical contexts and classify the specific combination of the drivers leading to abandonment – so that solutions for recovery can also be better tailored.	Focus Group 'Recovery of abandoned agricultural lands'
	Find and develop alternative crops or animal productions and strategies best adapted to the context of abandoned land, or other ways to bring more added value into the farm enterprise, by processing in the farm, or collectively in the region, and/or by shared marketing strategies.	Focus Group 'Recovery of abandoned agricultural lands'
	Find specific innovative technical solutions for animal or crop production. These solutions should be affordable and easy to handle in order to facilitate the use of remote and abandoned areas, easing the burden of heavy manual work that is still required in many areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Explore a case on the sustainable use of available biomass in abandoned land for soil improvement, energy production, building materials, or other biobased industries. Identify how to build biomass-based processing units that can support a sustainable business in remote areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Cost and benefit analysis of abandonment versus keeping land under production. Assess the cost of non-action – how much does it cost, in loss of ecosystems services, to let agricultural land go under abandonment, in marginal and remote areas or in peri-urban areas. The multiple benefits or ecosystem services may be adaptation and mitigation to climate change, landscape quality, mental health benefits for citizens and bringing children to the outdoors (mostly in peri-urban contexts), improving biodiversity, territorial cohesion, etc.	Focus Group 'Recovery of abandoned agricultural lands'

	Farming system research (e.g. on-farm nutrient assessment and management, cascading production of food and energy, increasing food systems efficiency by promoting short food supply chains and localised food networks, etc.).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Practical implementation of reduced tillage/no-till and permanent soil cover. Reduced tillage/no-till and permanent soil cover present solutions to several negative impacts of traditional tilling, such as erosion, compaction, degradation of soil life, reduction of soil organic matter, and reduction of soil water-holding capacity. Several methods, including conservation tillage, direct seeding, direct seeding without herbicides, direct seeding in permanent pastures, no tilling, cover crops, roller-crimped cover crops, and shredded cover crops, offer promising alternatives. However, further research is needed to assess their efficacy in different soil types, crops and farming practices, assessing their cost-benefit ratio.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Enhancing soil life and biotic interactions in different farming systems and crops through sustainable farming. Conventional farming is degrading soil life, soil productivity and the performance of several ecosystem services. Conservation farming and organic farming practices significantly contribute to increase soil life, soil productivity and ecosystem services. Better knowledge of the biotic interactions occurring in soil and their linkages with agroecosystem functioning is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Water harvesting and storing. With rising temperatures, decreased precipitation, increased droughts, and growing water scarcity, there is a heightened demand of water across various needs, including irrigation, deficit irrigation, livestock, human consumption, firefighting, and ecosystems. Certain months experience water abundance and flooding, while others endure prolonged dry spells. Large-scale dams and infrastructure for water harvesting often entail significant financial, environmental, and social costs. Alternatives to large-scale dams include off-stream dams, lakes and ponds, swales and roads with a keyline (1-2% slope) leading to ponds, keyline design, and varied terrain modelling techniques such as swales, terraces, dykes, jessours, gabions and half-moons. Other methods include mulching and afforestation. Water harvesting at the landscape scale can also help reduce temperatures. Several questions need further exploration, such as the comparative cost and efficiency of various water harvesting and storage techniques. Innovation in water storage is crucial to reduce costs for farmers, as current methods can be expensive. Research should address whether it is more effective to store water underground or in dams and surface reservoirs, the optimal terrain modelling solutions for water harvesting, and how can regions shift from individual farm off-stream rainwater harvesting to integrated landscape level approaches. Additionally, exploring how roads best support water harvesting needs in adapting to climate change is essential.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Forests and water cycle at mesoscales: can afforestation increase rainfall in Europe? The reduction of precipitation due to increasing temperatures poses a significant challenge, particularly in regions such as south and central Europe. Afforestation has been proposed as a solution to reinforce the water cycle at a mesoscale, potentially allowing rain (warm fronts) to extend over thousands of kilometres and addressing desertification and water security issues. Research suggests that large-scale afforestation programmes, creating contiguous forests along ocean and coastal areas, may increase rainfall in some areas of Europe and serve as an effective adaptation to climate change. Further research is needed to understand the potential impacts and feasibility of such programmes, particularly in agroforestry and agro-silvo-pastoral systems.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Alternative water supplies. Water scarcity is a pressing issue for both animals and humans, but also for irrigation, exacerbated by increased aridity. Alternative water supply methods, such as traps (harvesting water from fogs to provide drinking water for animals and humans), recycling of greywaters from urban areas, farms and households, and desalinisation offer potential solutions to mitigate this challenge. Further research is needed to assess the cost-effectiveness of implementing alternative water supply technologies and to innovate cost-effective solutions. This research is relevant to South and Central Europe.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
3. Biodiversity and genetic resources in agriculture and forestry (34)	**Research on the understanding of farmer's motivations and barriers to the adoption of HDLF.** Understanding these motivations and barriers to adopting HDLF is crucial for promoting the uptake of HDLF. While farmers seek information on issues impacting their farms or requiring specific solutions, biodiversity conservation is not yet openly in demand, highlighting the need for public awareness and educational activities. Research is needed to understand the socio-cultural and environmental factors enabling farmers to establish or maintain HDLF, such as social norms and contextual suitability. Identifying challenging factors such as conflicting arguments, workload, financial compensation, and politics is essential.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effectiveness and effort involved in creating and using different communication channels. Biodiversity knowledge is communicated to farmers using various methods and tools. The success and effort involved in creating these tools, as well as the effort required to utilise different communication methods, can vary significantly. To determine the most effective cost/benefit combination of tools and methods for promoting biodiversity in the field, it is crucial to understand the communication needs of farmers, such as their preferences for digital or analogue approaches and face-to-face interactions.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Economic assessment and valuation of High-Diversity Landscape Features. The economic assessment of the costs and benefits related to HDLF at the landscape level is currently lacking. Specifically, there is a need to gain a better understanding of the mismatches between economic and ecological outcomes across farm and landscape scales. This includes identifying the optimal number and size of HDLF for different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research on the effects of HDLF on water retention and microclimate. The effects of HDLF on water retention and microclimate are not fully understood, and there are gaps in knowledge regarding their correlation. In extremely dry conditions, for instance, it may be challenging to establish certain vegetative or woody landscape features. However, these features themselves can influence water conditions, making subsequent steps towards enhancing HDLF easier. Some research findings may not be widely known among farmers, highlighting the need for interdisciplinary research to identify knowledge gaps and communicate results effectively. Research on the effects of HDLF on water retention and microclimate is crucial, particularly for production farms facing issues related to water scarcity, soil degradation, and drought. Conducting this research at a European-wide level will provide insights applicable across various farms and geographical regions and farming systems.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Analysis of the co-benefits of HDLF for climate change adaptation. There is a wealth of information available on the benefits of HDLF and financial tools for promoting landscape greening through the Rural Development Programmes (RDP) in the previous programming period and CAP Strategic Plans in the ongoing 2023-2027 programming period, such as eco-schemes or support for Agri-Environment Climate measures. However, the implementation of these measures by farmers is progressing slowly due to concerns about potential loss of productive land and other management costs. A significant research challenge lies in conducting a cost-benefit analysis of HDLF in relation to on-farm adaptation to climate change. This analysis would help disseminate knowledge regarding the eco-economic benefits of HDLF and eco-schemes, thereby motivating farmers to adopt and actively participate in eco-schemes through the CAP. Implementing climate change adaptation or mitigation measures can provide multiple co-benefits to farmers. The research is particularly crucial on intensively managed landscapes with a low proportion of HDLF, such as lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the understanding of enablers and barriers to the adoption of HDLF. Farmers seek information on issues directly affecting their farms or concrete solutions they need. Biodiversity is not always a priority topic, which means that a lot of work must be done to stimulate interest. To address this challenge, research is necessary to understand the socio-cultural and environmental factors that motivate farmers to maintain or establish HDLF, such as social norms and contextual suitability. Similarly, it is important to understand those factors that may have an adverse effect, such as conflicting arguments, required workload, (lack of) financial compensation, etc.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into knowledge exchange between different actors. Ecologists, scientists and policymakers think differently from farmers, as they belong to different thought collectives with different interests (goals), ways of knowing, working contexts and languages. To overcome these challenges, research is needed to identify the factors (e.g. importance of context, choice of language, motivating factors, personal exchange, self-study) that facilitate effective knowledge exchange between these groups.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research on how biodiversity advice is organised in different European countries. Advisory service in Europe is very diverse, with different financing models and organisations involved. One main difference is advisory through NGOs or official authorities. Other differences can be the extent of advisory service, independence of advisory organisations, qualification of advisors, the financial aspect (funding possibilities for measurements, free advisory or with costs, etc.), and more. Therefore, the effects, quality, and acceptance of biodiversity advisory might differ significantly. To understand these variations, research is needed to provide an overview of existing advisory systems and their relation to biodiversity. Such an overview would help in establishing new advisory services by leveraging the pross and cons of different systems. Moreover, the research could look at the correlations between advisory offers and establishment of HDLF.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Locate the most relevant sites for HDLF setup. Advising farmers to implement HDLF requires identifying the agricultural areas to prioritise for landscape restoration and the extent to which additional habitat amount and complexity should be increased. Evidence-based results and spatially-explicit tools are needed to assess the contribution of individual farms to produce spatial patterns of ecological importance at the landscape level for diverse taxa.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Develop indicators to provide guidance for the best setup and management of HDLF. There is a significant need for scientifically validated indicators to guide the appropriate setup and management of HDLF. These indicators are needed to assess the quality a priori and a posteriori of HDLF on farms regarding the services expected, including the services benefiting society in general, in order to provide incentives for farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Understand the variety and intensity of interactions between above and below-ground biodiversity. The interactions between above-ground and below-ground biodiversity, particularly how the health and functioning of soil organisms are affected by above-ground biodiversity, require further research. Understanding these interactions is essential for maximizing the ecological benefits provided by below-ground biodiversity. To fill this gap, research on the influence of above-ground biodiversity on the ecological benefits provided by below-ground biodiversity is needed.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Assess the costs and economic benefits associated with HDLF at the farm level. There is a particular need to understand the trade-offs between economic and ecological performances, including the identification of economic and ecological optima regarding the number and size of HDLF on different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research into co-benefits of pollinator conservation actions. Farmers perceive risks in managing parts of their farm for HDLF due to concerns of losing productive land and incurring additional costs and extra time for management. Despite these concerns, managing farmland for pollinators through HDLF can provide numerous co-benefits to farmers. To overcome these challenges, evidence-based research results are necessary to support farmers through knowledge exchange and training to demonstrate the co-benefits of pollinator conservation actions, which will help farmers make informed decisions about managing their land. Furthermore, the research should also consider under which circumstances the co-benefits do not exceed the costs and which type of compensation measures or contract solutions can be applied.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into effects of tillage management practices and regenerative and/or conservation agriculture on pollinators (direct drilling, min-tilling, and ploughing). The benefits to soil, such as improved structure and increased organic matter content, from direct drilling or min-tilling have become relatively well known where conditions allow. However, the impacts of these practices on pollinators and broader biodiversity are less understood. Therefore, research in this area could uncover another lever for adoption by farmers. This could include examining the advantages and disadvantages associated with the use of herbicides and catch, companion, and cover crops in place of traditional ploughing. To overcome this challenge, evidence-based research is needed to document the scientific links between tilling practices and pollinators, potentially providing another driver for farmer adoption.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the advantages or disadvantages of allowing wildflowers to naturally regenerate instead of seed sowing on plant and pollinator diversity. Seed sowing is cost-intensive but can provide resources for pollinators. However, despite sowing a diversity of seeds, certain species tend to dominate over time. In contrast, natural regeneration may initially result in the dominance of some species, but diversity tends to increase over time. A recent study indicates that tolerating the injurious weed species within the agricultural environment may be of greater benefit to flower-visiting insects, more than the sowing of 'wildflower mixes' The challenge is to maintain flowering resources for pollinators and other groups of species with cost effective measures. To overcome this challenge, a combination of on-farm research and monitoring of plant communities, specifically floral resources, and pollinator diversity is needed.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the perception of different HDLF by various stakeholder groups (farmers, tourists, citizens, ag-Science students, etc.) and their contribution to maintenance and restoration, for example through place-based actions. This research could explore how to develop and implement place-based actions aimed at maintaining, restoring, or enhancing HDLF to deliver socio-cultural benefits at the community level (e.g. social cohesion, integration of different groups). Also, it is important to assess how different types of HDLF fit into perceptions of landscapes and whether these different types of HDLF provide social and cultural benefits.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research on the development of theoretical and practical tools aimed at promoting, protecting and enhancing social and cultural benefits of HDLF. This research should shift the focus from individual farmers to shared practices and routine activities that farmers engage in collectively. The research should target the social and institutional contexts that shape social norms, shared meanings and understandings, and material conditions that facilitate and encourage certain types of practices (i.e. related to creation and maintenance of HDLF). The goal is to understand how certain conventions are established, how they evolve, what are the opportunities for change, and what practical tools can support this shift. This implies a focus on the societal-level system characteristics and the practices which that system promotes or facilitates. A key inquiry could explore the social and cultural norms that shape which HDLF are preferred by farmers and/or by society and if these norms are related to how HDLF are maintained, enhanced, or created.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the creation of indicators for measuring and monitoring the social and cultural benefits of HDLF. The indicators should be applicable across different contexts and relate to a wide range of common HDLF, such as their habitat value, functions, and roles in microclimate provisioning to various groups. These materials could be used in farmer training, primary and secondary schooling, and continuing education opportunities for different professions that may be involved in HDLF maintenance, restoration or enhancement (including community involvement).	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	A need for demonstration sites/examples/good practices. The challenge for future research is a lack of evidence for HDLF long-term benefits to ecosystem services and demonstration sites/examples/ good practices (new ones, studying existing ones, establishing a 'HDFL best practices' network or an 'Innovation path of future HDFLs'). Future research on HDLF should focus on different benefits for farmers, including yields, resilience, water balance, soil/below-ground benefits and structures, and the impact of HDLF on microclimate. While there are estimates of ecosystem benefits, these mainly address past scenarios, rather than future ones, particularly in the context of climate change. Therefore, the models needed to project this benefit accurately. The need for this research is especially acute in intensively managed landscapes with a low proportion of HDLF – e.g., lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research and an innovative idea for the integration of HDLF in existing production systems. The integration of individual or combinations of HDLF, including agroforestry elements, into existing production systems can potentially have positive effects regarding climate change adaptation, such as higher water holding capacity, erosion reduction, shading, and a reduction in heat. However, it is important to acknowledge potential trade-offs, such as competition for nutrients or effects on plant health. Furthermore, farmers are facing challenges regarding mechanisation possibilities, rising workloads, and costs, due to a lack of reliable data on economic benefits. Further research needs to provide information on practical implementation, including, e.g., suitable varieties for treelines or hedges, options to maintain mechanisation, effects on nutrient management, and economic viability. For permanent crops, the analysis of long-term effects of agroforestry on product quality is also an important topic. The need for research is especially relevant for crops with specific production systems, such as permanent crops and vegetables.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Find innovative grazing strategies. Implement grazing strategies which support a business model for livestock production and which are at the same time supported with public policies due to their nature and conservation value.	Focus Group 'Recovery of abandoned agricultural lands'
	Sustainable use of biomass in abandoned land. Explore a case on the sustainable use of available biomass on abandoned land for soil improvement, energy production, building materials or other biobased industries; identify how to build biomass-based processing units that can make a sustainable business in remote areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Knowledge of the climate envelopes and climate adaptation of species, crops, cultivars, varieties and breeds (plants and animals). In the context of a changing climate and changing weather patterns, choosing species, cultivars, or varieties adapted to these changes is very important for successful adaptation. However, a significant challenge lies in the lack of information or integration of knowledge regarding the climate envelope and climate adaptability of each crop, limiting access for farmers, researchers, and other stakeholders. Research is needed to catalogue and compile knowledge on the climate adaptability of species, crops and varieties. This information should be integrated and made accessible to stakeholders. One approach is to create an open-access online catalogue containing data on the climate envelope and climate adaptability of species, crops and varieties, both plants and animals. This resource would empower farmers, farm advisors, and the public to make informed decisions. Knowing which crops and varieties are more resistant to drought, heat waves, flooding, etc., enables farmers, plant nurseries and companies to adapt and produce what is most needed to improve farming adaptation. Modelling and simulations using these climate envelopes and climate change scenarios can also help in spatial planning, farm planning, etc. Further research should focus on conducting studies on the climate envelope and climate adaptability of species, crops and varieties. This includes defining relevant indicators that are meaningful for farmers and other stakeholders.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Developing climate adapted varieties and breeds. Cultivars and animal breeds have been developed for specific purposes and types of farming over a long time. Climate-adapted breeds and varieties that are required for smart and climate-resilient farming are not available on the market. Climate-adapted diversified farming is very context specific, requires numerous varieties and breeds, and therefore requires farmers and/or local/regional partners to select, develop, and conserve animal breeds and plant varieties that are more adapted to present and future climates. This process needs further research through applied-research and/or action-research, in close partnership with farmers (to address their needs). Throughout the climate vulnerable regions of Europe, plant varieties and animal breeds must be selected, improved, tested, and evaluated, to be disseminated and promoted as a climate adaptation measure for the different agro-climatic zones and types of farming. This research can include genetic variability and new breeding techniques but without the use of Genetically Modified Organisms (GMO).	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Analyse the productivity and profitability of Integrated Pest Management (IPM) strategies at the farm level. To make that possible, data should be gathered at the EU level, including data from different regions, to pilot farmers. That data could also be used to assess the effectiveness of IPM strategies at the farm level and analyse the effects of IPM-based strategies on risk levels, determining whether they increase or decrease risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Evaluate the economic impact of implementing sustainable practices in various contexts. The development of methods to calculate the environmental and health impacts of different farming systems and enable cost comparisons.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Holistic assessment of IPM strategies. Conduct research to harmonise and holistically assess the impact of implementing different IPM strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identify the most cost-effective economic incentives that also provide ecosystem services. To determine the costs of pesticide use, it was recommended to perform residue analysis at both the farm and crop level to understand the residues associated with pesticides used in different crop management strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Develop new and improved techniques for detecting and sampling pests, diseases and weeds. These methods should include innovative approaches such as DNA barcoding, which allows a quick and accurate identification of pests. Similar to Covid tests, these techniques could enable rapid identification of selected pests. Additionally, automated monitoring sensors need development to monitor and detect pests, diseases and weeds.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Understanding the population dynamics of bio-control agents, both micro- as well as macro-organisms. By studying their interactions and reproductive patterns, researchers can support the deployment of these agents and enhance bio-control strategies in Integrated Crop Management strategies. This includes manipulating plants and habitats to enhance natural enemies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing the impact of non-chemical control techniques on biodiversity and environmental footprint. Gather data on the impact of non-chemical control techniques and strategies on biodiversity but also quantify the environmental footprint of alternative management strategies to minimise any potential negative effects on the environment to ensure sustainable practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Make farm biodiversity measurable and comparable. With a scoring system, farmers could have a standardised and comparable framework to assess and monitor biodiversity on farms more effectively. By implementing such a system, farmers can track and enhance biodiversity on their farms, contributing to sustainable agriculture.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Investigate the potential of genetic resources. E.g. new varieties developed with new breeding technologies, DNA-based monitoring of pests and diseases, and the use of satellite imaging for detection.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Predictive modelling of crop, pest, disease and weed population dynamics. Develop models that can predict crop, pest, disease and weed population growth.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
10. Multi-functional forests for future generations (2)	**Resistance from farmers to new business.** Resistance from farmers to the relatively new business of biomass use for producing biofuels and biochemicals stems from a lack of technical and non-technical know-how, concern about soil depletion due to residues collection, and problems accessing funding opportunities. Main challenges are recognised to be logistics, organisation and management at the different steps in the biomass supply chain.	EIP-AGRI Workshop: 'Building new biomass supply chains for the bio-based economy'
	Forests and water cycle at mesoscale: can afforestation increase rainfall in Europe? With the increase of temperature, precipitation reduces, since the cloud condensation level is higher at lower temperatures (direct relation with relative humidity). Decrease in precipitation is a major challenge for south and central Europe. Several authors show that afforestation can reinforce the water cycle at a mesoscale, allowing rain (warm fronts) to extend through thousands of kilometres, thus revealing 'good potential for forest-mediated solutions of the global desertification and water security problems'. Further research could explore if large scale afforestation programmes that create contiguous forests in the continuation of ocean and coastal areas could increase rainfall in some areas of Europe and a be a good adaptation to climate change.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
Healthier plants and animals		
6. Healthy plants in an ever-changing environment (16)	**Innovative solutions for sustainable agriculture in remote areas.** Find specific innovative technical solutions for animal or crop production that are at the same time affordable and easy to handle in order to facilitate the use of remote and abandoned areas, easing the burden of heavy manual work that is still required in many areas.	Focus Group 'Recovery of abandoned agricultural lands'

	Enhancing soil life and biotic interactions in different farming systems and crops through sustainable farming. Conventional farming is degrading soil life, soil productivity and the performance of several ecosystem services. Conservation farming and organic farming practices significantly contribute to increase soil life, soil productivity and ecosystem services. Better knowledge of the biotic interactions occurring in soil and their linkages with agroecosystem functioning is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Climate adaptation of crops. In the context of a changing climate and changing weather patterns, choosing species, cultivars, or varieties adapted to these changes is very important for successful adaptation. However, a significant challenge lies in the lack of information or integration of knowledge regarding the climate envelope and climate adaptability of each crop, limiting access for farmers, researchers, and other stakeholders. Research is needed to catalogue and compile knowledge on the climate adaptability of species, crops and varieties. This information should be integrated and made accessible to stakeholders. One approach is to create an open-access online catalogue containing data on the climate envelope and climate adaptability of species, crops and varieties, both plants and animals. This resource would empower farmers, farm advisors, and the public to make informed decisions. Knowing which crops and varieties are more resistant to drought, heat waves, flooding, etc., enables farmers, plant nurseries and companies to adapt and produce what is most needed to improve farming adaptation. Modelling and simulations using these climate envelopes and climate change scenarios can also help in spatial planning, farm planning, etc. Further research should focus on conducting studies on the climate envelope and climate adaptability of species, crops and varieties. This includes defining relevant indicators that are meaningful for farmers and other stakeholders.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Developing climate adapted varieties and breeds. Cultivars and animal breeds have been developed for specific purposes and types of farming over a long time. Climate-adapted breeds and varieties that are required for a smart and climate resilient farming are not available on the market. Climate-adapted diversified farming is very context specific, requires numerous varieties and breeds, and therefore requires farmers and/or local/regional partners to select, develop, and conserve animal breeds and plant varieties that are more adapted to present and future climates. This process needs further research through applied-research and/or action-research, in close partnership with farmers (to address their needs). Throughout the climate vulnerable regions of Europe plant varieties and animal breeds must be selected, improved, tested, and evaluated, to be disseminated and promoted as a climate adaptation measure for the different agro-climatic zones and types of farming. This research can include genetic variability and new breeding techniques but without the use of Genetically Modified Organisms (GMO).	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Managing invasive pests in a changing climate. As climate changes, species, namely pests and diseases, migrate. New pests and diseases can constitute a serious threat to farming and food security in Europe. Integrated and best practices in pest management are not sufficiently disseminated and implemented. In addition, the potential for unpredictable mass spread of pests and diseases increases in a changing climate and in the context of large-scale monocultures and homogeneous farming with reduced species, crop and genetic diversity in agroecosystems. Applying integrated pest management and best practices in EU farming at a landscape scale could prove helpful. More monitoring of pests and diseases spread, as well as more knowledge on how to efficiently prevent, control and regulate new invasive species and diseases would be needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Evaluating the impact of Integrated Pest Management (IPM) strategies. Analyse the productivity and profitability of Integrated Pest Management (IPM) strategies at the farm level. To make that possible, data at the EU level should be gathered, including data from different regions, to pilot farmers. That data could also be used to assess the effectiveness of IPM strategies at the farm level and analyse the effects of IPM-based strategies on risk levels, determining whether they increase or decrease risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing the economic and environmental impact of sustainable farming practices. Evaluate the economic impact of implementing sustainable practices in various contexts, the development of methods to calculate the environmental and health impacts of different farming systems and enable cost comparisons.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Holistic assessment of IPM strategies. Conduct research to harmonise and holistically assess the impact of implementing different IPM strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Cost-effective economic incentives and ecosystem services. Identify the most cost-effective economic incentives that also provide ecosystem services. To determine the costs of pesticide use, it was recommended to perform residue analysis at both the farm and crop level to understand the residues associated with pesticides used in different crop management strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Innovative techniques for pest and disease detection. Develop new and improved techniques for detecting and sampling pests, diseases and weeds. These methods include innovative approaches, such as DNA barcoding, which allows a quick and accurate identification of pests. Like Covid tests, these techniques could enable rapid identification of selected pests. Additionally, automated monitoring sensors need development to monitor and detect pests, diseases, and weeds.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Enhancing bio-control strategies through population dynamics. Understanding the population dynamics of bio-control agents, both micro- as well as macro-organisms. By studying their interactions and reproductive patterns, researchers can support the deployment of these agents and enhance bio-control strategies in Integrated Crop Management strategies. This includes manipulating plants and habitats to enhance natural enemies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Assessing the impact of non-chemical control techniques on biodiversity and environmental footprint. Gather data on the impact of non-chemical control techniques and strategies on biodiversity, but also quantify the environmental footprint of alternative management strategies to minimise any potential negative effects on the environment to ensure sustainable practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Modelling climate change impacts on crop production. Develop models to assess and predict the impacts of climate change on crop production. This knowledge could help farmers adapt their practices and mitigate potential risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Harnessing genetic resources and technology for agricultural innovation. Investigate the potential of genetic resources, e.g. new varieties developed with new breeding technologies, DNA-based monitoring of pests and diseases, and the use of satellite imaging for detection.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Predictive models for agricultural populations. Develop models that can predict crop, pest, disease, and weed population growth.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Communicating the benefits of IPM in a changing climate. Develop and present different discourses and frames for discussing IPM, connecting it to broader challenges such as climate change, to communicate the benefits of changed practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
7. Healthy animals for healthy people (8)	**Comparing quality and impact: conventional versus organic farming.** To better investigate the differences of product quality and environmental impact between conventional/intensive and organic/less intensive farming (e.g. in terms of food nutritional properties, greenhouse gas emissions, water pollution).	EU CAP Network workshop 'Animal welfare and innovation'
	Measuring environmental impacts of innovative farming systems. To measure emissions and all environmental impacts of innovative farming systems and to transfer the knowledge and apply science to everyday practice considering all affected factors, such as society, human health and environment.	EU CAP Network workshop 'Animal welfare and innovation'

	Enhancing animal welfare and productivity through technology. Monitoring animal welfare and productivity, investigating their links with farm profitability and the development of new indicators of 'positive welfare' (i.e. not only indicators of negative welfare due to mistreatment) and the use of IT technology and AI.	EU CAP Network workshop 'Animal welfare and innovation'
	Advancing cage-free production systems for resilient farming. For 'Cage-free production systems', finding more adaptive and resilient genotypes under different systems, providing farmers with decision support tools and evidence of a cost/benefit analysis for renovating existing facilities and building new facilities for cage-free systems. More knowledge on feasible cage-free systems for minor species (e.g. rabbits) is also needed, considering their socio-economic impact and effective solutions to control parasites and predation in cage-free/outdoor systems.	EU CAP Network workshop 'Animal welfare and innovation'
	Develop effective indicators for animal welfare monitoring. Indicators and monitoring methods: animal welfare indicators should be correct, reliable, harmonised and validated in practice, in pilot farms, and in collaboration with farmers and advisors to evaluate and monitor animal welfare. Indicators should be selected in agreement with the majority of stakeholders, considering the value of the results, their impact on the animal welfare assessment outcome, compared to other indicators, and considering the cost to use them. However, it has been suggested that research should focus on a few effective 'iceberg indicators', to be collected in a continuous and harmonised way, in order to monitor all herds and efficiently identify those with poor welfare. This approach would save the limited resources of competent authorities, allowing them to focus their control activities more on bad farms with the most animal welfare problems.	EU CAP Network workshop 'Animal welfare and innovation'
	Enhancing welfare labelling and certification in livestock production. New innovative research is also needed to improve 'Welfare labelling and certification'. Effective tools and communication channels should be developed and used to inform citizens and consumers about livestock production methods and animal welfare standards, and to educate stakeholders at every step of the chain, including replacement of workers, information/dialogue with society/citizens, and renewable/generation shifts in agriculture.	EU CAP Network workshop 'Animal welfare and innovation'
	Standardising animal welfare metrics across certification schemes. Research for standardisation of key figure calculations to compare animal welfare across different countries and certification schemes. Discussion, via round tables, of what changes are necessary in the livestock industry could help to take into account the needs and expectations of consumers/farmers/researchers.	EU CAP Network workshop 'Animal welfare and innovation'
	Comparing animal welfare in small farms versus large operators in CSA. Investigating the extent to which small farms, operating within Community Supported Agriculture (CSA model), could secure better animal welfare compared to large farm operators.	EU CAP Network workshop 'Animal welfare and innovation'

Integrated ecological approaches, from farm to landscape level		
4. Ecological approaches in land-based primary production (28)	**Continue research on the understanding of farmer's motivation and barriers to the adoption of HDLF.** Farmers seek information on issues that impact their farms or for which they require specific solutions. The topic of biodiversity is not yet openly in demand, highlighting the need for public awareness and educational activities. To tackle the challenging task of ensuring the appropriateness of such initiatives, research is necessary to understand the socio-cultural and environmental factors that facilitate farmers in maintaining or establishing HDLF, such as social norms and contextual suitability. Additionally, it is essential to identify factors that hinder them, such as conflicting arguments, workload, financial compensation and politics.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effectiveness and effort involved in, creating and engaging different communication channels. Biodiversity knowledge is communicated to farmers using various methods and tools. The success and effort involved in creating these tools, as well as the effort required to utilise different communication methods, can vary significantly. To determine the most effective cost/benefit combination of tools and methods for promoting biodiversity in the field, it is crucial to understand the communication needs of farmers, such as their preferences for digital or analogue approaches and face-to-face interactions.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Economic assessment and valuation of High-Diversity Landscape Features. The economic assessment of the costs and benefits related to HDLF at the landscape level is currently lacking. Specifically, there is a need to gain a better understanding of the mismatches between economic and ecological outcomes across farm and landscape scales. This includes identifying the optimal number and size of HDLF for different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effects of HDLF on water retention and microclimate. Not all the effects of different HDLF on water, soil, and microclimate are well known or thoroughly explored. The correlations between HDLF and microclimate are not yet fully understood. In extremely dry conditions, for instance, it may be challenging to establish landscape features such as vegetation or trees. However, these features themselves can influence water conditions, making subsequent steps towards enhancing HDLF easier. Some research findings may not be widely known among farmers. The challenge for a scientific team is to identify knowledge gaps and conduct further interdisciplinary research. The results can then be effectively communicated to farmers using appropriate methods, as outlined in the Mini Paper on knowledge transfer. This approach would ensure that farmers are aware of the potential positive effects from the outset. This research is particularly relevant to production farms that face issues related to water scarcity, soil degradation, and drought.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Analysis of co-benefits of HDLF for climate change adaptation. There are numerous general sources of information available on various HDLF and their benefits, as well as financial tools for promoting landscape greening through the Rural Development Programmes (RDP) in the previous programming period, and CAP Strategic Plans in the ongoing 2023-2027 programming period, including eco-schemes or support for Agri-Environment Climate measures. However, the implementation of these measures by farmers is progressing slowly due to concerns about potential loss of productive land and management costs. A significant research challenge lies in conducting a cost-benefit analysis of HDLF concerning on-farm adaptation to climate change. This analysis would help disseminate knowledge regarding the eco-economic benefits of HDLF and eco-schemes, thereby motivating farmers to adopt and actively participate in eco-schemes through the CAP. Implementing climate change adaptation or mitigation measures can provide multiple co-benefits to farmers. The need for this research is particularly crucial on intensively managed landscapes with a low proportion of HDLF, such as lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on understanding the enablers and barriers to the adoption of HDLF. Farmers typically seek information about issues that affect their farm or for which they are looking for concrete solutions. The topic of biodiversity is not always in high demand, which means that significant efforts are needed to stimulate interest. To address this challenge, research is necessary to understand the socio-cultural and environmental factors that motivate farmers to maintain or establish HDLF, such as social norms and contextual suitability. Similarly, it is important to identify and analyse those factors that may have an adverse effect, such as conflicting arguments, required workload, (lack of) financial compensation, etc.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into knowledge exchange between different actors. Ecologists, scientists and policymakers think differently to farmers. They belong to different thought collectives. This means different interests (goals), ways of knowing, working contexts and languages. To overcome these challenges, research is needed to explore what factors (e.g. importance of context, choice of language, motivating factors, personal exchange, self-study) favour the exchange of knowledge between the different thought collectives, and how these can be aligned to deliver for biodiversity and farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on how biodiversity advice is organised in different European countries. Advisory service in Europe is very diverse, with different financing models and organisations involved. One main difference is advisory through NGOs or official authorities. Other differences can be the extent of advisory service, independence of advisory organisations, qualification of advisors, the financial side (funding possibilities for measurements, free advisory or with costs, etc.), and more. Therefore, the effects, quality and acceptance of biodiversity advisory might differ significantly. The term advisory is used very broadly, and it is not always clear what lies behind its meaning. Experts (e.g. in Focus Groups) might think of totally different advisory systems because of the different systems in European countries. It would be helpful to have an overview over the existing advisory systems and how they relate to biodiversity. For the establishment of new advisory services, one could profit from the experiences with pros and cons of different systems. Moreover, the research could look at the correlations between advisory offers and establishment of HDLF.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Locate the most relevant sites for HDLF setup. Advising farmers to implement HDLF requires identifying the agricultural areas to prioritise for landscape restoration and the extent to which additional habitat amount and complexity should be increased. Evidence-based results and spatially-explicit tools are needed to assess the contribution of individual farms to produce spatial patterns of ecological importance at the landscape level for diverse taxa (groups of organisms, such as plants, animals or fungi).	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Develop indicators to provide guidance for the best setup and management of HDLF. Indicators are missed that are robustly validated by science to provide guidance for the appropriate setup and management of HDLF. Indicators are needed to assess the quality a priori and a posteriori of HDLF on farms regarding the services expected, including the services benefiting society in general in order to provide incentives for farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Understand the variety and intensity of interactions between above-and below-ground biodiversity. How the health and effective functioning of soil organisms is affected by the presence and health of above-ground biodiversity is still in need of further research. To fill this gap, research on the influence of above-ground biodiversity on the ecological benefits provided by below-ground biodiversity is needed.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Assess the costs and economic benefits associated with HDLF at the farm level. The economic assessment of the costs and benefits associated with HDLF at the farm level is still largely missing. There is a particular need to better understand the trade-offs between economic and ecological performances, including the identification of economic and ecological optima regarding the number and size of HDLF on different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into co-benefits of pollinator conservation actions. The challenge for farmers is a perceived risk to manage a part of their farm for HDLF due to concerns such as losing productive land, requiring additional time and money, and incurring additional management costs. Despite these concerns, managing farmland for pollinators through HDLF can provide numerous co-benefits to farmers. To overcome these challenges, evidence-based research results are necessary to support farmers through knowledge exchange and training to demonstrate the co-benefits of pollinator conservation actions, which will help farmers make informed decisions about managing their land. Furthermore, the research should also consider under which circumstances the co-benefits do not exceed the costs and which type of compensations measures or contract solutions can be applied.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research into the effects of tillage management practices and regenerative and/or conservation agriculture on pollinators (direct drilling, min-tilling, and ploughing). The benefit to soils, such as. structure and organic matter content, from direct drilling or min-tilling, where conditions allow, has become relatively common. However, the challenge is that the impacts on pollinators and broader biodiversity are less understood; therefore another lever for adoption may be uncovered through research. This could include looking into the advantages and disadvantages associated with the use of herbicides and catch, companion, and cover crops in place of traditional ploughing. To overcome this challenge, evidence-based research is needed to document the scientific linkage between tilling practices and pollinators to potentially provide another driver for farmer adoption.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the advantages or disadvantages of allowing wildflowers to naturally regenerate instead of seed sowing on plant and pollinator diversity. Seed sowing is cost-intensive but can provide resources for pollinators. Despite sowing a diversity of seeds, over time, a dominance of certain species over others occurs. The opposite can be said for natural regeneration. Initially, there can be a dominance of some species over others, but over time diversity increases. The results of a recent study indicate that tolerating the injurious weed species within the agricultural environment may be of greater benefit to flower-visiting insects than the sowing of 'wildflower mixes'. The challenge is to maintain flowering resources for pollinators and other groups of species with cost effective measures. To overcome this challenge, a combination of on-farm research and monitoring of plant communities (specifically floral resources) and pollinator diversity is needed.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the perception of different HDLF by various stakeholder groups (farmers, tourists, citizens, ag-science students etc.) and understanding how diverse groups of society can contribute to their maintenance and restoration, for example through place-based actions. This research could explore how to develop and implement place-based actions aimed at maintaining, restoring, or enhancing HDLF which can deliver socio-cultural benefits at the community level (e.g. social cohesion, integration of different groups). Also of interest is assessing how different types of HDLF fit into perceptions of landscapes and if these different types of HDLF provide social and cultural benefits.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the development of theoretical and practical tools aimed at promoting, protecting and enhancing social and cultural benefits of HDLF. This research should shift the focus from individual farmers to focus on shared practices and routinised activities that farmers engage in. The research should target the social and institutional context that gives rise to social norms, shared meanings and understandings, and material conditions that facilitate and encourage certain types of practices (i.e. related to creation and maintenance of HDLF). The research should aim to understand how certain conventions are established, how they evolve, what are the opportunities for change, and what practical tools can support this shift. This implies a focus on the societal-level system characteristics and the practices which that system promotes or facilitates. A key inquiry could explore the social and cultural norms that shape which HDLF are preferred by farmers and/or by society, and if these norms are related to how HDLF are maintained, enhanced, or created.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research on the creation of indicators for measuring and monitoring the social and cultural benefits of HDLF. The indicators should relate to a wide range of common HDLF such as those identified in this paper, and be applicable across different contexts. This research and related outputs can also be used to inform the development of educational and experiential materials to communicate the many social benefits (e.g. related to their habitat value, functions and roles in microclimate provisioning) of HDLF to different groups of people through different venues, such as for farmer training, primary and secondary schooling, and continuing education opportunities for different professions that may be involved in HDLF maintenance, restoration or enhancement (including community involvement). This research is relevant at a Europe-wide level and for all farm types to better capture a wide range of HDLF and socio-cultural contexts.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Exploring ecological inclusion: developing landscape and biodiversity by including participants in social farming. The potential of social farming to promote biodiversity in farms is much higher than what has been achieved to date (e.g. in active landscape development, by applying farming systems, which include handicraft, skills, etc.). Research is required on how social farming can further promote such activity and facilitate a win-win situation for the different target groups involved, for biodiversity and for climate change.	Focus Group 'Social farming and innovations'
	Mapping land abandonment and potential new uses in rural areas. Combine information sources to map with precision and reliability the state of land in remote and marginal areas with high risk of abandonment: which land is definitively abandoned, and which is severely affected but with a possibility for new uses. Establish benchmarks for the status of abandonment. Based on the most advanced remote sensing techniques combined with field work, select spatial indicators that can make this assessment and monitoring straightforward.	Focus Group 'Recovery of abandoned agricultural lands'
	Alternative crop and animal production strategies for abandoned land. Find and develop alternative crops or animal productions and strategies best adapted to the context of abandoned land, or other ways to bring more added value into the farm enterprise, by processing on the farm, or collectively in the region, and/or by shared marketing strategies.	Focus Group 'Recovery of abandoned agricultural lands'
	Innovative strategies for livestock production. Find innovative grazing strategies that can support a business model for livestock production and at the same time be supported with public policies due to its nature and conservation value.	Focus Group 'Recovery of abandoned agricultural lands'
	Cost-benefit analysis of agricultural land abandonment versus production. Assess the cost of non-action – how much does it cost, in terms of loss of ecosystems services, to let agricultural land go under abandonment, in marginal and remote areas or in peri-urban areas. The multiple benefits of ecosystem services may be adaptation and mitigation to climate change, landscape quality, mental health benefits for citizens and bringing children to the outdoors (mostly in peri-urban contexts), improving biodiversity, territorial cohesion, etc.	Focus Group 'Recovery of abandoned agricultural lands'

	Mitigation of GHG and carbon assessment in different types of farming. Mitigation of GHG from agriculture remains a significant challenge, with key issues to address, including emissions from enteric fermentation in livestock and from rice cultivation. Other critical concerns include the depletion of soil organic matter, and the high use of inputs associated with GHG emissions, such as fertilizers and fossil fuels for machinery. Storing carbon in the soil by increasing permanent crops (storing C in plant roots) and organic matter in the soil provides a useful path forward. Nevertheless, further research could cover: 1) Methodologies for measuring Carbon sink and GHG emissions of farms and agriculture that are agreed upon and support farmers practicing mitigation. 2) Assessment of GHG emissions of different methods and contexts of livestock or dairy production and correct policies and incentives for different types of farming depending on environmental performance.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Enhancing soil life and biotic interactions in different farming systems and crops through sustainable farming. Conventional farming is degrading soil life, soil productivity and the performance of several ecosystem services. Conservation farming and organic farming practices significantly contribute to increase soil life, soil productivity and ecosystem services. Better knowledge of the biotic interactions occurring in soil and their linkages with agroecosystem functioning is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Alternative water supplies. Increased aridity and water scarcity for animals and humans but also for irrigation remain significant challenges in many areas, such as in Southern and Central Europe. Options for alternative water supplies exist, such as fog traps (harvesting water from fogs to provide drinking water for animals and humans), recycling of greywaters from urban areas, farms and households, as well as desalinization. However, research and innovation on achieving cost-effective solutions to implement technologies for alternative water supplies is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Soil biology indicators for enhanced soil health management. Develop soil biology indicators to better manage soil health.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Make digital databases of (anonymous) European Union farmers accessible to the scientific community. These databases should contain valuable information such as the frequency of chemical treatments, types of products used, and crop yield data spanning multiple years. Sharing this information with researchers can provide valuable insights and contribute to improving agricultural practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

1. Climate action in agriculture and forestry (19)	**Continue research to understand farmers' motivation and the barriers to the adoption of HDLF.** Farmers seek information on issues that impact their farms or for which they require specific solutions. The topic of biodiversity is not yet openly in demand, highlighting the need for public awareness and educational activities. To tackle the challenging task of ensuring the appropriateness of such initiatives, research is necessary to understand the socio-cultural and environmental factors that facilitate farmers in maintaining or establishing HDLF, such as social norms and contextual suitability. Additionally, it is essential to identify factors that hinder them, such as conflicting arguments, workload, financial compensation, and politics.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effectiveness of, versus the effort involved in, creating and engaging different communication channels. Biodiversity knowledge is communicated to farmers using various methods and tools. The success and effort involved in creating these tools, as well as the effort required to utilise different communication methods, can vary significantly. To determine the most effective cost/benefit combination of tools and methods for promoting biodiversity in the field, it is crucial to understand the communication needs of farmers, such as their preferences for digital or analogue approaches and face-to-face interactions.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Analysis of co-benefits of HDLF for climate change adaptation. There are numerous general sources of information available on various HDLF and their benefits, as well as financial tools for promoting landscape greening through the Rural Development Programmes (RDP) in the previous programming period and CAP Strategic Plans in the ongoing 2023-2027 programming period, such as eco-schemes or support for Agri-Environment Climate measures. However, the implementation of these measures by farmers is progressing slowly due to concerns about potential loss of productive land and management costs. A significant research challenge lies in conducting a cost-benefit analysis of HDLF concerning on-farm adaptation to climate change. This analysis would help disseminate knowledge regarding the eco-economic benefits of HDLF and eco-schemes, thereby motivating farmers to adopt and actively participate in eco-schemes through the CAP. Implementing climate change adaptation or mitigation measures can provide multiple co-benefits to farmers. The need for this research is particularly crucial on intensively managed landscapes with a low proportion of HDLF, such as lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	A need for demonstration sites/examples/good practices. Related to the previous issue, the challenge for future research is a lack of evidence for HDLF long-term benefits to ecosystem services and demonstration sites/examples/good practices (new ones, studying existing ones, establishing a 'HDFL best practices' network or an 'Innovation path of future HDFLs'. The research study of future HDLF must focus on different benefits addressed to farmers in terms of yields, resilience, water balance, soil/below-ground benefits and structures, and impact of HDLF on microclimate. There are older studies providing estimations for eco-system benefits, but these are mostly based on past models that did not adequately consider the impact of climate change Therefore these studies would need to be updated. The need for this research is especially acute in intensively managed landscapes with a low proportion of HDLF – e.g., lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research and an innovative idea for the integration of HDLF in existing production systems. The integration of individual or combinations of HDLF, including agroforestry elements, in existing production systems can potentially have positive effects regarding climate change adaptation, such as higher water holding capacity, erosion reduction, shading, and a reduction in heat. On the other hand, trade-offs are also conceivable, for example, competition for nutrients or effects on plant health. Furthermore, farmers are facing challenges regarding mechanisation possibilities, rising workloads, and costs, without reliable data on economic benefits. The challenge for further research is to provide information on practical implementation, including, e.g., suitable varieties for treelines or hedges, options to maintain mechanisation, effects on nutrient management and economic viability. For permanent crops, the analysis of long-term effects of agroforestry on product quality is also an important topic. The need for research is especially relevant for crops with specific production systems, such as permanent crops and vegetables.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Innovative sustainable technologies for agriculture. Developing new and sustainable technologies (e.g. green hydrogen, plastic alternatives, short-term and long-term energy storage solutions, improving energy efficiency of machinery and farm equipment, carbon capture techniques, diversified renewable energy sources, sustainable fertilisation including renewable and recycled nutrient sources, bio-stimulants, pyrolysis, biochar, and suitability of robotics and artificial intelligence to reduce dependencies).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Enhancing the efficiency of existing agricultural technologies. Improving and increasing efficiency of already existing technology and machinery (e.g. biogas production, storage solutions, solar power, waterpower, wind power).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Mitigation of GHG and carbon assessment in different types of farming. Mitigation of GHG from agriculture remains a significant challenge, with key issues to address, including emissions from enteric fermentation in livestock and from rice cultivation. Other critical concerns include the depletion of soil organic matter, and the high use of inputs associated with GHG emissions, such as fertilizers and fossil fuels for machinery. Storing carbon in the soil by increasing permanent crops (storing C in plant roots) and organic matter in the soil provides a useful path forward. Nevertheless, further research could cover: 1) Methodologies for measuring Carbon sink and GHG emissions of farms and agriculture that are agreed upon and support farmers practicing mitigation. 2) Assessment of GHG emissions of different methods and contexts of livestock or dairy production and correct policies and incentives for different types of farming depending on environmental performance.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Practical implementation of reduced tillage/no-till and permanent soil cover. Reduced tillage/no-till and permanent soil cover present solutions to several negative impacts of traditional tilling, such as erosion, compaction, degradation of soil life, reduction of soil organic matter, and reduction of soil water-holding capacity. Several methods, including conservation tillage, direct seeding, direct seeding without herbicides, direct seeding in permanent pastures, no tilling, cover crops, roller-crimped cover crops, and shredded cover crops, offer promising alternatives. However, further research is needed to assess their efficacy in different soil types, crops and farming practices, assessing their cost-benefit ratio.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Enhancing soil life and biotic interactions in different farming systems and crops through sustainable farming. Conventional farming is degrading soil life, soil productivity and the performance of several ecosystem services. Conservation farming and organic farming practices significantly contribute to increase soil life, soil productivity and ecosystem services. Better knowledge of the biotic interactions occurring in soil and their linkages with agroecosystem functioning is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Water harvesting and storage. With rising temperatures, decreased precipitation, increased droughts, and growing water scarcity, there is an increased demand for water across various needs, including irrigation, deficit irrigation, livestock, human consumption, firefighting, and ecosystems. Certain months experience water abundance and flooding, while others endure prolonged dry spells. Large-scale dams and infrastructure for water harvesting often entail significant financial, environmental, and social costs. Alternatives to large-scale dams, include off-stream dams, lakes and ponds, swales and roads with a keyline (1-2% slope) leading to ponds, keyline design, and varied terrain modelling techniques such as swales, terraces, dykes, jessours, gabions and half-moons. Other methods include mulching and afforestation. Water harvesting at the landscape scale can also help reduce temperatures. Several questions need further exploration, such as the comparative cost and efficiency of various water harvesting and storage techniques. Innovation in water storage is crucial to reduce costs for farmers, as current methods can be expensive. Research should address whether it is more effective to store water underground or in dams and surface reservoirs, the optimal terrain modelling solutions for water harvesting, and how regions can shift from individual farm off-stream rainwater harvesting to integrated landscape level approaches. Additionally, exploring how roads best support water harvesting needs in adapting to climate change is essential.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Forests and water cycle at mesoscale: can afforestation increase rainfall in Europe. With the increase of temperature, precipitation reduces, since the cloud condensation level is higher at lower temperatures (direct relation with relative humidity). Decrease in precipitation is a major challenge for south and central Europe. Several authors show that afforestation can reinforce the water cycle at a mesoscale, allowing rain (warm fronts) to extend through thousands of kilometres, thus revealing 'good potential for forest-mediated solutions of the global desertification and water security problems'. Further research could explore if large scale afforestation programmes that create contiguous forests in the continuation of ocean and coastal areas could increase rainfall in some areas of Europe and a be a good adaptation to climate change.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Alternative water supplies. Increased aridity and water scarcity for animals and humans but also for irrigation remain significant challenges in many areas, such as in Southern and Central Europe. Options for alternative water supplies exist, such as fog traps (harvesting water from fogs to provide drinking water for animals and humans), recycling of greywaters from urban areas, farms and households as well as desalinization. However, research and innovation on achieving cost-effective solutions to implement technologies for alternative water supplies is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Knowledge of the climate envelopes and climate adaptation of species, crops, cultivars, varieties and breeds (plants and animals). In the context of a changing climate and changing weather patterns, choosing species, cultivars, or varieties that are adapted to climate change is a very important adaptation measure. The challenge relies on the fact that the information on the climate envelope and climate adaptability of each crop is not known or not integrated and available to farmers, researchers and other stakeholders. It is necessary to research, catalogue and compile knowledge on the climate adaptability of species, crops and varieties, and to integrate all the existing knowledge and make it accessible to stakeholders, for example by creating an open-access online catalogue available to farmers, farm advisors and the general public, with the climate envelope and climate adaptability of species, crops and varieties, both plants and animals. By knowing which crops and varieties are more resistant to drought, heat waves, flooding etc, farmers, plant nurseries, and companies can adapt and produce what is most needed to improve farming adaptation. Modelling and simulations, using these climate envelope and climate change scenarios, can also help in spatial planning, farm planning, etc. What needs further research: Studies on the climate envelope and climate adaptability of species, crops and varieties. Articulation of indicators that are relevant for farmers and other relevant stakeholders.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Developing climate-adapted species and breeds. Cultivars and animal breeds have been developed for specific purposes and types of farming during a long time. Climate-adapted breeds and varieties that are required for a smart and climate resilient farming are not available on the market. Climate-adapted diversified farming is very context-specific, requires numerous varieties and breeds, and therefore requires farmers and/or local/regional partners to select, develop, and conserve animal breeds and plant varieties that are more adapted to present and future climates. This process needs further research through applied-research and/or action-research, in close partnership with farmers (to address their needs). Throughout the climate-vulnerable regions of Europe, plant varieties and animal breeds must be selected, improved, tested, and evaluated, to be disseminated and promoted as a climate adaptation measure for the different agro-climatic zones and types of farming. This research can include genetic variability and new breeding techniques but without the use of Genetically Modified Organisms (GMO).	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Managing invasive pests in a changing climate. As climate changes, species, namely pests and diseases, migrate. New pests and diseases can constitute a serious threat to farming and food security in Europe. Integrated and best practices in pest management are not sufficiently disseminated and implemented. In addition, the potential for unpredictable mass spread of pests and diseases increases in a changing climate and in the context of large-scale monocultures and homogeneous farming with reduced species, crop and genetic diversity in agroecosystems. Applying integrated pest management and best practices in EU farming at a landscape scale could prove helpful. More monitoring of pests and diseases spread, as well as more knowledge on how to efficiently prevent, control and regulate new invasive species and diseases, would be needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Effectiveness, cost-effectiveness and cost-benefit analysis of solutions and Decision Support Systems for climate change adaptation. There are many adaptation strategies, with hundreds of measures and solutions for climate adaptation at farm level. In addition, there are many techniques and variations with significant differences regarding effectiveness, cost, and secondary positive and negative impacts. When faced with the need to decide and invest to adapt and reduce their vulnerability to climate change, farmers and stakeholders have difficulty in finding and using appropriate decision support systems and comparing the effectiveness, cost and benefit of the different adaptation solutions. Potential solutions include assessing and comparing the effectiveness of adaptation measures and solutions at farm level, analysing the cost-effectiveness and/or cost-benefit relation for the different solutions, and using appropriate decision support systems for the different types of farming and the different scales. Further research would be needed on the effectiveness of the adaptation solutions, namely using indicators that are relevant and applicable for climate adaptation and useful for farmers' decision-making, as well as on the development, testing and streamlining indicators and decision support systems to integrate this information, and support farmers and stakeholders in decision-making at the appropriate level.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Modelling climate change impacts on crop production. Develop models to assess and predict the impacts of climate change on crop production. This knowledge could help farmers adapt their practices and mitigate potential risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Sustainability of innovative farming systems. To measure emissions and all environmental impacts of innovative farming systems and to transfer the knowledge and apply science to everyday practice considering all affected factors, such as society, human health and environment.	EU CAP Network workshop 'Animal welfare and innovation'
8. Sustainable livestock systems (11)	**Innovative grazing strategies for sustainable livestock production.** Find innovative grazing strategies that can support a business model for livestock production and at the same time be supported with public policies due to their nature and conservation value.	Focus Group 'Recovery of abandoned agricultural lands'
	Cost and benefit analysis of abandonment versus keeping land under production. Assess the cost of non-action – how much does it cost, in loss of ecosystems services, to let agricultural land go under abandonment, in marginal and remote areas or in peri-urban areas. The multiple benefits or ecosystem services may be adaptation and mitigation to climate change, landscape quality, mental health benefits for citizens and bringing children to the outdoors (mostly in peri-urban contexts), improving biodiversity, territorial cohesion, etc.	Focus Group 'Recovery of abandoned agricultural lands'

	Mitigation of GHG and carbon assessment in different types of farming. Mitigation of GHG from agriculture remains a significant challenge, with key issues to address, including emissions from enteric fermentation in livestock and from rice cultivation. Other critical concerns include the depletion of soil organic matter and the high use of inputs associated with GHG emissions, such as fertilizers and fossil fuels for machinery. Storing carbon in the soil by increasing permanent crops (storing C in plant roots) and organic matter in the soil provides a useful path forward. Nevertheless, further research could cover: 1) Methodologies for measuring Carbon sink and GHG emissions of farms and agriculture that are agreed upon and support farmers practicing mitigation. 2) Assessment of GHG emissions of different methods and contexts of livestock or dairy production and correct policies and incentives for different types of farming depending on environmental performance.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Water harvesting and storage. With rising temperatures, decreased precipitation, increased droughts, and growing water scarcity, there is an increased demand of water across various needs, including irrigation, deficit irrigation, livestock, human consumption, firefighting, and ecosystems. Certain months experience water abundance and flooding, while others endure prolonged dry spells. Large-scale dams and infrastructure for water harvesting often entail significant financial, environmental, and social costs. Alternatives to large-scale dams include off-stream dams, lakes and ponds, swales and roads with a keyline (1-2% slope) leading to ponds, keyline design, and varied terrain modelling techniques such as. swales, terraces, dykes, jessours, gabions and half-moons. Other methods include mulching and afforestation. Water harvesting at the landscape scale can also help reduce temperatures. Several questions need further exploration, such as the comparative cost and efficiency of various water harvesting and storage techniques. Innovation in water storage is crucial to reduce costs for farmers, as current methods can be expensive. Research should address whether it is more effective to store water underground or in dams and surface reservoirs, the optimal terrain modelling solutions for water harvesting, and how regions can shift from individual farm off-stream rainwater harvesting to integrated landscape level approaches. Additionally, exploring how roads best support water harvesting needs in adapting to climate change is essential.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Comparing quality and environmental impact: conventional versus organic farming. To better investigate the differences of product quality and environmental impact between conventional/intensive and organic/less intensive farming (e.g. in terms of food nutritional properties, greenhouse gas emissions, water pollution).	EU CAP Network workshop 'Animal welfare and innovation'
	Monitoring animal welfare and productivity for profitability. Monitoring animal welfare and productivity, investigating their links with farm profitability and the development of new indicators of 'positive welfare' (i.e. not only indicators of negative welfare due to mistreatment) and the use of IT technology and AI.	EU CAP Network workshop 'Animal welfare and innovation'

	Enhancing cage-free production systems for livestock. For 'Cage-free production systems', finding more adaptive and resilient genotypes under different systems, providing farmers with decision support tools and evidence of a cost/benefit analysis for renovating existing facilities and of building new facilities for cage-free systems. More knowledge on feasible cage-free systems for minor species (e.g. rabbits) is also needed, taking into account their socio-economic impact and effective solutions to control parasites and predation in cage-free/outdoor systems.	EU CAP Network workshop 'Animal welfare and innovation'
	Developing harmonised indicators for animal welfare monitoring. Animal welfare indicators should be correct, reliable, harmonised and validated in practice, in pilot farms, in collaboration with farmers and advisors, to evaluate and monitor animal welfare. Indicators should be selected in agreement with most stakeholders, considering the value of the results, their impact on the animal welfare assessment outcome, compared to other indicators, and considering the cost to use them. However, it has been suggested that research should focus on a few effective 'iceberg indicators', to be collected in a continuous and harmonised way, and to monitor all herds and efficiently identify those with poor welfare. This approach would save the limited resources of competent authorities, allowing them to focus their control activities more on bad farms with the most animal welfare problems.	EU CAP Network workshop 'Animal welfare and innovation'
	New innovative research is also needed to improve 'Welfare labelling and certification'. Effective tools and communication channels should be developed and used to inform citizens and consumers about livestock production methods and animal welfare standards and to educate stakeholders at every step of the chain, including replacement of workers, information/dialogue with society/citizens, and renewable/generation shifts in agriculture.	EU CAP Network workshop 'Animal welfare and innovation'
	Standardising animal welfare metrics: bridging gaps between stakeholders. Research for standardisation of key figure calculations to compare animal welfare across different countries and certification schemes. Discussion, via round tables, of what changes are necessary in the livestock industry could help to consider the needs and expectations of consumers/farmers/researchers.	EU CAP Network workshop 'Animal welfare and innovation'
	Evaluating animal welfare in small farms within the CSA model. Investigating the extent to which small farms, operating within Community Supported Agriculture (CSA model), could secure better animal welfare compared to large farm operators.	EU CAP Network workshop 'Animal welfare and innovation'

Enhancing rural innovation – modernising rural territories and policies		
New openings for rural growth		
9. Small-scale, sustainable bio-based systems (15)	**Expanding access to social farming services for broader community engagement.** Investigate how social farming services could be made available to a broader target group and thereby bridge the gap between agriculture and society. Social farming has the potential to offer substantial benefits to people outside the 'typical' target groups of social farming (e.g. people with burnout, caregivers, children, refugees). Research is needed on how social farming can be opened up to meet this potential area of development and how this could also help bridge the wide concept gap of understanding between agriculture and society.	Focus Group 'Social farming and innovations'
	Characterising land abandonment processes across geographical contexts. Characterise the specificity of the land abandonment process in different geographical contexts and classify the specific combination of the drivers leading to abandonment so that solutions for recovery can also be better tailored.	Focus Group 'Recovery of abandoned agricultural lands'
	Developing entrepreneurial skills for enterprises in abandoned areas. Identify entrepreneurial, collaboration, or other soft skills required for individuals who want to set up an enterprise in areas at risk of land abandonment or already abandoned areas, and which training modules and support structures can better create the conditions for these skills to be acquired.	Focus Group 'Recovery of abandoned agricultural lands'
	Alternative crop and animal production strategies for abandoned land. Find and develop alternative crops or animal productions and strategies best adapted to the context of abandoned land, or other ways to bring more added value into the farm enterprise, by processing in the farm, or collectively in the region, and/or by shared marketing strategies.	Focus Group 'Recovery of abandoned agricultural lands'
	Affordable innovative solutions for animal and crop production in rural areas. Find specific innovative technical solutions for animal or crop production that are at the same time affordable and easy to handle in order to facilitate the use of remote and abandoned areas, easing the burden of heavy manual work that is still required in many areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Sustainable biomass utilisation in abandoned land. Explore a case on the sustainable use of available biomass in abandoned land for soil improvement, energy production, building materials or other biobased industries; identify how to build biomass-based processing units that can make a sustainable business in remote areas.	Focus Group 'Recovery of abandoned agricultural lands'

	Enhancing efficiency of existing agricultural technologies. Improving and increasing the efficiency of already existing technology and machinery (e.g. biogas production, storage solutions, solar power, waterpower, wind power).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Research on sustainable farming systems. Farming system research (e.g. on-farm nutrient assessment and management, cascading production of food and energy, increasing food systems efficiency by promoting short food supply chains and localised food networks, etc.).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Practical implementation of reduced tillage/no-till and permanent soil cover. Reduced tillage/no-till and permanent soil cover present solutions to several negative impacts of traditional tilling, such as erosion, compaction, degradation of soil life, reduction of soil organic matter, and reduction of soil water-holding capacity. Several methods, including conservation tillage, direct seeding, direct seeding without herbicides, direct seeding in permanent pastures, no tilling, cover crops, roller-crimped cover crops, and shredded cover crops, offer promising alternatives. However, further research is needed to assess their efficacy in different soil types, crops and farming practices, assessing their cost-benefit ratio.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Managing invasive pests in a changing climate. As climate changes, species, namely pests and diseases, migrate. New pests and diseases can constitute a serious threat to farming and food security in Europe. Integrated and best practices in pest management are not sufficiently disseminated and implemented. In addition, the potential for unpredictable mass spread of pests and diseases increases in a changing climate and in the context of large-scale monocultures and homogeneous farming with reduced species, crop and genetic diversity in agroecosystems. Applying integrated pest management and best practices in EU farming at a landscape scale could prove helpful. More monitoring of pests and diseases spread, as well as more knowledge on how to efficiently prevent, control and regulate new invasive species and diseases, would be needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Analyse the productivity and profitability of Integrated Pest Management (IPM) strategies at the farm level. To achieve this, gather data at the EU level, including data from different regions and pilot farms. This data could also be used to assess the effectiveness of IPM strategies at the farm level and analyse the effects of IPM-based strategies on risk levels, determining whether they increase or decrease risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Evaluate the economic impact of implementing sustainable practices in various contexts. The development of methods to calculate the environmental and health impacts of different farming systems and enable cost comparisons.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Holistic assessment of IPM strategies. Conduct research to harmonise and holistically assess the impact of implementing different IPM strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identify the most cost-effective economic incentives that also provide ecosystem services. To determine the costs of pesticide use, residue analysis should be performed at both the farm and crop levels to understand the residues associated with pesticides used in different crop management strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Comparative scenarios of sustainable agro-economic practices. Develop scenarios that compare common practices with known sustainable practices in terms of economy, safety, and well-being. Explore different agro-economic systems that are attractive to young farmers, considering farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmer well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
11. Enabling digital and data technologies (14)	**Defining the role of advisors and innovation brokers in social farming.** Examine the profile of a skilled adviser and (social) innovation broker in social farming. With a lack of advisors and innovation brokers in social farming at national and EU levels, there is a need to identity the profile and skills (not only agronomic skills) of current and future agricultural advisors and innovation brokers for social farming.	Focus Group 'Social farming and innovations'
	Quantifying the impacts of social farming for support and sustainability. How can we quantify of the impacts of social farming? There is a lack of data, which quantifies the impact of social farming in numbers, and specific values, which can be key to securing support for social farming. There is a need to identify impacts, which are possible to quantify more easily, as well as those, which can be converted to economic values.	Focus Group 'Social farming and innovations'
	Leveraging LAGs and LEADER for mitigating land abandonment. Assess the potential of the LAGs and LEADER approach to support mitigation actions of land abandonment; identify best approaches for each geographical, cultural and institutional context.	Focus Group 'Recovery of abandoned agricultural lands'
	Redefining rural communities: engaging stakeholders through digital innovation. Identifying a new way to think of a rural community, engaging different stakeholders, and making use of modern digital and other new technologies to enable this. Assess what the digital network minimum needs are for the digital transition to be made a reality, including in remote rural areas.	Focus Group 'Recovery of abandoned agricultural lands'

	Regional viability: assessing spatial planning strategies to combat land abandonment. Discuss and assess spatial planning instruments and approaches to be used to tackle the risk of land abandonment where not only the viability of one isolated farm is analysed and optimised but the viability of a whole region is considered through small-scale regional cultivation, food systems approaches, and management plans that engage farmers, enterprises, and municipalities throughout a territorialised food system.	Focus Group 'Recovery of abandoned agricultural lands'
	Enhancing energy efficiency of existing agricultural technologies. Improving and increasing efficiency of already-existing technology and machinery (e.g. biogas production, storage solutions, solar power, waterpower, wind power).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Creating accessible digital databases for EU farmers. Make digital databases of (anonymous) European Union farmers accessible to the scientific community. These databases should contain valuable information such as the frequency of chemical treatments, types of products used, and crop yield data spanning multiple years. Sharing this information with researchers can provide valuable insights and contribute to improving agricultural practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Exploring genetic resources for enhanced agricultural practices. Investigate the potential of genetic resources, e.g. new varieties developed with new breeding technologies, DNA-based monitoring of pests and diseases, and the use of satellite imaging for detection.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Predictive modelling for crop and pest dynamics. Develop models that can predict crop, pest, disease and weed population growth.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Harmonised insurance criteria for sustainable farming practices. Develop harmonised insurance criteria for sustainable farm practices, incorporating sustainability evolution into insurance policies to lower premiums for farmers based on standardised criteria. Assess the impact of the insurance systems on the adoption and implementation of best available practices. Investigate how these insurance systems can be integrated into policies and established as permanent frameworks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Attractive agro-economic systems for young farmers. Explore different agro-economic systems that are attractive to young farmers, taking into account farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmers' wellbeing.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Animal welfare and productivity monitoring in farming. Monitoring animal welfare and productivity, investigating their links with farm profitability and the development of new indicators of 'positive welfare' (i.e. not only indicators of negative welfare due to mistreatment) and the use of IT technology and AI.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Developing effective animal welfare indicators and monitoring methods. Animal welfare indicators should be correct, reliable, harmonised and validated in practice, in pilot farms, in collaboration with farmers and advisors to evaluate and monitor animal welfare. Indicators should be selected in agreement with most stakeholders, considering the value of the results, their impact on the animal welfare assessment outcome, compared to other indicators, and considering the cost to use them. However, it has been suggested that research should focus on a few effective 'iceberg indicators', to be collected in a continuous and harmonised way, and to monitor all herds and efficiently identify those with poor welfare. This approach would save the limited resources of competent authorities, allowing them to focus their control activities more on bad farms with the most animal welfare problems.	EU CAP Network workshop 'Animal welfare and innovation'
	Enhancing welfare labelling and certification in livestock production. New innovative research is also needed to improve 'Welfare labelling and certification'. Effective tools and communication channels should be developed and used to inform citizens and consumers about livestock production methods and animal welfare standards, and to educate stakeholders at every step of the chain, including replacement of workers, information/dialogue with society/citizens, and renewable/generation shifts in agriculture.	EU CAP Network workshop 'Animal welfare and innovation'
Enhancing the human and social capital in rural areas		
12. Agricultural Knowledge and Innovation Systems (AKIS) of the future (30)	**Addressing land abandonment: transaction costs and market mobility in high-risk areas.** In high-risk areas related to land abandonment (for example certain areas in Spain, Portugal, Greece): a) Assess the influential factors related to transaction costs of land ownership or use rights, such as unknown ownership, co-ownership, or inaccurate land registers, and identify and test solutions to overcome these limitations, including an assessment of advantages and drawbacks; b) Examine the factors that restrict greater mobility in land markets and prevent land owners from engaging in land markets, including the issues related to tenure security, and behavioural and psychological factors. Find the most efficient and pragmatic ways to identify the owners of existing rights and map property boundaries. This is about new or adapted legal instruments and approaches, and their articulation with economic incentives.	Focus Group 'Recovery of abandoned agricultural lands'
	Innovative collective solutions for property fragmentation. Identify and propose new forms of collective arrangements that can help cope with the extreme fragmentation of property, resulting in parcels that can be used by the same farm systems, and support viability in business models.	Focus Group 'Recovery of abandoned agricultural lands'

	Building entrepreneurial skills for resilient enterprises in rural areas. Identify entrepreneurial, collaborative or other soft skills required for individuals who want to set up an enterprise in areas at risk of land abandonment or in already abandoned areas, and which training modules and support structures can better create the conditions for these skills to be acquired.	Focus Group 'Recovery of abandoned agricultural lands'
	Regional variability: strategies for mitigating land abandonment. Discuss and assess spatial planning instruments and approaches to be used to tackle the risk of land abandonment where not only the viability of one isolated farm is analysed and optimised, but the viability of a whole region is considered through small-scale regional cultivation, food systems approaches, and management plans that engage farmers, enterprises and municipalities throughout a territorialised food system.	Focus Group 'Recovery of abandoned agricultural lands'
	Enhancing cooperation in peri-urban food sectors. Identify how to integrate different 'peri-urban food visions' and how to improve cooperation among the different food sectors in peri-urban areas through planning, initiatives from the farming sector, landowners (public and private owners), legislation regarding food markets, and post-harvesting facilities.	Focus Group 'Recovery of abandoned agricultural lands'
	Sustainable agricultural technologies: innovations in energy and resource management. Developing new and sustainable technologies (e.g. green hydrogen, plastic alternatives, short term and long-term energy storage solutions, improving energy efficiency of machinery and farm equipment, carbon capture techniques, diversified renewable energy sources, sustainable fertilisation including renewable and recycled nutrient sources, bio-stimulants, pyrolysis, biochar, and suitability of robotics and artificial intelligence to reduce dependencies).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Effectiveness, cost-effectiveness and cost-benefit analysis of solutions and Decision Support Systems for climate change adaptation. There are many adaptation strategies, with hundreds of measures and solutions for climate adaptation at farm level. In addition, there are many techniques and variations with significant differences regarding effectiveness, cost, and secondary positive and negative impacts. When faced with the need to decide and invest to adapt and reduce their vulnerability to climate change, farmers and stakeholders have difficulty in finding and using appropriate decision support systems and comparing the effectiveness, cost and benefit of the different adaptation solutions. Potential solutions include assessing and comparing the effectiveness of adaptation measures and solutions at farm level, analysing the cost-effectiveness and/or cost-benefit relation for the different solutions and using appropriate decision support systems for the different types of farming and the different scales. Further research would be needed on the effectiveness of the adaptation solutions, namely using indicators that are relevant and applicable for climate adaptation and useful for farmers' decision-making, as well as on the development, testing and streamlining indicators and decision support systems to integrate this information, and support farmers and stakeholders in decision-making at the appropriate level.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Economic impact analysis of the Farm to Fork Strategy on crop yields and food imports across the EU. Research the country-specific and EU-wide economic impact of the Farm to Fork strategy, including its effects on crop yields and food imports.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Advancing detection and monitoring techniques for pests, disease and weeds. This research focuses on developing new and improved techniques for detecting and sampling pests, diseases, and weeds. Innovative approaches, such as DNA barcoding, can enable quick and accurate identification similar to rapid COVID-19 tests for selected pests. Additionally, the development of automated monitoring sensors is essential for real time detection and tracking of pests, diseases, and weeds.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Understanding of the population dynamics of bio-control agents, both micro- as well as macro-organisms. By studying their interactions and reproductive patterns, researchers can support the deployment of these agents and enhance bio-control strategies in Integrated Crop Management strategies. This includes manipulating plants and habitats to strengthen the presence of natural enemies.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Assessing non-chemical control techniques: biodiversity and environmental footprint. Gather data on the impact of non-chemical control techniques and strategies on biodiversity but also to quantify the environmental footprint of alternative management strategies to minimise any potential negative effects on the environment to ensure sustainable practices.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Soil biology indicators for enhanced soil health. Develop soil biology indicators to better manage soil health. By identifying key biological markers, farmers and land managers can make more informed decisions to improve soil function, productivity, and resilience.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Modelling climate change impacts on crop production for adaptive farming. Develop models to assess and predict the impacts of climate change on crop production. This knowledge could help farmers adapt their practices and mitigate potential risks.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'
	Developing a standardised scoring system to measure and enhance farm biodiversity. Make farm biodiversity measurable and comparable. With a scoring system, farmers could have a standardised and comparable framework to assess and monitor biodiversity on farms more effectively. By implementing such a system, farmers can track and enhance biodiversity on their farms, contributing to sustainable agriculture.	EU CAP Network workshop 'Innovative arable crop protection - using pesticides sustainably'

	Creating accessible, anonymous EU farmer databases for enhanced agricultural research. Make digital databases of (anonymous) European Union farmers accessible to the scientific community. These databases should contain valuable information such as the frequency of chemical treatments, types of products used, and crop yield data spanning multiple years. Sharing this information with researchers can provide valuable insights and contribute to improving agricultural practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Exploring genetic resources and advanced technologies for crop improvement and pest monitoring. Investigate the potential of genetic resources, e.g. new varieties developed with new breeding technologies, DNA-based monitoring of pests and diseases, and the use of satellite imaging for detection.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identifying farmers education and research needs. Identify farmers' knowledge gaps and specific needs for tailor-made education and outreach programmes.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Farming IPM for climate resilient agriculture. Develop and present different discourses and frames for discussing IPM, connecting it to broader challenges such as climate change, to communicate the benefits of changed practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Factors influencing farmers willingness to change practices. Investigate the factors that make farmers willing to change or partially change their practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Harmonised insurance criteria for sustainable farming practices. Develop harmonised insurance criteria for sustainable farm practices, incorporating sustainability evolution into insurance policies to lower premiums for farmers based on standardised criteria. Assess the impact of the insurance systems on the adoption and implementation of best available practices. Investigate how these insurance systems can be integrated into policies and established as permanent frameworks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Scenarios for sustainable practices: economic, safety and well-being impacts on young farmers. Develop scenarios that compare common practices with known sustainable practices in terms of economy, safety, and well-being. Explore different agro-economic systems that are attractive to young farmers, considering farming system types, agro-ecological practices, diversification, on-farm biodiversity practices and their impact on farmers' well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Exploring agro-economic systems for young farmers: practices, diversification and well-being. Explore different agro-economic systems that are attractive to young farmers, taking into account farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmer well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing farmer well-being across farming systems and practices. Study the well-being of farmers and publish the results, taking into account different farming system types and practices, including aspects of health and personal satisfaction.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Optimising AKIS for knowledge sharing and farmer engagement. Analyse use of Agricultural Knowledge and Innovation Systems (AKIS) to facilitate knowledge-sharing and accelerate change, including identifying AKIS success factors and understanding how to effectively reach farmers.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Effective incentives for enhancing farmer value and recognition. Investigate the most effective incentives for increasing the value and recognition of farmers. Evaluate different types of incentives and develop education and communication campaigns based on the findings.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Comparative analysis of product quality and environmental impact in conventional versus organic farming. This aims to explore the differences in product quality and environmental impact between conventional/intensive and organic/less intensive farming systems. Key factors of comparison include food nutritional properties, greenhouse gas emissions and water pollution.	EU CAP Network workshop 'Animal welfare and innovation'
	Measuring emissions and environmental impacts of innovative farming systems: bridging science and practice. To assess emissions and the full range of environmental impacts of innovative farming systems, while effectively transferring knowledge and applying scientific insights to everyday practice. This approach must consider all relevant factors, including society, human health and the environment.	EU CAP Network workshop 'Animal welfare and innovation'
	Enhancing cage-free production systems: adaptive genotypes, decision support tools and socio-economic impacts. For 'Cage-free production systems', it is important to identify more adaptive and resilient genotypes suited for different systems. Farmers need decision support tools and evidence from cost/benefit analysis for renovating existing facilities and building new ones for cage-free systems. There is also a need for more knowledge on feasible cage-free systems for minor species such as rabbits, taking into account their socio-economic impact and finding effective solutions to control parasites and predation in cage-free or outdoor systems.	EU CAP Network workshop 'Animal welfare and innovation'

	Standardising animal welfare metrics: a collaborative approach for the livestock industry. Research for standardisation of key figure calculations to compare animal welfare across different countries and certification schemes. Discussion, via round tables, of what changes are necessary in the livestock industry that could help to consider the needs and expectations of consumers/farmers/researchers.	EU CAP Network workshop 'Animal welfare and innovation'
	Animal welfare in community supported agriculture: small versus large farms. Investigating the extent to which small farms, operating within Community Supported Agriculture (CSA model), could secure better animal welfare compared to large farm operators.	EU CAP Network workshop 'Animal welfare and innovation'
13. Innovative policies, business models, and value chains enabling sustainable food systems (23)	**Social farming for all: strategies to connect agriculture and community.** Investigate how social farming services can be made available to a broader target group, thereby bridging the gap between agriculture and society. Social farming holds the potential to offer substantial benefits to people beyond the 'typical' target groups such as individuals with burnout, caregivers, children and refugees. Research is needed to explore how social farming can be expanded to meet this potential and how it can help bridge the wide conceptual gap between agriculture and society.	Focus Group 'Social farming and innovations'
	Exploring ecological inclusion. Developing landscape and biodiversity by including participants in social farming. The potential of social farming to promote biodiversity on farms is significantly greater than what has been achieved to date. This can be realised through active landscape development, and the adoption of farming systems that integrate traditional skills, handicrafts and other sustainable practices. Further research is needed to explore how social farming can enhance these activities, creating a win-win situation for biodiversity, climate change mitigation, and the diverse target groups.	Focus Group 'Social farming and innovations'
	Examine the profile of a skilled adviser and (social) innovation broker in social farming. With a lack of advisors and innovation brokers in social farming at both national and EU levels, there is a need to identity the profile and skills (not only agronomic skills) of current and future agricultural advisors and innovation brokers for social farming.	Focus Group 'Social farming and innovations'
	How to quantify the impacts of social farming. There is a lack of data quantifying the impact of social farming in numerical and specific values, which are crucial for securing support. There is a need to identify impacts that can be easily quantified, as well as those that can be converted into economic values.	Focus Group 'Social farming and innovations'

	Combine information sources to precisely and reliably map the state of land in remote and marginal areas at high risk of abandonment. Determine which land is definitively abandoned and which is severely affected but has the potential for new uses. Establish benchmarks for the status of abandonment. Using advanced remote sensing techniques combined with field work, select spatial indicators that can make this assessment and monitoring straightforward.	Focus Group 'Recovery of abandoned agricultural lands'
	Addressing land ownership challenges in high-risk abandoned areas. In high-risk areas prone to land abandonment (for example, certain areas in Spain, Portugal, Greece): a) Assess the influential factors related to transaction costs of land ownership or use rights, such as unknown ownership, co-ownership, or inaccurate land registers. Identify and test solutions to overcome these limitations, with assessment of advantages and drawbacks; b) Explore factors that hinder higher mobility of land markets and factors preventing landowners from engaging with land markets, including the issues related to tenure security, and behavioural and psychological factors. Find the most efficient and pragmatic ways to identify the owners of existing rights and map property boundaries. This involves developing new or adapted legal instruments and approaches, and their articulation with economic incentives.	Focus Group 'Recovery of abandoned agricultural lands'
	Effective strategies from LAGs and LEADER. Assess the potential of the LAGs and LEADER approach to support mitigation actions of land abandonment; identify best approaches for each geographical, cultural and institutional context.	Focus Group 'Recovery of abandoned agricultural lands'
	Innovative collective arrangements for land consolidation. Identify and propose new forms of collective arrangements to address extreme fragmentation. These arrangements should enable the consolidation of parcels to be used by the same farm systems, and support viability of business models.	Focus Group 'Recovery of abandoned agricultural lands'
	Transform rural communities through digital engagement. Identify new ways to conceptualise rural communities by engaging with different stakeholders, and utilising modern digital technologies to facilitate this process. Access the minimum digital network requirements to make the digital transition a reality, particularly in remote rural areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Integrated spatial planning for regional viability and land abandonment prevention. Discuss and assess spatial planning instruments and approaches to be used to tackle the risk of land abandonment where not only the viability of one isolated farm is analysed and optimised but the viability of a whole region is considered through small-scale regional cultivation, food systems approaches, and management plans that engage farmers, enterprises, and municipalities all along a territorialised food system.	Focus Group 'Recovery of abandoned agricultural lands'

	Integrating peri-urban food visions for enhanced sector cooperation. Identify how to integrate different 'peri-urban food visions' and how to improve cooperation among the different food sectors in peri-urban areas through planning, initiatives from the farming sector, landowners (public and private owners), legislation regarding food markets, and post-harvesting facilities.	Focus Group 'Recovery of abandoned agricultural lands'
	Advancing sustainable agricultural technologies for a greener future. Developing new and sustainable technologies (e.g. green hydrogen, plastic alternatives, short term and long-term energy storage solutions, improving energy efficiency of machinery and farm equipment, carbon capture techniques, diversified renewable energy sources, sustainable fertilisation including renewable and recycled nutrient sources, bio-stimulants, pyrolysis, biochar, and suitability of robotics and artificial intelligence to reduce dependencies).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Analysing the economic impact of the Farm to Fork Strategy on crop yields and food imports. Research the country-specific and EU-wide economic impact of the Farm to Fork strategy, including its effects on crop yields and food imports.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Establishing a scoring system for measurable farm biodiversity. Make farm biodiversity measurable and comparable. With a scoring system, farmers could have a standardised and comparable framework to assess and monitor biodiversity on farms more effectively. By implementing such a system, farmers can track and enhance biodiversity on their farms, contributing to sustainable agriculture.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing farmers' knowledge gaps for tailored educational programmes. Identify farmers' knowledge gaps and specific needs for tailor-made education and outreach programmes.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Communicating the benefits of IPM: framing strategies for climate change challenges. Develop and present different discourses and frames for discussing IPM, connecting it to broader challenges such as climate change, to communicate the benefits of changed practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identifying drivers for practice change in farming. Investigate the factors that make farmers willing to change or partially change their practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Establishing harmonised insurance criteria to incentivise sustainable farming practices. Develop harmonised insurance criteria for sustainable farm practices, incorporating sustainability evolution into insurance policies to lower premiums for farmers based on standardised criteria. Assess the impact of the insurance systems on the adoption and implementation of best available practices. Investigate how these insurance systems can be integrated into policies and established as permanent frameworks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Comparing common and sustainable practices: economic, safety and well-being scenarios for young farmers. Develop scenarios that compare common practices with known sustainable practices in terms of economy, safety, and well-being. Explore different agro-economic systems that are attractive to young farmers, considering farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmers' well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Agro-economic systems for young farmers: diversification, sustainability and well-being. Explore different agro-economic systems that are attractive to young farmers, considering farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmers' well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing farmers' well-being across diverse farming systems and practices. Study the well-being of farmers and publish the results, taking into account different farming system types and practices, including aspects of health and personal satisfaction.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Optimising AKIS for knowledge sharing and farmer engagement. Analyse the use of Agricultural Knowledge and Innovation Systems (AKIS) to facilitate knowledge-sharing and accelerate change, including identifying AKIS success factors and understanding how to effectively reach farmers.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Enhancing farmer value: Effective incentives and communication strategies. Investigate which incentives are most effective in increasing the value and recognition of farmers, testing different types of incentives, and developing education and communication campaigns based on the findings.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

14. Rural and social dynamics: towards smart, green and inclusive rurality (19)	**Investigating the broader availability of social farming services.** Investigate how social farming services could be made available to a broader target group and thereby bridge the gap between agriculture and society. Social farming has the potential to offer substantial benefits to people outside of the 'typical' target groups of social farming (e.g. people with burnout, caregivers, children, refugees). Research is needed on how social farming can be opened up to meet this potential area of development and on how this could also help bridge the wide concept gap of understanding between agriculture and society.	Focus Group 'Social farming and innovations'
	Advancing biodiversity through social farming: enhancing landscape and ecological inclusion. Exploring ecological inclusion: Developing landscape and biodiversity through the involvement of participants in social farming. The potential of social farming to enhance biodiversity on farms exceeds current achievements (e.g. in active landscape development, through farming systems, that incorporate handicraft, skills, etc.). Research is needed on how social farming can further promote such activities and facilitate a win-win situation for various target groups benefiting biodiversity and addressing climate change.	Focus Group 'Social farming and innovations'
	Defining the role and skills of social farming advisors and innovation brokers. Examine the profile of a skilled adviser and (social) innovation broker in social farming. With a lack of advisors and innovation brokers in social farming at national and EU levels, there is a need to identity the profile and skills (not only agronomic skills) of current and future agricultural advisors and innovation brokers for social farming.	Focus Group 'Social farming and innovations'
	Quantifying the impacts of social farming: establishing data and economic metrics. The challenge lies in quantifying the impacts of social farming. There is a lack of data that quantifies the impact of social farming in numerical terms and specific values, which are crucial for securing support. There is a need to identify impacts which can be quantified more easily, as well as those which can be converted to economic values.	Focus Group 'Social farming and innovations'
	Characterising land abandonment: contextual drivers and tailored solutions. Characterise the specificity of the land abandonment process in different geographical contexts and classify the specific combination of the drivers leading to abandonment so that solutions for recovery can also be better tailored.	Focus Group 'Recovery of abandoned agricultural lands'
	Mapping land abandonment and potential reuse in remote areas. Combine information sources in order to map with precision and reliability the state of land in remote and marginal areas with high risk of abandonment: which land is definitively abandoned, and which is severely affected but with a possibility for new uses. Establish benchmarks for the status of abandonment. Based on the most advanced remote sensing techniques combined with field work, select spatial indicators that can make this assessment and monitoring straightforward.	Focus Group 'Recovery of abandoned agricultural lands'

	Addressing land ownership challenges in high-risk areas for abandonment. In high-risk areas prone to land abandonment (for example, certain areas in Spain, Portugal, Greece): a) Assess the influential factors related to transaction costs of land ownership or use rights, such as unknown ownership, co-ownership, or inaccurate land registers. Identify and test solutions to overcome these limitations evaluating their advantages and drawbacks; b) Explore factors that hinder higher mobility of land markets including issues related to tenure security, and behavioural and psychological factors. Identify the most efficient and pragmatic methods to identify owners of existing rights and map property boundaries. This involves developing new or adapted legal instruments and approaches, and their articulation with economic incentives.	Focus Group 'Recovery of abandoned agricultural lands'
	Leveraging LAGs and LEADER for land abandonment mitigation. Assess the potential of Local Action Groups (LAGs) and the LEADER approach to support mitigation actions against land abandonment; identify best approaches for each geographical, cultural and institutional context.	Focus Group 'Recovery of abandoned agricultural lands'
	Innovative collective strategies for managing property fragmentation. Identify and propose new forms of collective arrangements to manage extreme fragmentation of property. These arrangements should facilitate consolidation of parcels for use by the same farm systems and enhance viability in business models.	Focus Group 'Recovery of abandoned agricultural lands'
	Essential skills and training for entrepreneurs in areas with abandoned land. Identify entrepreneurial, collaborative, or other soft skills necessary for individuals intending to establish enterprises in areas at risk of land abandonment or already abandoned areas. Recommend training modules and support structures that can effectively facilitate the acquisition of these skills.	Focus Group 'Recovery of abandoned agricultural lands'
	Reimagining rural communities: engaging stakeholders through digital transformation. Identification of a new way to conceptualise rural community, engaging different stakeholders, and making use of modern digital and other new technologies to enable this. Assess what the digital network minimum needs are for the digital transition to be made a reality, also in remote rural areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Identifying peri-urban food visions: Enhancing collaboration across food sectors. Identify how to integrate different 'peri-urban food visions' and how to improve cooperation among the different food sectors in peri-urban areas through planning, initiatives from the farming sector, landowners (public and private owners), legislation regarding food markets, and post-harvesting facilities.	Focus Group 'Recovery of abandoned agricultural lands'

	Advancing farming systems research for sustainable practices. Farming system research (e.g. on-farm nutrient assessment and management, cascading production of food and energy, increasing food systems efficiency by promoting short food supply chains and localised food networks, etc.).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Assessing the economic impact of the Farm to Fork strategy. Research the country-specific and EU-wide economic impact of the Farm to Fork strategy, including its effects on crop yields and food imports.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identifying farmers knowledge gaps and tailored education needs. Identify farmers' knowledge gaps and specific needs for tailor-made education and outreach programmes.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Motivations for change in farming practice. Investigate the factors that motivate farmers to change or partially change their practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Exploring farmer well-being across diverse agricultural systems. Study the well-being of farmers and publish the results, taking into account different farming system types and practices, including aspects of health and personal satisfaction.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Enhancing farmer engagement through agricultural knowledge and innovation systems (AKIS). Analyse use of Agricultural Knowledge and Innovation Systems (AKIS) in facilitating knowledge-sharing and accelerating change. This includes identifying success factors within AKIS and understanding effective strategies for reaching farmers.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Enhancing farmer value: effective incentives and communication strategies. Investigate the most effective incentives for increasing the value and recognition of farmers. Test various types of incentives and develop education and communication campaigns based on the findings.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

Annex II. Research needs from practice categorised by the most relevant CAP objectives

CAP objective	Research needs from practice	Source
CCO – Building up a well-functioning AKIS, including digitalisation (7)	**Examine the profile of a skilled adviser and (social) innovation broker in social farming.** With a lack of advisors and innovation brokers in social farming at national and EU levels, there is a need to identify the profile and skills (not only agronomic skills) of current and future agricultural advisors and innovation brokers for social farming.	Focus Group 'Social farming and innovations'
	Identifying farmers knowledge gaps and tailored education needs. Identify farmers' knowledge gaps and specific needs for tailor-made education and outreach programmes.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Communicating the benefits of IPM: framing strategies for climate change challenges. Develop and present different discourses and frames for discussing IPM, connecting it to broader challenges such as climate change, to communicate the benefits of changed practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Identifying drivers for practice change in farming. Investigate the factors that make farmers willing to change or partially change their practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Comparing common and sustainable practices: economic, safety and well-being scenarios for young farmers. Develop scenarios that compare common practices with known sustainable practices in terms of economy, safety, and well-being. Explore different agro-economic systems that are attractive to young farmers, taking into account farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmers' well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Agro-economic systems for young farmers: diversification, sustainability and well-being. Explore different agro-economic systems that are attractive to young farmers, taking into account farming system types, agro-ecological practices, diversification, on-farm biodiversity practices, and their impact on farmers' well-being.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Optimising AKIS for knowledge sharing and farmer engagement. Analyse use of Agricultural Knowledge and Innovation Systems (AKIS) to facilitate knowledge sharing and accelerate change, including identifying AKIS success factors and understanding how to effectively reach farmers.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Effective incentives for enhancing farmer value and recognition. Investigate which incentives are most effective in increasing the value and recognition of farmers, testing different types of incentives, and developing education and communication campaigns based on the findings.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
CCO - Modernising the sector by fostering and sharing of knowledge, innovation and digitalisation in agriculture and rural areas, and encouraging their uptake (11)	**Quantifying the impacts of social farming for support and sustainability.** How can we quantify of the impacts of social farming? There is a lack of data, which quantifies the impact of social farming in numbers, and of specific values, which can be key to securing support for social farming. There is a need to identify impacts which are possible to quantify more easily, as well as those which can be converted to economic values.	Focus Group 'Social farming and innovations'
	Analyse the productivity and profitability of Integrated Pest Management (IPM) strategies at the farm level. To facilitate this, gather data at the EU level, including information from different regions and pilot farms. That data could also be used to assess the effectiveness of IPM strategies at the farm level and analyse the effects of IPM-based strategies on risk levels, determining whether they increase or decrease risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Assessing the economic and environmental impact of sustainable farming practices. Evaluate the economic impact of implementing sustainable practices in various contexts, the development of methods to calculate the environmental and health impacts of different farming systems, and enable cost comparisons.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Holistic assessment of IPM strategies. Conduct research to harmonise and holistically assess the impact of implementing different IPM strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Cost-effective economic incentives and ecosystem services. Identify the most cost-effective economic incentives that also provide ecosystem services. To determine the costs of pesticide use, it is recommended to conduct residue analysis at both the farm and crop levels to understand the residues associated with pesticides used in different crop management strategies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Develop new and improved techniques for detecting and sampling pests, diseases and weeds. These methods should include innovative approaches such as DNA barcoding, which allows for quick and accurate identification of pests. Similar to Covid tests, these techniques could enable rapid identification of specific pests. Additionally, there is a need to develop automated monitoring sensors for continuous monitoring and detection of pests, diseases and weeds.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Enhancing bio-control strategies through population dynamics. Understanding of the population dynamics of bio-control agents, both micro- as well as macro-organisms. By studying their interactions and reproductive patterns, researchers can support the deployment of these agents and enhance bio-control strategies in Integrated Crop Management strategies. This includes manipulating plants and habitats to enhance natural enemies.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Creating accessible digital databases for EU farmers. Make digital databases of (anonymous) European Union farmers accessible to the scientific community. These databases should include valuable information such as the frequency of chemical treatments, types of products used, and crop yield data spanning multiple years. Sharing this information with researchers can provide valuable insights and contribute to improving agricultural practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Exploring genetic resources for enhanced agricultural practices. Investigate the potential of genetic resources, e.g. new varieties developed with new breeding technologies, DNA-based monitoring of pests and diseases, and the use of satellite imaging for detection.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Predictive modelling of crop, pest, disease and weed population dynamics. Develop models that can predict crop, pest, disease, and weed population growth.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Harmonised insurance criteria for sustainable farming practices. Develop harmonised insurance criteria for sustainable farm practices, integrating sustainability evolution into insurance policies to reduce premiums for farmers based on standardised criteria. Assess the impact of these insurance systems on the adoption and implementation of best practices. Investigate methods to integrate these insurance systems into policies and establish them as permanent frameworks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
SO1 - Support viable farm income and resilience across the EU territory to enhance food security (19)	**Characterising land abandonment processes across geographical contexts.** Characterise the specificity of the land abandonment process in different geographical contexts and classify the specific combination of the drivers leading to abandonment so that solutions for recovery can also be better tailored.	Focus Group 'Recovery of abandoned agricultural lands'
	Integrate multiple information sources to accurately map the condition of land in remote and marginal areas at a high risk of abandonment. Determine which lands are definitively abandoned and which are severely affected but with a possibility for new uses. Establish benchmarks for the abandonment status. Utilise advance remote sensing techniques combined with field work to select spatial indicators that streamline assessment and monitoring.	Focus Group 'Recovery of abandoned agricultural lands'
	Addressing land abandonment: transaction costs and market mobility in high-risk areas. In high-risk areas related to land abandonment (for example certain areas in Spain, Portugal, Greece): a) Assess the influential factors concerning transaction costs of land ownership or use rights, such as unknown ownership, co-ownership, or inaccurate land registers. Identify and test solutions to overcome these limitations, assessing their advantages and drawbacks; b) Explore factors that inhibit higher mobility in land markets and factors preventing landowners from entering into land markets, including the issues related to tenure security, and behavioural and psychological factors; finding the most efficient and pragmatic ways to identify the owners of existing rights and map property boundaries. This includes exploring new or adapted legal instruments and approaches, and how they integrate with economic incentives.	Focus Group 'Recovery of abandoned agricultural lands'
	Effective strategies from LAGs and LEADER. Assess the potential of the LAGs and LEADER approach to support mitigation actions of land abandonment; identify best approaches for each geographical, cultural, and institutional context.	Focus Group 'Recovery of abandoned agricultural lands'
	Innovative collective strategies for managing property fragmentation. Identify and propose new forms of collective arrangements that can help cope with the extreme fragmentation in property and that can result in parcels that can be used by the same farm systems, and support viability in business models.	Focus Group 'Recovery of abandoned agricultural lands'

	Essential skills and training for entrepreneurs in land abandoned areas. Identify the entrepreneurial, collaborative and other soft skills necessary for individuals interested in establishing enterprises in areas at risk of or already affected by land abandonment. Recommend training modules and support structures that can effectively cultivate these skills.	Focus Group 'Recovery of abandoned agricultural lands'
	Alternative crop and animal production strategies for abandoned land. Find and develop alternative crops or animal productions and strategies best adapted to the context of abandoned land, or other ways to bring more added value into the farm enterprise, by processing in the farm, or collectively in the region, and/or by shared marketing strategies.	Focus Group 'Recovery of abandoned agricultural lands'
	Find specific innovative technical solutions for animal or crop production that are affordable and easy to handle, aiming to facilitate the use of remote and abandoned areas. This will help ease the burden of heavy manual work that is still required in many areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Find innovative grazing strategies. Innovative grazing strategies can support a business model for livestock production while also being supported by public policies due to their nature and conservation value.	Focus Group 'Recovery of abandoned agricultural lands'
	Sustainable biomass utilisation in abandoned land. Explore a case on the sustainable use of available biomass in abandoned land for soil improvement, energy production, building materials or other biobased industries; identify how to build biomass-based processing units that can make a sustainable business in remote areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Identification of a new way to conceptualise rural community, engaging diverse stakeholders, and making use of modern digital and other new technologies. Assess what are the digital network minimum needs for making the digital transition a reality, including in remote rural areas.	Focus Group 'Recovery of abandoned agricultural lands'
	Integrated spatial planning for regional viability and land abandonment prevention. Discuss and assess spatial planning instruments and approaches to be used to tackle the risk of land abandonment where not only the viability of one isolated farm is analysed and optimised, but the viability of a whole region is considered through small-scale regional cultivation, food systems approaches and management plans that engage farmers, enterprises, and municipalities throughout a territorialised food system.	Focus Group 'Recovery of abandoned agricultural lands'

	Integrating peri-urban food visions for enhanced sector cooperation. Identify how to integrate different 'peri-urban food visions' and how to improve cooperation among the different food sectors in peri-urban areas – through planning, initiatives from the farming sector, landowners (public and private owners), legislation regarding food markets, and post-harvesting facilities.	Focus Group 'Recovery of abandoned agricultural lands'
	Cost and benefit analysis of abandonment versus keeping land under production. Assess the cost of non-action, namely how much does it cost, in loss of ecosystem services, to let agricultural land go under abandonment, in marginal and remote areas or in peri-urban areas. The multiple benefits of ecosystem services may be adaptation and mitigation to climate change, landscape quality, mental health benefits for citizens and bringing children to the outdoors (mostly in peri-urban contexts), improving biodiversity, territorial cohesion, etc.	Focus Group 'Recovery of abandoned agricultural lands'
	Advancing farming systems research for sustainable practices. Farming system research (e.g. on-farm nutrient assessment and management, cascading production of food and energy, increasing food systems efficiency by promoting short food supply chains and localised food networks, etc.).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
	Mitigation of GHG and carbon assessment in different types of farming. Mitigation of GHG from agriculture remains a significant challenge, with key issues to address, including emissions from enteric fermentation in livestock and from rice cultivation. Other critical concerns include the depletion of soil organic matter and the high use of inputs associated with GHG emissions, such as fertilizers and fossil fuels for machinery. Storing carbon in the soil by increasing permanent crops (storing C in plant roots) and organic matter in the soil provide a useful path forward. Nevertheless, further research could cover: 1) Methodologies for measuring Carbon sink and GHG emissions of farms and agriculture that are agreed upon and support farmers practicing mitigation; 2) Assessment of GHG emissions of different methods and contexts of livestock or dairy production and correct policies and incentives for different types of farming depending on environmental performance.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Practical implementation of reduced tillage/no-till and permanent soil cover. Reduced tillage/no-till and permanent soil cover present solutions to several negative impacts of traditional tilling, such as erosion, compaction, degradation of soil life, reduction of soil organic matter, and reduction of soil water-holding capacity. Several methods, including conservation tillage, direct seeding, direct seeding without herbicides, direct seeding in permanent pastures, no tilling, cover crops, roller-crimped cover crops, and shredded cover crops, offer promising alternatives. However, further research is needed to assess their efficacy in different soil types, crops and farming practices, assessing their cost-benefit ratio.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Water harvesting and storage. With rising temperatures, decreased precipitation, increased droughts, and growing water scarcity, there is an increased demand for water across various needs, including irrigation, deficit irrigation, livestock, human consumption, firefighting, and ecosystems. Certain months experience water abundance and flooding, while others endure prolonged dry spells. Large-scale dams and infrastructure for water harvesting often entail significant financial, environmental, and social costs. Alternatives to large-scale dams, include off-stream dams, lakes and ponds, swales and roads with a keyline (1-2% slope) leading to ponds, keyline design, and varied terrain modelling techniques such as. swales, terraces, dykes, jessours, gabions and half-moons. Other methods include mulching and afforestation. Water harvesting at the landscape scale can also help reduce temperatures. Several questions need further exploration, such as the comparative cost and efficiency of various water harvesting and storage techniques. Innovation in water storage is crucial to reduce costs for farmers, as current methods can be expensive. Research should address whether it is more effective to store water underground or in dams and surface reservoirs the optimal terrain modelling solutions for water harvesting and how can regions shift from individual farm off-stream rainwater harvesting to integrated landscape level approaches. Additionally, exploring how roads best support water harvesting needs in adapting to climate change is essential.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Alternative water supplies. Increased aridity and water scarcity for animals and humans but also for irrigation remain significant challenges in many areas, such as in Southern and Central Europe. Options for alternative water supplies exist, such as fog traps (harvesting water from fogs to provide drinking water for animals and humans), recycling of greywaters from urban areas, farms and households as well as desalinization. However, research and innovation on achieving cost-effective solutions to implement technologies for alternative water supplies is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
SO2 - Enhance market orientation and increase competitiveness including greater focus on research, technology and digitalisation (1)	**Enhancing soil life and biotic interactions in different farming systems and crops through sustainable farming.** Conventional farming is degrading soil life, soil productivity and the performance of several ecosystem services. Conservation farming and organic farming practices significantly contribute to increase soil life, soil productivity and ecosystem services. Better knowledge of the biotic interactions occurring in soil and their linkages with agroecosystem functioning is needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

SO4 – Contribute to climate change mitigation and adaptation, as well as sustainable energy (4)	**Developing climate-adapted varieties and breeds.** Cultivars and animal breeds have been developed for specific purposes and types of farming during a long time. Climate-adapted breeds and varieties that are required for a smart and climate resilient farming are not available on the market. Climate-adapted diversified farming is very context specific, requires numerous varieties and breeds, and therefore requires farmers and/or local/regional partners to select, develop, and conserve animal breeds and plant varieties that are more adapted to present and future climates. This process needs further research through applied-research and/or action-research, in close partnership with farmers (to address their needs). Throughout the climate-vulnerable regions of Europe plant varieties and animal breeds must be selected, improved, tested, and evaluated, to be disseminated and promoted as a climate adaptation measure for the different agro-climatic zones and types of farming. This research can include genetic variability and new breeding techniques but without the use of Genetically Modified Organisms (GMO).	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Develop models to assess and predict the impacts of climate change on crop production. This knowledge could help farmers adapt their practices and mitigate potential risks.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Measure emissions and all environmental impacts of innovative farming systems and work to transfer this knowledge into everyday practice considering all affected factors, such as society, human health and the environment.	EU CAP Network workshop 'Animal welfare and innovation'
SO5 – Foster sustainable development and efficient management of natural resources such as water, soil and air (2)	**Effectiveness, cost-effectiveness, and cost-benefit analysis of solutions and Decision Support Systems for climate change adaptation.** There are many adaptation strategies, with hundreds of measures and solutions for climate adaptation at farm level. In addition, there are many techniques and variations with significant differences regarding effectiveness, cost, and secondary positive and negative impacts. When faced with the need to decide and invest to adapt and reduce their vulnerability to climate change, farmers and stakeholders have difficulty in finding and using appropriate decision support systems and comparing the effectiveness, cost and benefit of the different adaptation solutions. Potential solutions include assessing and comparing the effectiveness of adaptation measures and solutions at farm level, analysing the cost-effectiveness and/or cost-benefit relation for the different solutions, and using appropriate decision support systems for the different types of farming and the different scales. Further research would be needed on the effectiveness of the adaptation solutions, namely using indicators that are relevant and applicable for climate adaptation and useful for farmers' decision-making, as well as on the development, testing and streamlining indicators and decision support systems to integrate this information, and support farmers and stakeholders in decision-making at the appropriate level.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Soil health monitoring. Develop soil biology indicators to better manage soil health.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
SO6 - Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes (25)	**Continue research on the understanding of farmer's motivation and barriers to the adoption of HDLF.** Farmers often seek information on issues that directly impact their farms or require specific solutions. Currently, biodiversity is not a topic in high demand, highlighting the need for public awareness and educational activities. To ensure the effectiveness of such initiatives, research is needed to understand the socio-cultural and environmental factors that facilitate farmers in maintaining or establishing HDLF, such as social norms and contextual suitability. Additionally, it is essential to identify factors that hinder them, such as conflicting arguments, workload, financial compensation and politics.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effectiveness of, versus the effort involved in, creating and engaging different communication channels. Biodiversity knowledge is communicated to farmers using various methods and tools. The success and effort involved in creating these tools, as well as the effort required to utilise different communication methods, can vary significantly. To determine the most effective cost/benefit combination of tools and methods for promoting biodiversity in the field, it is crucial to understand the communication needs of farmers, including their preferences for digital or analogue approaches and face-to-face interactions.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Economic assessment and valuation of High-Diversity Landscape Features. The economic assessment of the costs and benefits related to HDLF at the landscape level is currently lacking. Specifically, there is a need to gain a better understanding of the mismatches between economic and ecological outcomes across farm and landscape scales. This includes identifying the optimal number and size of HDLF for different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the effects of HDLF on water retention and microclimate. Not all the effects of different HDLF on water, soil and microclimate are well-known or thoroughly explored. The correlations between HDLF and microclimate are not yet fully understood. In extremely dry conditions, for instance, establishing initial vegetation or tree features may pose challenges. However, these features can influence water conditions, making subsequent steps towards enhancing HDLF easier. Some research findings may not be widely known among farmers. The challenge for a scientific team is to identify knowledge gaps and conduct further interdisciplinary research. The results can then be effectively communicated to farmers using appropriate methods, as outlined in the Mini Paper on knowledge transfer. This approach would ensure that farmers are aware of the potential positive effects from the outset.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Analysis of co-benefits of HDLF for climate change adaptation. While there are numerous sources of information on various HDLF and their benefits, as well as financial tools for promoting landscape greening through Rural Development Programmes (RDP) in the previous programming period and CAP Strategic Plans (CSP) for 2023-2027, the adoption of these measures by farmers is slow. The hesitation is due to concerns for potential loss of productive land and management costs. A significant research challenge is conducting a cost-benefit analysis of HDLF concerning on-farm adaptation to climate change. Such analysis would help disseminate knowledge about the eco-economic benefits of HDLF and eco-schemes, motivating farmers to participate actively in eco-schemes through the CAP. Implementing climate change adaptation or mitigation measures can provide multiple co-benefits to farmers. This research is particularly crucial on intensively managed landscapes with a low proportion of HDLF, such as lowland areas with highly productive soils.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on enablers and barriers to the adoption of HDLF. Farmers tend to seek information about issues that directly impact their operations or for which they require concrete solution. However, the topic of biodiversity is not a high priority, indicating that a substantial effort must be done to stimulate interest. To address this challenge, research is necessary to understand the socio-cultural and environmental factors that motivate farmers to maintain or establish HDLF, such as social norms and contextual suitability. Similarly, it is important to identify and analyse those factors that may have an adverse effect, such as conflicting arguments, required workload, (lack of) financial compensation, etc.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into knowledge exchange between different actors. Ecologists, scientists and policymakers often think differently from farmers, as they belong to distinct thought collectives. This results in varying interests, ways of knowing, working contexts, and languages. To overcome these challenges, research is needed to explore factors such as the importance of context, choice of language, motivating factors, personal exchange and self-study that can facilitate the exchange of knowledge between these groups. Understanding and aligning these factors can help deliver benefits for both biodiversity and farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on how biodiversity advice is organised in different European countries. Advisory services in Europe are very diverse, with various financing models and organisations involved. A key difference lies between advisory services provided by NGOs and those offered by official authorities. Other distinctions include the extent of advisory service, independence of advisory organisations, advisor qualifications, and the financial aspects such as funding possibilities for measures and whether advisory services are free or come with costs. Consequently, the effects, quality and acceptance of biodiversity advisory services can vary significantly. The term 'advisory' is broadly used and often carries ambiguous implications, describing vastly different systems across European countries. An overview of existing advisory frameworks and their impact on biodiversity would be beneficial. Establishing new advisory services could benefit from understanding the pros and cons of different systems.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Locate the most relevant sites for HDLF setup. Advising farmers to implement HDLF requires identifying agricultural areas to prioritise for landscape restoration and determining the extent to which additional habitat amount and complexity should be increased. Evidence-based results and spatially-explicit tools are needed to assess the contribution of individual farms in creating spatial patterns of ecological importance at the landscape level for diverse taxa.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Develop indicators to provide guidance for the best setup and management of HDLF. Although some initiatives were reviewed, we still lack scientifically validated indicators to provide guidance for the appropriate setup and management of HDLF. Indicators are needed to assess the quality a priori and a posteriori of HDLF on farms regarding the services expected, including the services benefiting the society in general to provide incentives for farmers.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Understand the variety and intensity of interactions between above and below-ground biodiversity. Further research is needed to understand how the health and effective functioning of soil organisms are affected by the presence and health of above-ground biodiversity. To fill this gap, studies should focus on the influence of above-ground biodiversity on the ecological benefits provided by below-ground biodiversity.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Assess the costs and economic benefits associated with HDLF at the farm level, focusing on economy and incentives. Currently there is a significant gap in the economic assessment of HDLF at farm level. It is crucial to gain a better understanding of the trade-offs between economic and ecological performance, including identifying economic and ecological optima concerning the number and size of HDLF across different farm types.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into co-benefits of pollinator conservation actions. Farmers face challenges in designating parts of their farm for HDLF due to concerns about losing productive land, needing additional time and money, and incurring management costs. Despite these concerns, managing farmland for pollinators through HDLF can provide numerous co-benefits. To address these challenges, evidence-based research is necessary to support farmers through knowledge exchange and training, demonstrating the co-benefits of pollinator conservation actions and helping them make informed decisions about land management. Additionally, research should consider the circumstances under which co-benefits do not exceed costs and explore compensation measures or contract solutions that can be applied.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research into effects of tillage management practices and regenerative and/or conservation agriculture on pollinators (direct drilling, min-tilling, and ploughing). While direct drilling or min-tilling has become relatively common and offers benefits to soil such as improved soil structure and organic matter content where conditions allow, their impact on pollinators and broader biodiversity are less understood. Another aspect to consider is the use of herbicides and catch, companion, and cover crops as alternatives to traditional ploughing. Addressing this challenge requires evidence-based research to establish scientific links between tilling practices and pollinators, potentially providing additional incentives for farmer adoption. This research should be conducted at a Europe wide level and is particularly relevant to crop and mixed production farms.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the advantages or disadvantages of allowing wildflowers to naturally regenerate instead of seed sowing on plant and pollinator diversity. Seed sowing is cost-intensive but can provide resources for pollinators. Despite sowing a diversity of seeds, over time a dominance of certain species over others occurs. Conversely, natural regeneration may initially lead to a dominance of some species, but diversity tends to increase over time. A recent study indicates that tolerating injurious weed species within the agricultural environment might benefit to flower-visiting insects more than sowing 'wildflower mixes'. The challenge lies in maintaining flowering resources for pollinators and other species groups through cost effective measures. To address this, it is essential to conduct on-farm research and monitor plant communities, particularly focusing on floral resources, and pollinator diversity.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research into the perception of different HDLF by various stakeholder groups (farmers, tourists, citizens, ag-science students etc.) and understanding how diverse groups of society can contribute to their maintenance and restoration, for example through place-based actions. This research could explore how to develop and implement place-based actions aimed at maintaining, restoring, or enhancing HDLF which can deliver socio-cultural benefits at the community level (e.g. social cohesion, integration of different groups). Also of interest is assessing how different types of HDLF fit into perceptions of landscapes, and if these different types of HDLF provide social and cultural benefits.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research on the development of theoretical and practical tools aimed at promoting, protecting and enhancing the social and cultural benefits of HDLF. This research should shift the focus from individual farmers to focus on shared practices and routinised activities in which farmers engage. The research should target the social and institutional context that gives rise to social norms, shared meanings and understandings, and material conditions that facilitate and encourage certain types of practices (i.e. related to creation and maintenance of HDLF). The research should aim to understand how certain conventions are established, how they evolve, what are the opportunities for change, and what practical tools can support this shift. This implies a focus on the societal-level system characteristics and the practices which that system promotes or facilitates. A key inquiry could explore the social and cultural norms that shape which HDLF are preferred by farmers and/or by society, and if these norms are related to how HDLF are maintained, enhanced, or created.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Research on the creation of indicators for measuring and monitoring the social and cultural benefits of HDLF. The aim is to develop indicators that encompass various common HDLF characteristics identified in this paper and are applicable across diverse contexts. This research and its outputs can inform the development of educational and experiential materials aimed at communicating the numerous social benefits such as their habitat value, functions, and roles in microclimate provisioning of HDLF to different groups of people. These materials can be utilised in venues such as farmer training, primary and secondary education, and continuing education opportunities for professions involved in HDLF maintenance, restoration or enhancement including community involvement.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	A need for demonstration sites/examples/good practices. Related to the previous issue, the challenge for future research is a lack of evidence for HDLF long-term benefits to ecosystem services and demonstration sites/examples/good practices (new ones, studying existing ones, establishing a 'HDFL best practices'' network or an 'Innovation path of future HDFLs'. The research study of future HDLF must focus on different benefits addressed to farmers in the yields, resilience, water balance, soil/below-ground benefits and structures, and the impact of HDLF on microclimate. The existing studies provide estimations for eco-system benefits, but these are mostly based on past models that did not adequately consider the impact of climate change. Therefore, there is a pressing need for models that can predict these future scenarios. This research need is particularly acute in intensively managed landscapes, which have a low proportion of High-Density Linear Forests (HDLFs), such as lowland areas with highly productive soils at a pan-European level.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'

	Research and an innovative idea for the integration of HDLF in existing production systems. The integration of individual or combinations of HDLF, including agroforestry elements, in existing production systems can potentially have positive effects on climate change adaptation, such as increasing water holding capacity, erosion reduction, shading, and heat reduction. On the other hand, trade-offs are also conceivable, such as competition for nutrients or effects on plant health. Furthermore, farmers face challenges regarding mechanisation possibilities, rising workloads, and costs without reliable data on economic benefits**.** The challenge for further research is to provide information on practical implementation, including suitable varieties for treelines or hedges, options to maintain mechanisation, effects on nutrient management, and economic viability. For permanent crops, analysing the long-term effects of agroforestry on product quality is also an important topic. The need for research is especially relevant for crops with specific production systems, such as permanent crops and vegetables, and can be conducted in different regions of Europe or at a Europe-wide level.	Focus Group 'Enhancing the biodiversity on farmland through high-diversity landscape features'
	Exploring ecological inclusion: developing landscape and biodiversity by including participants in social farming. The potential of social farming to promote biodiversity in farms is much higher than what has been achieved to date (e.g. in active landscape development, by applying farming systems, which include handicraft, skills, etc.) Research is required on how social farming can further promote such activity and facilitate a win-win situation for the different target groups involved, for biodiversity, and for climate change.	Focus Group 'Social farming and innovations'
	Forests and water cycle at mesoscale: can afforestation increase rainfall in Europe? With the increase of temperature, precipitation reduces, since the cloud condensation level is higher at lower temperatures (direct relation with relative humidity). Decrease in precipitation is a major challenge for south and central Europe. Several authors show that afforestation can reinforce the water cycle at a mesoscale, allowing rain (warm fronts) to extend through thousands of kilometres, thus revealing 'good potential for forest-mediated solutions of the global desertification and water security problems'. Further research could explore if large scale afforestation programmes that create contiguous forests in the continuation of ocean and coastal areas could increase rainfall in some areas of Europe and a be a good adaptation to climate change.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'
	Managing invasive pests in a changing climate. As climate changes, species, namely pests and diseases, migrate. New pests and diseases can constitute a serious threat to farming and food security in Europe. Integrated and best practices in pest management are not sufficiently disseminated and implemented. In addition, the potential for unpredictable mass spread of pests and diseases increases in a changing climate and in the context of large-scale monocultures and homogeneous farming with reduced species, crop and genetic diversity in agroecosystems. Applying integrated pest management and best practices in EU farming at a landscape scale could prove helpful. More monitoring of pests and diseases spread, as well as more knowledge on how to efficiently prevent, control and regulate new invasive species and diseases would be needed.	EU CAP Network workshop 'Enhancing food security under changing weather patterns: farm adaptation'

	Assessing the impact of non-chemical control techniques on biodiversity and environmental footprint. It is important to gather data on the impact of non-chemical control techniques and strategies on biodiversity, as well as to quantify the environmental footprint of alternative management strategies. This will help minimise any potential negative effects on the environment to ensure sustainable practices.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
SO7 - Attract young farmers and facilitate business development in rural areas (1)	**Enhancing the efficiency of existing agricultural technologies.** The goal is to improve and increase the efficiency of existing technology and machinery (e.g. biogas production, storage solutions, solar power, waterpower, wind power).	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
SO8 - Promote employment, growth, social inclusion and local development in rural areas, including bioeconomy and sustainable forestry (2)	**Social farming for all: strategies to connect agriculture and community.** Investigate how social farming services can be made available to a broader target group, thereby bridging the gap between agriculture and society. Social farming has the potential to offer substantial benefits to people outside of the 'typical' target groups of social farming (e.g. people with burnout, caregivers, children, refugees). Research is needed on how social farming can be opened to meet this potential area of development and on how this could also help bridge the wide concept gap of understanding between agriculture and society.	Focus Group 'Social farming and innovations'
	Advancing sustainable agricultural technologies for a greener future. Focus on developing new and sustainable technologies such as. green hydrogen, plastic alternatives, short term and long-term energy storage solutions, and improving the energy efficiency of machinery and farm equipment. Additionally, explore carbon capture techniques, diversified renewable energy sources, sustainable fertilisation using renewable and recycled nutrient sources, bio-stimulants, pyrolysis, biochar, and the suitability of robotics and artificial intelligence to reduce dependencies.	EU CAP Network seminar 'Smart circular farming to address high energy and fertiliser prices'
SO9 - Improve the response of EU agriculture to societal demands on food and health, including safe, nutritious and sustainable food, food waste, as well as animal welfare (10)	**Assessing the economic impact of the Farm to Fork strategy.** Research the country-specific and EU-wide economic impact of the Farm to Fork strategy, including its effects on crop yields and food imports.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'
	Exploring farmer well-being across diverse agricultural systems. Study the well-being of farmers and publish the results, taking into account different farming system types and practices, including aspects of health and personal satisfaction.	EU CAP Network workshop 'Innovative arable crop protection – using pesticides sustainably'

	Comparative analysis of product quality and environmental impact in conventional versus organic farming. Investigate the differences in product quality and environmental impact between conventional/intensive and organic/less intensive farming, particularly in terms of food nutritional properties, greenhouse gas emissions and water pollution. Comprehensive research is needed.	EU CAP Network workshop 'Animal welfare and innovation'
	Animal welfare and productivity monitoring in farming. Monitoring animal welfare and productivity, investigating their links with farm profitability and developing new indicators of 'positive welfare' (i.e. indicators beyond negative welfare due to mistreatment) through the use of IT technology and AI.	EU CAP Network workshop 'Animal welfare and innovation'
	Enhancing cage-free production systems for livestock. For 'Cage-free production systems', it is crucial to identify more adaptive and resilient genotypes suited to different systems. Providing farmers with decision support tools and conducting a cost/benefit analysis of renovating existing facilities and building new ones for cage-free systems are essential steps. Additionally, there is a need for more knowledge on feasible cage-free systems for minor species such as rabbits, considering the socio-economic impact. Effective solutions to control parasites and predation in cage-free/outdoor systems also require further investigation.	EU CAP Network workshop 'Animal welfare and innovation'
	Indicators and monitoring methods for animal welfare. In terms of animal welfare, it is essential to develop indicators and monitoring methods that are correct, reliable, harmonised, and validated through practical implementation, in pilot farms. Collaboration with farmers and advisors is crucial to effectively evaluate and monitor animal welfare. Indicators should be selected in consensus with most stakeholders, considering their impact on animal welfare assessment outcomes compared to other indicators, and considering the cost to use them. However, it has been suggested that research should focus on a few effective 'iceberg indicators', to be collected in a continuous and harmonised way, in order to monitor all herds and efficiently identify those with poor welfare. This approach would save the limited resources of competent authorities, allowing them to focus their control activities more on farms with the most animal welfare problems.	EU CAP Network workshop 'Animal welfare and innovation'
	Enhancing welfare labelling and certification in livestock production. Innovative research is needed to improve welfare labelling and certification. Effective tools and communication channels should be developed and used to inform citizens and consumers about livestock production methods and animal welfare standards, and to educate stakeholders at every step of the chain. This includes the replacement of workers, fostering information and dialogue with society and citizens, and addressing renewable and generational shifts in agriculture.	EU CAP Network workshop 'Animal welfare and innovation'

	Standardising animal welfare metrics. Research is needed to standardise key figure calculations for comparing animal welfare across different countries and certification schemes. Round table discussions about necessary changes in the livestock industry could help address the needs and expectations of consumers, farmers and researchers.	EU CAP Network workshop 'Animal welfare and innovation'
	Evaluating animal welfare in small farms within the CSA model. Investigate the extent to which small farms, operating within Community Supported Agriculture (CSA) model, can achieve better animal welfare compared to large farm operators.	EU CAP Network workshop 'Animal welfare and innovation'

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