D1.1 - Conceptual framework for network management and knowledge exchange on Climate Smart Farming

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Disclaimer

List of Abbreviations

AKIS - Agriculture Knowledge and Innovation Systems

AMM – Adaptation and Mitigation Measures

AMP – Adaptation and Mitigation Plan

CFD - Climate Farm Demo

CLF – Climate Lighthouse Farmer

CS – Climate Smart

CSF - Climate Smart Farming

EF – Experimental Farm

EU - European Union

GHG - GreenHouse Gasses

KE - Knowledge Exchange

LF – Lighthouse Farm

M&E – Monitoring and Evaluation

PIPs – Projects, Flagship Initiatives, Policymakers

PDF - Pilot Demo Farm

WP - Work Package

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Abstract

This deliverable lays out the key concepts of the knowledge exchange rationale for Climate Farm Demo to reach its objective to strengthen the EU farmers' capacities to implement, demonstrate and uptake climate smart farming. Starting from the definition of climate smart farming and the role of social learning and networks in the transition towards more climate smart farming, the knowledge exchange is explained as encounters between different levels of knowledge creation in the project, so-called boundary spaces. Five main levels of knowledge creation are distinguished in the project: the pilot demo farmer, the hub, national level, EU level and project level (Executive Committee). Climate farm demo will both support knowledge creation activities on these different levels and facilitate exchanges between these levels through the creation of boundary spaces. These activities will contribute to different impact pathways to achieve the project's objective, i.e. by focussing on behaviour change of farmers and creation of an enabling environment for climate smart farming starting from the local context.

Chapter 1

Background and context

1 Background and context

1.1 EU policy for climate smart farming[1]

Adopted in April 2013, the EU Strategy on Adaptation to Climate Change provided the framework and spelled out the mechanisms to improve the preparedness of the EU for current and future impacts of climate change. It worked to increase the readiness of all government levels in building a climate-resilient Europe. By setting out a global adaptation goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, Article 7 of the Paris Agreement also accelerated the development and implementation of adaptation policies in many European countries. The agricultural sector is directly covered by the Effort Sharing Regulation-ESR-(EU) 2018/842 and the Land Use, Land Use Change and Forestry (LULUCF) Regulation (EU) 2018/841. The ESR sets Member States targets for emissions reduction in non-ETS sectors, including transport and fuels, buildings and agriculture. This legislation covers methane (CH4) and nitrous oxide (N2O) emissions that are a consequence of agricultural activities. Besides this, the LULUCF Regulation requires Member States to ensure that the amount of GHG absorbed by the LULUCF sector is at least equivalent to that emitted. In 2020, the European Green Deal sets out how to make Europe the first climate-neutral continent by 2050. In 2021, the European Council adopted the “FIT for 55” package, aiming to meet the target of reducing greenhouse gas emissions by at least 55% by 2030 compared to 1990. The Farm to Fork (F2F) strategy emphasizes the need to accelerate the transition to a sustainable food system and highlights the needs to develop new green business models. Agriculture is responsible for 10.1% of the European GHG emissions CH4, N2O, CO2) and contributes also to regulate the CO2 uptake via carbon sequestration in soils. A key challenge for the land use sector is to incentivize measures ensuring that EU activities on forests, soils and agriculture contribute to the Paris Agreement goals. These measures should not threaten food production and should aim to balance anthropogenic emissions and removals by 2050, while conserving and enhancing carbon storage. In parallel, the agricultural sector has to adopt best practices and solutions for climate change adaptation. For this purpose, innovative climate smart solutions need to be tested and implemented giving particular attention to their potential replication and transfer across regions and Member States.

[1] Grant Agreement, excellence section

1.2 Climate Farm Demo: The project[2]

Climate Farm Demo aims to strengthen European farmers' capacities to implement, demonstrate and uptake Climate Smart Farming (CSF) practice across the EU and reduce their GHG emissions by 35% along the project life thus achieving the EU 2030 Climate Target Plan. Therefore, Climate Farm Demo overall aims to

1. network Pilot Demo Farmers (PDFs) to boost climate smart farming knowledge exchange and cross fertilisation among agricultural sectors and EU and national Agriculture Knowledge and Innovation Systems (AKIS),
2. support and advise PDFs in implementing and demonstrating the Climate Smart Farming practices to increase innovation uptake and finally,
3. incentivise the adoption of CSF practices across Europe thanks to standardized methodologies and relevant rewarding mechanisms that will support farmers in their systemic transition.

Climate Farm Demo is a pan-European network of Pilot Demo Farmers (PDFs) covering 27 countries and all pedo-climatic areas. Its overall aim is to accelerate the adoption of Climate Smart Farming (CSF) practices and solutions by farmers and all actors of the Climate Smart Agriculture Knowledge & Innovation Systems (CS-AKIS). It focusses on both adapting agricultural production systems to climate change and mitigating the effect of agricultural practices on climate change by aiming for a carbon neutral agricultural sector by 2050, thereby meeting the targets of the EU Climate strategy. To reach this objective, the project adopts a Multi-Actor approach by connecting 1500 PDFs and their Climate Farm Advisors (CFAs) at European and national levels to increase knowledge exchange & cross-fertilisation in their respective AKIS. The CFA's will support the PDF's in implementing Adaptation and Mitigation Measures suggested by contextualised guidelines and will assess & monitor their environmental performance thanks to harmonized methodologies & tools. Technical and social innovations covering a broad range of thematic areas will be demonstrated to the wider farming community across six annual demonstration campaigns (with a total of 4500 demonstration events) supporting interactive and peer-to-peer learning. New and innovative CSF solutions will be co-created in 10 Living Labs spread across Europe and lessons learned from multi-actor innovation will be shared and scaled. A set of public and private rewarding mechanisms will be identified, proposed and demonstrated to the AKIS actors, thus incentivising the uptake of CSF practices while ensuring sustainable business models. Strategic and operational cooperation will be organised with other projects, flagship initiatives and policy-makers at European and national levels in order to share knowledge, organize coordinated actions, and produce policy briefs. To accelerate the wide spreading and uptake of results, an ambitious dissemination, exploitation and communication strategy will be deployed at EU and national levels.

[2] Project summary of the Grant Agreement

Chapter 2

What is climate smart farming?

This chapter provides a definition for climate smart farming and how we will use it in the climate farm demo project.

2 What is climate smart farming?

2.1 Definition

In the project we use the concept of “Climate Smart Farming”. In literature, the term climate smart farming is often used interchangeably with “climate smart agriculture”. So, although this document will refer to the concept Climate Smart Farming (CSF), note that it is in literature referred to as Climate Smart Agriculture. CSF is an approach that intents to help the reorientation of agricultural systems to guarantee food security under conditions of climate change (Martinez- Baron et al. 2018, p.12). According to the FAO, CSF is built on three pillars (Martinez- Baron et al. 2018, p.12):

1. Increasing agricultural productivity that supports equitable incomes, food security and development;
2. Adapting and building resilience to climate change of farms and nations;
3. Reducing greenhouse gas emissions as much as possible.

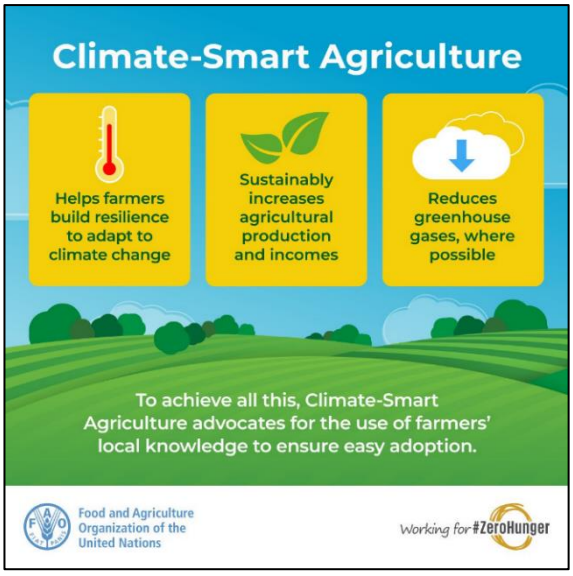

Figure 1. FAO’s definition of Climate Smart Agriculture[3]

[3] Source : https://www.facebook.com/UNFAO/photos/a.448783138585/10157901624448586/?type=3

Climate Smart Farming is not just a predefined set of practices, but should be interpreted as an "approach for integrating multiple interventions across a range of food systems, landscapes, value chains and government regulation or policy (Lipper et al., 2014; in Westermann et al. 2018). It can be related to actions on farm and beyond the farms, incorporating technologies, policies, institutions and investment. Climate Smart Farming can focus on ways to reduce emissions in livestock production, to reduce farm inputs (such as fuels, energy, pesticides, mineral fertilisers) for more resource-efficiency, or to keep carbon stored in the soil. Making farming systems more diverse can also make them more resilient in the face of climate change (EIP-AGRI Services, 2021).

Climate Smart Farming is a holistic approach that balances the relative priorities between adaptation, mitigation and food security to increase the resilience of agricultural systems (Martinez- Baron et al. 2018, p.12). Further, by linking stakeholders on global, national and local level it allows to take into account adaptation and mitigation synergies and trade-offs. Jarvis et al (2011, in Martinez-Baron et al. 2018) give two reasons why the synergies between adaptation and mitigation are essential. First, they state that adaptation is usually the more easy way to go for farmers compared to mitigation, which means that adaptation could be the best entry point to implement practices that have both adaptation and mitigation benefits. Adaptation measures that result in quick wins and return on investments are more likely to motivate farmers for adoption. This is an interesting insight for the Climate Farm Advisors who will advise farmers in their process towards more CSF. Second, because of synergies between adaptation and mitigation, Greenhouse Gas (GHG) reduction can be achieved more rapidly, when there is a widespread implementation of adaptation practices with mitigation co-benefits. This is an argument for the CFD project, to provide information to the CFA on the potential synergies and trade-offs for adaptation and mitigations of specific practices.

According to EIP-Agri, it is necessary to adapt climate smart farming practices to local conditions to improve the resilience and the environmental, social and economic performance of the farm. Sharing practical solutions through peer-to-peer knowledge exchange, on-farm demonstrations, different forms of collaboration with others in the value chain, pioneer farms, and good advisory support can help farmers in the transition towards more sustainable, climate-smart farming systems.

Although literature mostly refers to "Climate Smart Agriculture" as an approach to deal with the challenges of climate change, also other approaches related to sustainable agriculture in general targeting environmental, economic, and social objectives are interesting to further explore in the frame of climate smart farming, such as Carbon Farming, Regenerative Agriculture, Conservation Agriculture, and Agroecology, … (Oberc and Schnell, 2020). Practices and principles inherent to these approaches can inform the climate smart farming practices we intend to stimulate in Climate Farm Demo. For example (based on Oberc and Schnell (2020), which provides an extensive overview of the definition, principles, practices and challenges of multiple sustainable agriculture approaches):

- **Agroecology**: as climate smart farming, agroecology is also a holistic concept including the economic, environmental and social dimensions, that is not related to a single practice, is a heterogeneous and context- and location specific application of ecological and social principles. This puts some challenges to monitoring the adoption of agroecology as well as climate smart farming. The core principles of agroecology are related to: (i) planning: using a holistic approach in which the agroecosystem is viewed as one whole in contrast to a single crop; (ii) resources (nutrients and energy) are recycled and optimised within the farm system, (iii) field and landscape management by enhancing biological interactions and synergies among components of agrobiodiversity.

- **Conservation agriculture**: "*aims to "keep the soil together" as a living ecosystem that enables food production and helps address climate change '(Project Drawdown, n.a.; in Oberc and Schnell, 2020)*. It is underpinned by 3 principles: (i) minimizing soil disturbance, (ii) maintaining soil cover, (iii) managing crop rotations. Due to its narrow focus on soil ecosystem, it might have some adverse effects on other environmental aspects like water, biodiversity, and pest resistance due to an over-reliance on herbicides.
- **Regenerative agriculture**: as conservation agriculture, regenerative agriculture focusses on improving soil health to increase yields and resilience in face of climate change. The 5 principles outlined by Systemic and Soil Capital (2020; in Oberc and Schnell, 2020) are: (i) minimise or eliminate agrochemicals; (ii) maintain permanent cover of the soil, ideally with living roots; (iii) minimise soil disturbance; (iv) maximise functional biodiversity; and (v) adapt to context-specific design. It considers both crop and livestock farming. It relates to climate smart farming by improving resilience to climate change through increased soil health, including its fertility, structure, and possibility for plants to grow deeper roots, and by increasing agricultural yields, thus potentially presenting economic benefits to implementing this approach.
- **Carbon farming**: is based on the principles of conservation and regenerative agriculture and has as its key goal to store carbon in foils and vegetation. It involves the implementation of practices that improve the rate of CO2 removal from the atmosphere and its conversion into plant material or soil organic matter and the reduction of GHG emissions. It recognizes agriculture's contribution to climate change, and likewise its potential to sequester CO2 and reduce GHG emission as a land-based sector. Just as for CSF, it might be difficult to find exactly the right fit of practices for a given farm due to large variety of potential practices. Further, there are some difficulties in measuring the impact of carbon farming practices, which can be quite discouraging for farmers and causes uncertainty on how much climate benefits the approach provides. Because of its focus on active farmland's potential to mitigate climate change, some state that carbon farming diverts the focus from important priorities for minimising climate impact, which are the stop of clearing land and convert fields back into carbon sinks such as forests, permanent grasslands and peatlands. Because of its long-term impact on production and communities, financial incentives will be needed in the short term. The question remains to reward the implementation of practices or the achievement of results (which are hard to measure).

2.2 Adaptation and mitigation measures

Climate Farm Demo will cover a wide range of CSA practices that can be linked to 12 thematic areas (Figure 2). In scientific literature, there are multiple approaches to categorize adaptation and mitigation measures. Adaptation measures can be categorized according to the scale of implementation or distinguishing between type of change such as farm production practices (e.g., change to a different crop, new feed for livestock, new variety or breed), farm management changes (e.g., new way of feeding livestock, new way of growing crops, new way of managing crops or livestock), technological advancements, farm financial management, and participation in government programs (Smit and Skinner, 2002, in Descheemaeker et al, 2020; Tran et al. 2017). Mitigation measures are typically categorized according to the mitigation mechanisms, e.g., reduction of GHG (linked to the type and sources of GHG), carbon sequestration, prevention of deforestation and degradation of carbon-rich ecosystems. CSF practices listed by the FAO (in Oberc and Schnell, 2020) are:

- Integrated practices, involving management of production systems and natural resources, such as integrated crop and livestock production systems and agroforestry.
- Crop production adapted to climate change and using crop production for mitigation.
- Livestock measures that reduce GHG emissions
- Sustainable forest management
- Urban and peri-urban agriculture such as hydroponics and trees outside the forest
- Measures to improve the diversity of species, varieties and ecosystems
- Sustainable land and water management
- Proactive drought management including monitoring and warning systems
- Increased energy efficiency and minimal use of non-renewable energy
- Food waste reduction
- Applying nuclear and isotopic techniques to support climate-smart agriculture

In addition, research has been performed on the impact of climate change on the working conditions of farmers (McKinnon et al, 2016; Jones et al. 2020). Specifically, increased heat in both the workplace as on the fields and extreme weather events, can have major impacts on both the wellbeing of the farmers (e.g., physical risks, health risks, shorter available daylight working hours, mental stress) as on the productivity (e.g., due to reduced labour productivity, reduction of yield). Adaptation measures can thus also relate to taking measures to make the working conditions more climate proof. Examples of low cost measures are assured access to drinking water, frequent rest breaks, management of output targets (McKinnon et al, 2016). Other measures include the application of specific heat protection methods based on sustainable energy systems (McKinnon et al, 2016), or making the farm land more resilient to extreme weather events (Jones et al., 2020) .

Several studies incorporate the possible trade-offs between adaptation and mitigation measures that are mainly targeted at only one of both objectives. As previously mentioned, gaining insights in the synergies and trade-offs of AMM regarding adaptation and mitigation goals, could be interesting in the advice given to farmers. WP5 of the CFD project has the task to develop a list of AMM that can be understood as climate smart farming practices. When developing this list it might thus be interesting for the CFAs to provide insights in how these AMMs contribute to the adaptation and mitigation goals, how they are linked to the 12 thematic areas and at which level they require changes (farm production, farm management, technological innovations, farm financial management, government programs).

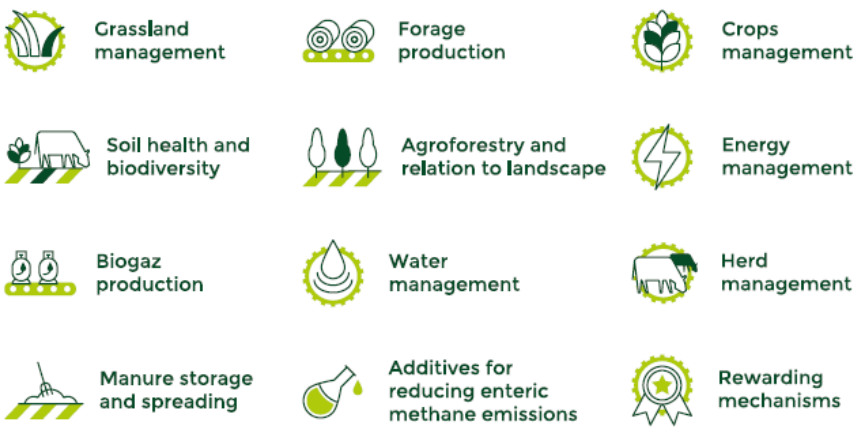

Figure 2 The 12 thematic areas of climate smart agriculture practices covered in Climate Farm Demo

2.3 Scaling the adoption of CSF

The successful implementation of climate smart farming practices highly depends on the adaptive capacity of societies to respond to the impact of climate change (Adger et al. 2015 , in Phuong et al. 2017). The adaptive capacity can be defined “as the ability of people and institutional systems to cope with incremental and rapidly changing conditions (Smit and Wandel, 2006; in Phuong et al. 2017)”. The focus on both individuals and communities in this is important, since the adaptive capacity has many different dimensions, such as the ability of a system, institutions, groups, and actors to deal with climate change (Phuong et al. 2017). Therefore it is important to engage stakeholders at multiple levels and in different contexts (human, social, financial, political, and institutional) to improve their adaptive capacity, and not to merely focus on the individual level (Phuong et al. 2017).

To increase the widespread implementation of Climate Smart Farming practices different scaling strategies can be followed: scaling out, scaling up and scaling deep (Moore et al. 2015; Martinez-Baron et al. 2018):

- **Scaling out** has the objective to increase the numbers and reach a wide number of farmers with improved practices in broader rural communities and territories. Strategies for scaling out are the deliberate replication of programmes geographically and to greater numbers and the dissemination of principles with adaptation to the new contexts. The adaptation to local policy, institutional, social and pedo-climatic contexts is highlighted as very important for the specific implementation of practices following this scaling out strategy (Cook and Fujisaka, 2004, in Martinez-Baron et al. 2018), since the value of adaptation measures are related to the local scale (FAO, 2008 in Martinez-Baron et al. 2018). CFD will highly contribute to this type of scaling through the exchange of practices via thematic networks on EU-level and national networks at national level. The organisation of on-farm demonstrations at the local level allows farmers and advisors to highlight the adaptation of practices/measures to the local context.
- **Scaling up** refers to achieving institutional buy-in and influencing policies and rules at higher levels. This can be achieved through new policy development, partnering and legal change efforts. Policies themselves can generate barriers to adoption of climate smart agriculture practices (Wreford et al., 2017). They could be identified through local experiences and should be removed or reduced through targeted and nuances policy and appropriate framing and dissemination of knowledge (Wreford, 2017). The importance of sharing local-scale experiences with policy networks linked to policy formulation cannot be stressed enough (Shames et al. (2016), in Martinez-Baron et al. 2018). The heterogeneity in the farmers community, with diversifying drivers, beliefs and actions, do not make it an easy job for policy makers as there is no single solution to be put forward. The national networks developed in the CFD will provide the perfect basis to create this link between farmers and policy makers. With the national coordinator and CFA as facilitator, specific demonstrations can be set up to make policy makers (and other influential actors) aware of the barriers for implementing specific practices. WP1 and 7 in this project can provide support for the national coordinators on this account. In addition, interesting synergies can be obtained through collaboration with the project ClimateSmartAdvisors, in which specific AKIS meetings will be organised on national level. By linking these AKIS meetings, to the PDF meetings or demonstrations, the long distance between policy and practice can be bridged.
- **Scaling deep** aims to change narratives, values and ideas. This can be achieved through the spreading of big cultural ideas and reframing stories to change beliefs and norms, intensively sharing knowledge and practices in learning communities and participatory approaches, and

investing in transformative learning, network and communities and practices (Moore et al. 2015). The development of a national and EU climate smart farming network, including PDFs (through Climate Farm Demo), advisors (through ClimateSmartAdvisors), and researchers (through the yet to be granted project on linking research stations) in the course of the next seven years, allows for the creation of shared narratives and values. Linking this network to national and EU AKIS actors allows for a changed and common mindset regarding climate smart farming. In addition, living labs set up in 10 countries will engage in an intensive participatory process to come to a shared understanding and generate a deeper impact at country level.

It is important to consider the various social networks farmers are operating to increase the adoption of CSF practices (Martinez-Baron et al., 2018). This network context can steer the development of interventions and their success to stimulate adoption of CSF practices. Although in many cases the uptake of adaptation strategies will be related to their perceived benefits (Adger et al. 2009 in: Martinez-Baron et al. 2018), it is important to acknowledge that the network context can influence the adoption of CSF practices either in positive or negative ways. The adoption can be influenced in a positive way because they can enable connections with other relevant networks and groups to access useful information. On the other hand, tightly bonded networks can also inhibit transformational adaptation (Dowd et al. 2014; in Martinez-Baron et al. 2018). Different network structures can have different impacts on the uptake of CSF practices. Before designing interventions to stimulate the adoption of CSF practices, it is important to have a good understanding of the local social networks, taking into account local variation when developing strategies. In the Climate Farm Demo project, this local understanding of the networks is guaranteed by putting a strong focus on the national and local level, by working with local Climate Farm Advisors (CFA) who are very knowledgeable about the local context, situation and networks farmers are working and living in. These CFAs should be aware of the personal networks, livelihoods and capital bases of the farmers, as it determines their capacity to adopt adaptation and mitigation measures (Martinez-Baron et al. 2018).

2.4 Adoption barriers for Climate smart farming practices

A major difficulty related to defining the adoption barriers for climate smart farming originates from the fact that we deal with a wide range of adaptation and mitigation practices. This has as a consequence that also different drivers and barriers will be related to the adoption of adaptation and mitigation measures, stemming from the different distribution of benefits related to different measures (e.g., individual direct benefits versus societal long term benefits) (Wreford et al. 2017). Since the primary aim of climate smart farming practices is not only focussed on increasing the financial performance of a farm, but rather on long-term resilience, farmers often perceive climate measures as not necessary and related to extra costs (Wreford et al. 2017). The decision to adopt a specific practice is strongly related to the local context, and will be influenced by a unique set of factors (Wreford et al. 2017), including both individual behaviour factors, but very importantly, also institutional and societal factors (defined by routines in the wider agrifood (chain) system, consumers, adivsory and other AKIS systems, policy, ...), which could be defined as the enabling environment. This again stresses the importance of tailoring adaptation measures to the local and evolving conditions (Wreford et al. 2017), but vice versa, also to seek on how to adapt the enabling environment in favour of the desired behaviour change.

Primarily, the biophysical context will define which adaptation and mitigation measures are most appropriate for application (Wreford et al., 2017). The following characteristics are deemed important for defining farmers' decisions (Wreford et al. 2017):

- Land capacity, location, climate and environmental quality (Dandy, 2012; van Dijl et al., 2015; in Wreford et al. (2017))
- Farm size and dispersion of parcels (Baumgart-Getz et al., 2012; Frisvold and Deva, 2012; in Wreford et al. (2017))
- Small scale farming versus large enterprises
- Mixed versus specialized production systems
- Biophysical pressure can also trigger transformative adaptation, for example, by stimulating farmers to move to more suitable locations or to change their production system (Marshall et al. 2016; Park et al. 2012; Kates et al. 2012; in Wreford et al. (2017)).

Wreford et al. (2017) performed an extensive literature review on the adoption barriers of climate smart farming practices, and categorized them according to their strength and the degree of agreement in the literature sources. However, they acknowledge that the relative importance will vary depending on specific circumstances, such as socio-economic characteristics, farming systems, bio-physical conditions, existing infrastructure, regulations and institutions. They state that in general the adoption barriers for mitigation measures will be harder to overcome, since it is harder to see the direct benefits of those measures for individual farmers, which limits their intrinsic motivation to adopt them. They distinguished between barriers at the farm level and barriers at the sector and policy level.

Barriers at the farm level, are related to the following conditions (Wreford et al.,2017):

- Structural conditions:
    - The absence of long-term security and certainty on their land, for example, regulated through land tenure.
    - The absence of infrastructure and complementary inputs related to the adoption of climate smart measures (e.g. irrigation).
    - The absence of farm succession or having higher farmer ages.
- Economic conditions
    - The lack of actual or perceived financial benefits; for example, having a negative impact on production, or implying a cost for the farmer. This is more related to mitigation measures compared to adaptation measures which generally create some kind of private benefit or avoid a cost for the farmer. When financial benefits are identified in advance, those are important drivers for adoption of new practices (Wreford et al. 2017).
    - The cost of adopting new practices and measures (e.g., equipment for precision agriculture) and the lack of financial capacity.
    - An oversimplification of cost assumptions, not taking into account farm-specific or contextual details and trade-offs between multiple climate smart measures, resulting in hidden and transaction (e.g., cost of learning and implementing new techniques) costs.
    - Limited access to credits.
- Socio-cultural factors
    - Local social norms defining what is seen as practices of a "good farmer", such as the negative attitude towards woodland planting related to the divide between farming

and forestry communities in some cultures. This phenomenon shows the importance of the attitudes of their neighbours for the decision to adopt a specific practice.
    - Emotional or cultural attachments to their land and land use may influence the adoption of specific measures.
    - Impact related to workload and work organisation and need for special equipment to to adopt AMM (Hostiou et al. 2021).
- Behavioural and cognitive barriers:
    - Sceptical beliefs towards climate change. It might be more impactful to focus on why farmers hold these sceptical views, than trying to directly change these views. Climate smart practices can be framed as addressing other problems farmers are facing (e.g. weather variability).
    - Farmers' perception of their own ability to mitigate or to adapt to the impact on climate change.
    - The absence of personal experiences with climate change.
    - Perceived long term horizons, uncertainty about future climate changes and relative risk perception. "Adaptation can be improved by a wide range of farm-level actions, from relatively short-term decisions made in response to observed changes in weather, such as changing crop variety or adjusting the timing of operations, to decisions that require a longer time to be fully effective (long lead time) or even be seemingly irreversible (long life time), such as planting shelterbelts or building housing to protect animals from heat stress (Wreford et al. 2017) ". In addition, climate smart strategies should take into account a wide range of possible climate change scenarios.
    - Competing pressures and demands, in which adapting to or mitigating the causes of climate change is not the farmers' priority.

Barriers at sector and policy level are related to (Wreford et al., 2017):

- The access to and level of information about climate change, its effects and the effect of mitigation measures.
    - The actual and perceived effect on the farm's or national production of the adoption of mitigation measures might hinder countries to act or scale back their agricultural production if competing countries are not doing the same out of a fear for economic disadvantages.
    - Insufficient information and awareness on agriculture's role in climate change and potential climate smart practices are an important factor limiting adoption of climate smart measures. This stresses the importance of information and education.
- Supply chain decisions and contracting schemes
    - Competitive production contracts focussing on yields are a barrier to the adoption of climate smart practices. For example, they might be encouraged by the buying companies to increase fertilizer use.
    - Post-production market chain-related constraints. For example, the absence of marketing of new low-emission or climate resilient crops or processing industries targeted at specific product varieties, can inhibit the adoption of climate smart practices.
    - Institutions and businesses have an influence on strategic choices of farmers and can stimulate or inhibit the adoption of climate smart practices through the development of best practices standards or programmes (e.g. Global GAP)
- The focus and type of the national and foreign climate policy in relation to agriculture.

    - Because of the many heterogeneous producers managing uncertain biological systems, there is an absence of explicit reference to agriculture in international climate agreements and policies regulating GHG emissions. However, they are needed to stimulate the adoption of mitigation practices that do not provide individual benefits on the short term for farmers. Implementation of policies targeting specific practices is often hard due to a lack of good Monitoring, Reporting and Validation systems.
    - Climate mitigation policy can limit the adoption of climate smart practices because: (i) they can divert farmers' resources and costs away from adapting their farm to actual climate change impacts towards compliance with mitigation policy; (ii) climate policies can create a hostility towards climate action, for example, through negative experiences with previous environmental policies.
    - Difficulties to report the impact of measures taken on national level or in a sector is recognized as a disincentive for adoption.
- Misaligned climate and non-climate related agricultural policies can inhibit the adoption of climate smart practices, for example, policies designed to support production or risk insurance can prevent farmers from adapting their farm management to climate change.

The overview of these barriers show that there are interventions to be developed at multiple levels. CSF has received crucial support from both private and public sectors from its outset, which makes it a beneficial concept for participatory approaches in which various actors and sectors along the value chain are included (Oberc and Schnell, 2020).

2.5 Role of advisory services in climate smart farming

To tackle the barriers on both farm and sector and policy level mentioned in section 2.4, rural advisory services can play a role on both levels. On farm level they can play a role by advising and disseminating information to change the behaviour, strategies and practices of farmers. On higher level they can act as a broker and facilitate the dialogue between farmers and other AKIS actors to improve the enabling environment for climate action at farm level and other levels. Rural advisory services can play a role in achieving CSF by disseminating climate information and technologies and information on CS practices through innovative approaches, by strengthening farmers' capacity, by facilitating and brokering, and through advocacy and policy support. Moreover, advisory services can play a bridging role by linking farmers with other service providers for farmers, such as researchers, rural organisations, farmer groups, input suppliers, carbon markets, insurance companies, meteorological services etc (FAO compendium CSA extension, p.9). Further, according to FAO compendium CSA extension (p10), advisory services are well placed to monitor the effects of climate change on agriculture and the advancements towards climate smart Farming and thus inform policies. Vice versa, they can play a role in explaining and translating climate change policies towards the farmer communities. This will however require capacity development at individual and organisational level and institutional changes at system level (FAO Compendium CSA Extension, p. 7).

There are two challenges linked to coming up with and disseminating climate smart practices: (i) determining what types of adaptive changes farmers need to make and when, (ii) ensuring that relevant

technologies and modes of dissemination keep up with the need for ever changing climate change adjustments (Simpson and Burpee, 2014; in: FAO Compendium CSA extension, p. 8). To meet these challenges, advisory services will have to collaborate more with researchers to find solutions to address climate change and will need to search good practices in other regions that are already more affected by climate change. Further, advisory services will have to shift their focus from the single farmer level to a more higher scales as climate change calls for adaptation changes on landscape level.

Sorenson et al. (2021) identified 5 categories of skills for professionals to engage in the transition towards sustainable agriculture:

- *A systems perspective*: refers to the need for a broad and holistic perspective taking into account the complexities of agricultural practices. It involves the capacity to zoom out from individual practices to the farm level, including different perspectives from multiple actors, and to understand the interactions between different practices
- *Lifelong learning*: refers to the importance to engage in an permanent process of learning and adapting knowledge to the progress in the transition. It involves innovative and creative thinking, the ability to experiment, solve problems, and think critically.
- *Integration of knowledge*: refers to the need to integrate different kinds of knowledge of different actors in agriculture. They should be able to combine scientific knowledge with practical and context-specific knowledge, and to link global issues with individual solutions on local level.
- *Creating and maintaining networks and learning communities*: refers to fostering new farmer networks and learning communities that share knowledge. It involves skills such the ability to build diverse knowledge capacities, seek out new or existing networks, share knowledge with different actors, and understand the value and potential of these networks.
- *Technical and subject-specific knowledge and technology:* refers to knowing how to navigate the new and permanently evolving technical and scientific developments we highlight the need to learn how to navigate the technical and technological developments that are constantly evolving.

The Climate Farm Demo project will contribute to the capacity development of advisors to support farmers in the development of adaptation and mitigation plans and to facilitate the knowledge exchange (though demonstrations) on CSF. For this, the project will also benefit from the close collaboration with ClimateSmartAdvisors, which is set up with this very objective.

Advisors are perfectly suited to support the promotion of CSF because they (https://www.fao.org/climate-smart-agriculture-sourcebook/enabling-frameworks/module-c2-supporting-rural-producers/chapter-c2-2/en/ (22/03/2023):

- Have close relationships with farmers. Farmers will be more receptive to information and experiment when advice is provided by trusted advisors
- Have a detailed and nuanced understanding of farmers' vulnerabilities and existing working conditions, such as assets of households, social dynamics within communities, farmers' adaptive capacities, which is necessary to provide appropriate adaptation and mitigation strategies.
- Have a clear view on the existing local support and services related to the implementation of adaptation and mitigation strategies. This can be related to market information of new crops, agrometeorological crop forecasting, suppliers, …

- Can play a mediating role for scaling climate smart farming, involving the promotion of interactions and knowledge exchange among multiple stakeholders within the AKIS.

The complexity related to Climate Smart Farming, requires that farmers will need to focus more on local and scientific knowledge, develop their observational and experimental skills and improve their critical thinking and problem solving abilities. Since there will be no one-size-fits-all solutions, they will have to make even more their own decisions on the appropriate practices for their farm from the menu of different options. Non-formal education and experiential learning approaches are appropriate ways to develop these farmer competencies (Braun, 2000 and Waddington et al. 2014; in FAO compendium CSA extension). Specifically for advisory services used to providing direct recommendations, this might require a shift in approach and the development of their soft skills.

The recent shift from knowledge transfer towards more participatory approaches with farmers for the development of technologies and facilitating innovation process, is perfectly aligned with the needs for context and site-specific assessments to identify suitable practices and technologies for CSF. Besides these participatory approaches, advisory services also have ample experience in other activities for disseminating information, technologies and practices, such as interpersonal interactions, farm demonstrations, printed materials, media, etc.

Chapter 3

Social learning and boundary work in Climate Farm Demo

3 Social learning and boundary work in Climate Farm Demo

3.1 Social learning and social networks for climate action

Despite numerous studies on the potential effect of CSF practices on mitigation, adaptation and food security, adoption by farmers is still lagging behind (Westermann et al. 2018). Theoretical studies are often based on experiments or models and discuss trade-offs by using qualitative or general terms without quantification (Descheemaeker et al. 2020). However, they don't take into account the agro-ecological, sociocultural, economic and institutional context and thus potential barriers (and drivers) for farmers to uptake these CSF practices (Descheemaeker et al. 2020).

Adoption of CSF practices by farmers is a complex dynamic process, rather than the linear process of binary decision taking it is often thought of (Glover et al., 2016; in Westermann et al. 2018). Despite the efforts to disseminate, apply and scale up research results, there still exists a gap between researchers, policy makers and practitioners to reach the full potential impact of the CSF practices (Westermann et al. 2018). Therefore, the role of intermediaries and innovation brokers is put forward to help bridge this gap, by facilitating collaboration between multiple groups of actors and stakeholders (Schut et al. 2014, in Westermann et al. 2018).

The complexity related to climate change and the differing understandings of what constitutes CSF (also related to different contexts) has increased the interest in social learning to deal with this topic (Ensor and Harvey, 2015). According to Ison (2010, in Phuong et al. 2017) social learning at the collective level is appropriate for dynamically complex situations, without systemic certainty, such as climate change. Social learning can be understood "*as a process of (inter)action between stakeholders in order to change actors' understanding of an issue so as to influence their future actions regarding the issue"* (Phuong et al. 2017).

Recent literature agrees that climate action needs to move beyond the mere provision of information, towards the embedding in processes that support learning, including increased local participation to share information and build shared knowledge and leading to behavioural and socio-institutional changes (Ensor and Harvey, 2015). While social learning can refer to multiple definitions and roots in literature, in the context of climate change it is mostly linked to theories of situated learning, in which the social setting and its role in structuring what is learnt is emphasized (Ensor and Harvey 2015). It recognizes that the context (including culture and practices) in which learners are embedded shape their thinking. This view stipulates that learning emerges from collaborative processes that allows for shared meaning making within a community. Interventions seeking for behaviour change focus on

enabling new meaning making (e.g. what does climate change mean in our context?), by creating shared understandings about particular issues through interaction between people with different perspectives. Ensor and Harvey (2015) define social learning as the result of "*practices that facilitate knowledge sharing, joint learning, and co-creation of experiences between stakeholders around a shared purpose in ways that:*

1. Take learning and change beyond the individual to communities, networks, or systems; and

2. Enable new shared ways of knowing to emerge that lead to changes in practice."

Social networks are critical to the achievement of social learning (Loeber et al. 2007). Over recent years, research findings and knowledge exchange advancements have demonstrated that innovation and uptake of new farming practices are better supported by co-production through stakeholder interactions in non-linear knowledge networks or systems (cf. Wielinga et al., 2017 and Faure et al., 2019 in Triste et al. 2023). Innovation is viewed as a systematic and interactive process that emerges from social networks (Wielinga et al., 2017, in Triste et al. 2023).

3.2 Boundary work to facilitate knowledge exchange in Climate Farm Demo

In Climate Farm Demo, a big social network will be developed to bring together all these multiple stakeholder types. This network will be characterized by multiple levels (Figure 2). Each level is defined by its own typical activities and actor types. We distinguish the following levels:

- Pilot Demo Farmers (PDF): which are the farmers who are willing to make their farm management more climate proof with the support of a CFA and share their experiences during demo events. This level is related to the individual learning and behaviour change process of the farmers.
- Hub: which is the group of PDFs together supported by the Climate Farm Advisor (CFA). At this level social learning between PDFs take place.
- Country: which is constituted of the different hubs, embedded in the Climate Smart-AKIS (CS-AKIS)
- EU: which is constituted of the thematic networks, embedded in the EU CS-AKIS (including other projects, initiatives and policy makers)
- Project- ExCom: which is constituted by the project coordination and work package and task leaders, and responsible for providing inputs for the other levels.

At each of these levels, distinct activities involving different actor types will take place, which will be elaborated on further in this document. Referring to the previous chapters, the PDF and Hub level activities will mainly focus on behaviour changes and climate action at the farm(er) level. This can be interpreted as the processes induced in the left side of Figure 3, linking the PDF, Hub and EU level through the Thematic knowledge exchange. The national and EU level, through the link with CS-AKIS's, will be targeted at improving the enabling environment for climate action. This can be interpreted as the flow of knowledge along the right side of Figure 3, between PDF, national and EU CS-AKIS . In the project, PDFs will interact mostly with the hub through the farm demonstration activities and country

level through national annual meetings. The hub level will interact with the country level through national annual meetings and the EU level through participation in thematic networks. The national level will interact with the EU level through encounters with other national countries (exchanges between national coordinators) and the EU CS-AKIS.

A challenge in CFD will be to facilitate the knowledge exchange and flows across these different levels. Collaboration between different actor (types) is not always straightforward, as each has their own values, perspectives, and objectives. "T*o achieve learning and innovation in hybrid networks, actors have to align their diverse attitudes, motivations and values into shared knowledge pool and collective or concerted action (*Tisenkopfs et al., 2015, p.15)*".* Within Climate Farm Demo, knowledge exchange will be facilitated through encounters between these different levels. Multiple activities between these different levels will be facilitated through the project. For example, to exchange experiences between the hub and PDF level, demonstration activities will be organised.

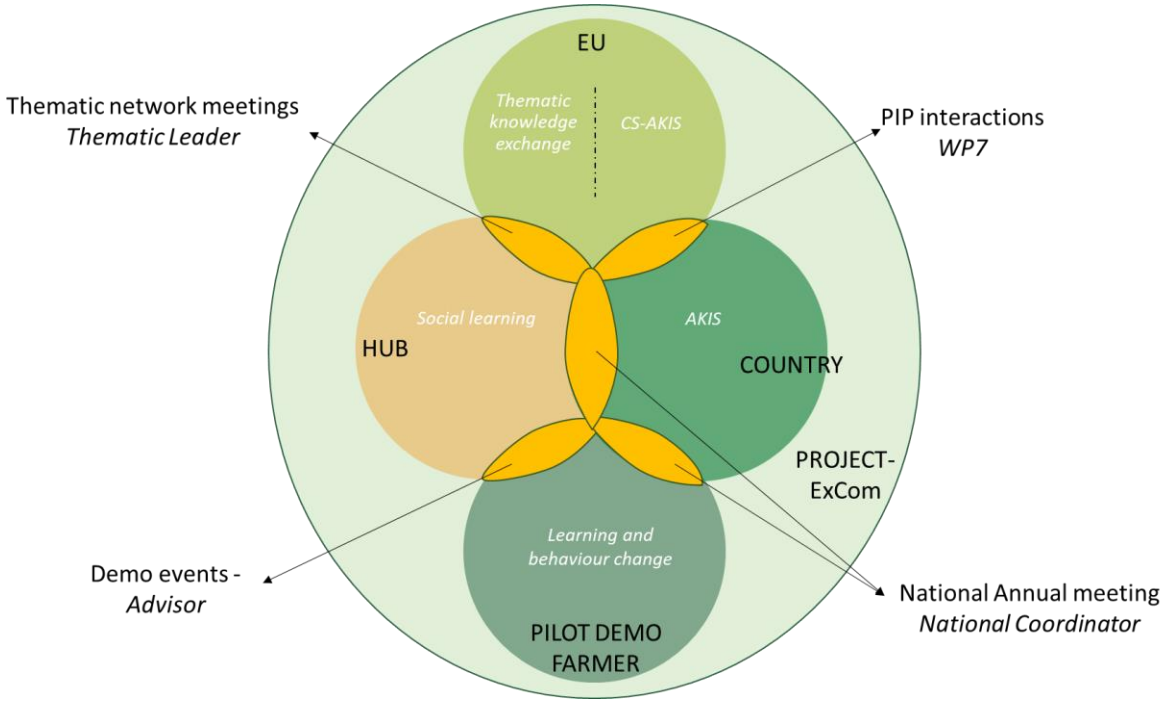

Figure 3. Knowledge creation levels within Climate Farm Demo

To get a grip on the exchange of information and knowledge between and across different levels, we introduce the concept of boundary work. **Boundary work** involves the management or enabling of knowledge processes across boundaries of the different life-worlds of actors (Tisenkopfs et al. 2015), which in our framework refers to the exchange between the different levels of PDF, hubs, countries, and EU marked by the yellow areas on the intersect between different levels (Figure 3). Boundary work improves connections between different life-worlds of actors, facilitates learning across the boundaries of these life-worlds and transformation of knowledge into innovation (Tisenkopfs et al., 2015). Connecting across boundaries of different levels can take place in so- called **boundary spaces** which are defined as "*an abstract, shared space between collaborating actors with different knowledge"* in which "*tacit knowledge becomes explicit and where actors are confronted with, and learn about each other's interests and perspectives (Stange et al. 2016, p.5)*". Actors can be individuals or groups that want to produce new knowledge based on their own individual knowledge, and in this project could be

PDFs, CFA, NCs, but also other farmers and CS-AKIS actors not directly involved in the project. Within these boundary spaces, the concept of **boundary objects** can help to understand the dynamics between different actor types in knowledge production and exchange processes and how they come to a common understanding in convergence (Stange et al, 2016). Star and Griesemer's (1989) define boundary objects as: "*objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation" (Star and Griesemer 1989:393).* Objects become boundary objects when they play a role in connecting these actors and help establish a shared understanding between them (Stange et al. 2016). Boundary objects can be both abstract and tangible, taking the form of (i) artefacts, such as tools, documents or models; (ii) discourses, i.e. a common language that allows people to communicate and negotiate meanings across boundaries; or (iii) processes, therefore shared processes, including explicit routines and procedures that allow people to coordinate their actions across boundaries. (Wenger 1998, 2000; *in* Moschitz and Home, 2012). A 'boundary object' is shared by different communities but used differently by each of them according to their own context (Tisenkopfs et al., 2015). The "*activities that are instrumental in making objects function as boundary objects (Stange et al. 2016; p.5)* ", are defined as **boundary activities**. These boundary activities create the entry point for actors to participate in a collaboration, such as face-to-face meetings, phone or video calls, workshops, demonstration events, seminars, etc. (Stange et al., 2016). Boundary activities are needed to make an object into a boundary object, and vice versa, objects trigger activity (Stange et al. 2016).

We will use these concepts of boundary spaces, activities, objects and work to explain and understand the interactions between the different levels in the project, and thus how knowledge can be shared and enforced across these different levels in the project. We will first focus on the PDF and hub level and frame them within the aim to change farmer behaviour towards climate actions. After this, we will explain the levels of the country and EU and how they fit within the aim to generate a more favourable enabling environment for climate action and thus can stimulate the behaviour change of farmers.

Chapter 4

Farmer behaviour change

4 Project activities supporting farmer behaviour change

The main target group in Climate Farm Demo are the Pilot Demo Farmers (PDF). The objective of the project is to help farmers respond effectively to climate change by changing their farm management towards more climate smart farming. This means that they will change their practices (i) by adapting to climate change and (ii) by mitigating their impact on climate change while (iii) maintaining a sustainable production and income.

4.1 Farmer behaviour change

Rather than the behaviouralist perspective on behaviour change to be "objective" externally observable physical behaviour, we follow Pelling et al. (2008) to interpret behaviour as "*that which learners do*", including internal actions, conscious or unconscious cognition or emotional affect. Church (n.d.) supports this wider definition by explaining that behaviour is not limited to physical actions but refers to "*anything which the learner does, or says, or writes, or thinks, or feels".* (https://www.tecks.co.nz/home/Importantlearningandteachingevents/Learningprocesseslearningoutcomesandphasesoflearning/Whatislearning/Learningincludesachangeinbehaviour; 11/05/2023), as this also reflects the learning process farmer are going through. One of their learnings might be that a given practice is not suitable for their context or farm.

Multiple studies have been performed to identify key factors influencing farmer behaviour. Rose et al (2018) identified the following key factors influencing farmer behaviour:

- *Personal factors/attitudes*: e.g., age, gender, education, experience, attitudes, and beliefs were very common determinants of behaviour. The personal beliefs of a farmer, influenced by individual circumstances and characteristics, but also stigma and fear, were found to be a key determinant of behaviour, and they influenced the effectiveness of behavioural interventions to a great extent (Rose et al. 2018; Wreford et al. 2017)). Classifying farmers into different types according to their beliefs, values and motivations can help identifying the driving forces behind their decision making and thus the types of interventions that are required to stimulate adoption (Wreford et al., 2017).
- *Business factors:* e.g;, farm size (owned versus rented), cashflow, staff numbers, succession plans, profitability (Rose et al. 2018) and labour conditions (Hostiou et al, 2021). The way they influence adoption is related to the type of CSF practice that you want to induce.
- *Opinions of family, peers, and advisor networks:* this so called "ring of confidence" (AIC, 2013; in: Rose et al. 2018) they help defining for a farmer what is accepted as "normal" farm management and are highly influential for decision making. Kuhfuss et al (2016; in Rose et al. 2018) showed that wine growers in France were more willing to enrol into a management

scheme if they believed that a majority of their peers would do the same. This shows the importance of developing farmer networks in which adopted practices are shared. Further, trusted advisors seem to play an important role in the behaviour change. A better understanding of the chain of communication between farmers, landowners, extension agents and others can be very interesting in understanding how to influence behaviour change (Rose et al., 2018).

- *Feeling in control of decision-making:* The perceived behavioural control, referring to the level of autonomy over decision-making and the perceived ease of implementing a specific behaviour (self-efficacy), was mentioned as a highly influential on behaviour change. This shows the importance of making farmers feel in control of the decision-making and make them feel confident that they will be supported in implementing the new practices.
- *Relative advantage (incentives/rewards)*: since there is often a cost related to change, direct financial incentives, the promotion of the relative advantages and/or the profitability related to implementation are important factors for the adoption of practices.
- *Market or compliance-based rewards:* this factor is a way of promoting the relative advantage of a specific behaviour, such as gaining higher prices or measures that help farmers to comply with market demands.
- *Information provision and education:* many papers highlighted information provision and education as key factors for behaviour change. The access to trusted information through advisors and extension services is very supportive in this, and they should be sustained over time to provide continued support for farmers. The provision of education influences the perceived behavioural control. However Hendrie et al. (2017 in: Rose et al. 2018) concluded that besides knowledge, rather the active demonstration of behaviour increase the confidence in performing a behaviour.
- *Nudges, through positive messaging, pricing and other incentives:* Rose et al.'s (2018) literature review shows how positive language and scenarios (if you do this, you will benefit in this way) influenced people's behaviour more that negative messages (if you don't do this, you will suffer from this).

Many behaviour change models in literature reflect this non-binary and uneven change process, such as the ADKAR model and the transtheoretical model. The ADKAR model, is a coaching tool to support a successful change and is an acronym for Awareness, Desire, Knowledge, Ability, Reinforcement, reflecting the different stages in the change process of individuals. Similarly, the trans-theoretical model conceptualizes the process of intentional behaviour change by integrating the most relevant principles and concepts from multiple theories of behaviour change (https://prochange.com/transtheoretical-model-of-behavior-change/). The stages of the transtheoretical model are: precontemplation, contemplation, preparation, action, maintenance. The picture below shows the similarity between the ADKAR model and the transtheoretical model.

The stage in the process where individuals are at and the barriers blocking individuals to advance in the process, will define the required interventions and activities needed to support their advancement (Figure 4. Stages in the behavioural change process (integration of ADKAR and Transtheoretical Theory)Figure 4). Farmers can find themselves in different stages in the process for different CSF practices and strategies.

The stage in the process where individuals are at and the barriers blocking individuals to advance in the process, will define the required interventions needed to support their advancement (Figure 5).

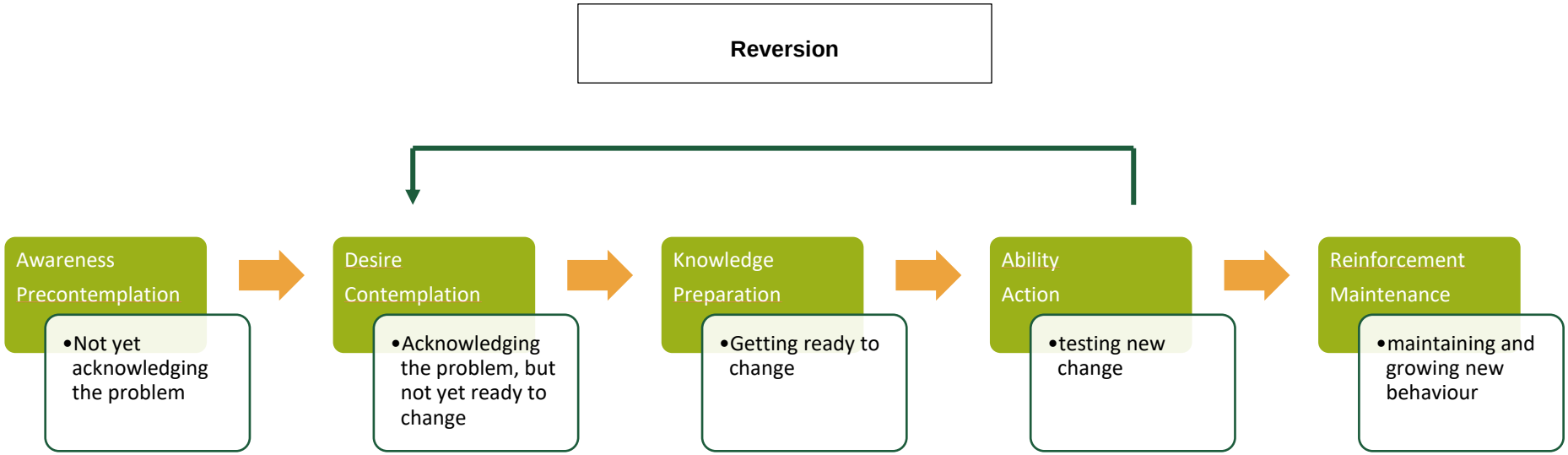

Figure 4. Stages in the behavioural change process (integration of ADKAR and Transtheoretical Theory)

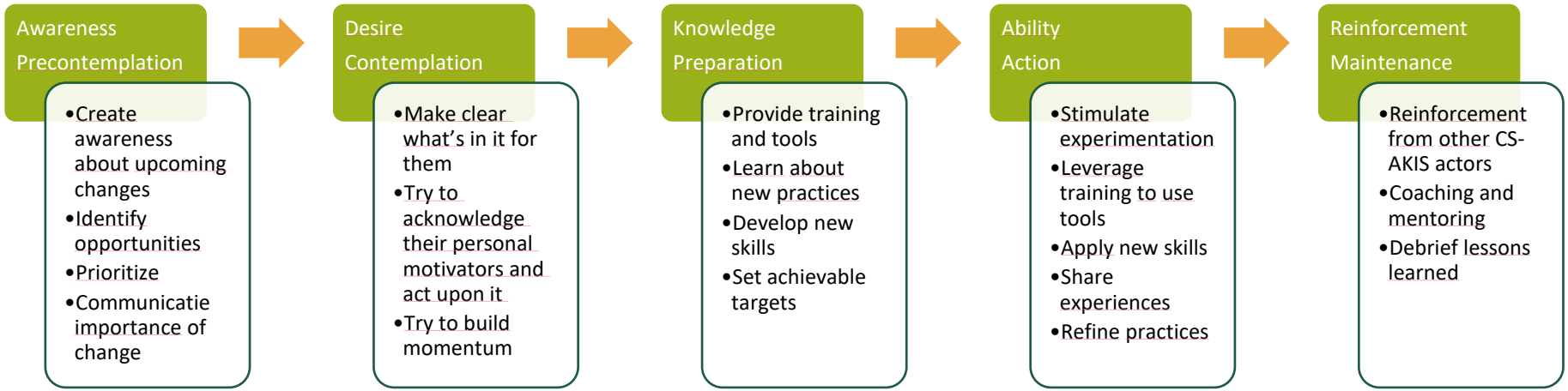

Figure 5. Stages in the behavioural change process, and the potential interventions related to each stage[4].

[4] Based on : https://www.beyond20.com/blog/adkar-organizational-change-management-ocm/

4.2 Interventions for farmer behaviour change

Interventions can be defined as activities designed to change behaviour (Mitchie et al. 2011). In the context of agriculture, extension methods can be seen as "*interventions that are designed to support voluntary change and they are a key mechanism through which farmer diversity and the adoption context can be considered and addressed (Nettle et al. 2022, p. B)".* The reference to the adoption context in this definition again shows that the effectiveness of extension methods highly depends on their adaptation to the local context (Nettle et al. 2022). It is important to differentiate interventions across regions, taking into account different farmer types (with diverting values, attitudes and beliefs, farm systems), land uses and socio-ecological contexts (Wreford et al., 2017). To meet the diversity of farmer types, a holistic, multi-faceted approach of interventions is more conducive to achieve behaviour change, focusing on multiple types of intervention strategies (Rose et al. 2018). Specifically for achieving long-term behaviour, a combination of strategies proves to be successful for adoption outcomes (Nettle et al. 2022). However, different intervention strategies can have different characteristics, with potential tradeoffs between them, mainly when induced at different levels and by multiple actor types (Westermann et al., 2018).

Different steps should be taken in the development of interventions to support behaviour change towards CSF (Based on Michie et al.(2011) ,and Wreford et al. (2017)):

1. Understand the problems of Climate change in local context
2. Understand the target behaviour: what kind of behaviour are you trying to achieve to deal with the local climate problems? Whose behaviour do you want to change?
    1. Define the problem in behavioural terms
    2. Select the target behaviour (what do you want to change to address the problem)
    3. Specify the target behaviour (what, where, when, how, with whom, in which context, …)
    4. Understand what needs to change to achieve target behaviour? What are the barriers with highest priority? At which stage does the farmer find him/herself in the behavioural change process?
3. Design the interventions
    5. Identify the required intervention functions based on the detected barriers and the stage in the change process;
    6. Identify the required behaviour change techniques
4. Deliver the intervention
    7. Select the mode of delivery

These steps show the importance of a good understanding of the context and current barriers for changing towards a target behaviour. Also, for defining target behaviour, social processes might be needed. These can be organised at the hub level with other farmers, but also at the national or EU level through interactions with the AKIS. Michie et al. (2011) identified 9 intervention types that are more or less effective depending on the identified barrier for behavioural change (Table1). For example, if the barrier for behaviour change is related to a lack of capability, training and enablement are likely to be the most suitable intervention types.

Table 1. Intervention functions and CFD activities that could meet these functions

Intervention function	Definition according to Michie et al. (2011)	Activities in CFD related to the intervention type
Education	Increasing knowledge or understanding	Training sessions for PDFs and CFAs on CSF practices Farm demonstrations Thematic networks
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Newsletters to inform about project activities and successes
Incentivisation	Creating expectation of reward	Showing the (economic) benefits related to the adoption of CSF practices (including the potential rewarding mechanisms)
Coercion	Creating expectation of punishment or costs	
Restriction	Using rules to reduce the opportunity to engage in competing behaviour	
Environmental restructuring	Changing the physical or social context	Development of AMP to stimulate motivation
Modelling	Providing an example for people to aspire to or imitate	Farm Demonstration Lighthouse farms Hubs
Enablement	Increasing means/reducing barriers to increase capability or opportunity	Living Labs National meetings with AKIS actors PIP-activities

Michie et al. (2011) report the general recognition of context being key in the effective design and implementation of interventions. This stresses the importance of the regional and local focus in Climate Farm Demo, by starting from the farmers' behaviour and barriers to adopt CSF practices in the context they live and work in.

Nettle et al. (2022) use the typology of 9 extension interventions used by Coutts et al. (2017) to encourage learning and change. They distinguish between:

- facilitated farmer discussion groups as a platform for social learning, including peer-to-peer learning and demonstrations
- Multi-actor technology development, focusing on collaborative approaches with farmers to address specific topics and problems such as application of new technology or tools
- Training, enabling the development of knowledge, skills and techniques
- Information provision, facilitating access to relevant information
- Consultancy (one-to-one, mentoring, coaching), providing individual support for decision-making
- E-extension, using information and communication technologies to provide information and extension support virtually/remotely
- Co-innovation, bringing people together in a collaborative process to negotiate and implement shared goals and outcomes
- Best Management-practice frameworks, a formalized process for self-assessing capacity and the responding to gaps and deficiencies.
- Social marketing, aiming to better understand and engage people towards specific behaviour changes.

The decision on which intervention techniques to choose will depend on 2 factors: the context and the goal for adoption (Nettle et al. 2022):

- The context of adoption involves the level of uncertainty, complexity and risk involved in the change , for example, "*the benefit from change is assured, how long it will take to see benefits from change and the perceptions to the level of exposure to different risks and vulnerabilities that change may bring, personally, socially, financially or environmentally".*
- The goal for adoption is related to the target populations and level of ambition for change.

High effectiveness in the extent, reach and time to change are supported by facilitated small-groups meetings and the provision of direct advisory or coaching (Nettle et al. 2022; Triste et al. 2018). This means that in Climate Farm Demo additional benefits can be generated by bringing together fixed groups of PDFs. However, the combination of methods addressing farmers needs and supporting the journey of change were reported as key to a greater impact. According to Nettle et al. (2022), the effectiveness of interventions depends on the context of adoption:

- When complexity, uncertainty and long time frames are involved in changing the farm practices, such as is the case for climate smart farming, facilitated groups, technology development, and co-innovation were reported as strong methods, and information provision as moderate. Although technology development is not the aim of this project, Climate Farm Demo can offer a platform for facilitated groups (hub level) and co-innovation, through the facilitation of 10 living labs.
- For known and uncontested contexts and impacts, such as the application of a specific techniques such as solar panels, training, information provision, one-on-one consultancy, best management practices, social marketing and e-extension are put forward as strong methods, whereas facilitated groups and technology development only as moderate. In Climate Farm Demo, the provision of tools, information sheets, videos, etc. through knowledge platfrom, can thus be a useful tool for the adoption of such known practices. Also training session organised at national level, can be conducive for making farmers familiar with specific practices.
- For known contexts and impacts, but complex and uncertain implementations, strategic groups, technology development and one-on-one advice are reported as strong methods. Whereas training, information provision, e-extension, co-innovation, best-management practice and social marketing are seen as moderate.

Facilitated groups, technology development, and information provisioning seem to score moderate to strong to all contexts of change. Both facilitated groups and information provisioning can be a facilitated through activities in Climate Farm Demo.

Table 3. A framework for assessing the relative strength of extension methods (1 through 9) according to the attributes of the context for change (A, B or C), derived from the review and case study findings.

Extension methods (1–9)	A	B	C
	The farm-practice context and impact from change is known and uncontested	The farm-practice context and impacts from change are known, yet there are complexities and uncertainties in implementing change	There is complexity, uncertainty or long time-frames in changing farm practices or in knowing the impacts from change
1. Facilitated groups/ peer learning	Moderate	Strong	Strong
2. Technology development	Moderate	Strong	Strong
3. Training	Strong	Moderate	Weak
4. Information provision and access	Strong	Moderate	Moderate
5. One-on-one/ consultancy (coach)	Strong	Strong	Weak
6. E-extension	Strong	Moderate	Weak
7. Co-innovation	Weak	Moderate	Strong
8. Best management practice	Strong	Moderate	Weak
9. Social marketing	Strong	Moderate	Weak

Figure 6. Extract from the paper of Nettle et al. (2022) on the strength of extension methods in different situations.

Nettle et al. (2022) report that the successful adoption outcomes could be linked to the application of combinations of methods/interventions, that were also continuously adapted to the (changing) learning needs of different groups of farmers. They recognize 3 strategies to combine methods:

1. Stacking: in which multiple methods are combined as a cohesive package to farmers within a single project. Stacking strategies tailor the methods to the learning needs and learning journeys for individuals, thus providing a suitable environment and the necessary tools for change. In Climate Farm Demo the combination of 1-on-1 advice and farmer group meetings at the hub level, are an example of stacking interventions.
2. Linking: multiple points for farmer engagement that support change are provided and farmers can choose their preferred ways of support. In linking strategies the diversity of interests and needs of individuals are met, by providing a range of methods providing an environment in which farmers can engage them according to their suitability. This can involve multiple organisations each specialized in another extension method, and require a kind of coordination. In Climate Farm Demo, the collaboration with other projects on national level, focussing on specific technologies or strategies, or on EU level, dealing with specific thematic topics are examples of this strategy of linking interventions.
3. Networking: different organisations create collaborations or networks to refer farmers to services that can meet their needs and support change. The aim is reach a wider range of the farming population by aligning with different preferences or interests in a topic of change through associations of different organisations. Although not a specific aim in Climate Farm Demo, the institutionalisation of collaborations between different actors at EU or national level could be a nice example of the networking strategy.

The decisions on how decide on the strategy to combine methods are influenced by: 1. The institutional arrangements of extensions and the need to link different types of expertise, and, 2. Is goal for supporting change related to deepen the engagement of an individual in a learning journey (stacking is more suitable) or to widen the target population (networking is more suitable).

Table 4. The features of different strategies when combining agricultural extension methods.

Item	Strategies when combining extension methods		
	Stacking	Linking	Networking
Description	• Multiple methods are combined within a single project or intervention, providing a cohesive package or offer to farmers • The combination of methods provides a learning journey for participants	• Multiple methods are linked to provide multiple points of access and engagement on a topic and to suit different preferences	• Multiple methods are supported by the collective effort of a network of organisations • Organisations cross-refer farmers to the resources and organisations that can meet their needs most effectively
Goals	1. Reinforcement of learning/addressing multiple stages of learning 2. Targeting of support to a learning need	1. Meet a diversity of interests, needs and engagement with a topic 2. Generate broad awareness or need for change 3. To coordinate and align information and services so that farmers can engage in a way that suits them	1. To leverage the associations that people from different organisations have with different farmers to achieve wider reach to a farming population 2. Align the interests of farmers and different organisations in a topic of change 3. To access different expertise that is required to support a change goal
Examples from the literature review	• Combining small-group learning with training and coaching or individual advice (Hansen 2015; Sobotta *et al.* 2016; Bewsell and Brenton-Rule 2019) • Combining e-extension and training (Hesse *et al.* 2019) • Combining facilitated groups/demonstrations and BMPs (Merhaut *et al.* 2013)	• Linking training to information resources and other technical support from the industry (Dillon *et al.* 2016) • Linking information provision to separate advisory services (Coleman *et al.* 2017) • Linking demonstrations to training and external follow-up (Goodhue *et al.* 2010)	• Developing cross-organisation networks for application of BMPs (Emtage and Herbohn 2012*a*, 2012*b*) • Providing access to a range of external expertise following group-learning (Brown and Bewsell 2009) • Accessing different interest groups to tailor information (Rollins *et al.* 2018)
Examples from the case studies	• Case study 2 (small-group learning, BMPs, training and coaching) • Targeted to better meet the needs of a specified group of farmers • Delivered by a single organisation	• Case study 1 (multiple advisory organisations sharing information and then providing this and advisory support to farmers • Advisory organisations linked farmers to the demonstration sites and other avenues for learning	• Case study 1 (a network and collaboration providing farmers with a variety of access points for information and tailored advice on all stages of the change • The collaboration provided scientists and advisers with a strong feedback and learning mechanism to continually update and improve the information available for farmers
When to apply the strategy	• When farmers need a 'next-step' to consolidate a change • When there is a group of farmers with different needs in being able to change or with different motivations on a topic • When the relationship between farmers and the delivering organisation needs strengthening	• When the reach of a single organisation to a population of farmers is constrained for any reason • When the expertise to support change lies outside a single organisation • When there is a willingness for organisations to cooperate to provide consistent messages and support to farmers • There is leadership in coordinating the extension response • There is farmer trust in the organisations in which extension methods are linked	• When there is shared interest across organisations in the agenda for change • When there is willingness to learn together with farmers and share and provide expertise to support the change • When the on-farm outcomes are the driver for collaboration and not the attribution • When there is a developing level of trust between organisations to collaborate on the extension goal

Figure 7. Extract from the paper of Nettle et al. (2022) on the different strategies for combining extension methods.

4.3 Project activities at the level of the PDF

Different forms of competency building activities for PDFs can be foreseen within Climate Farm Demo. These activities support the learning of factual knowledge on CSF (cognitive learning), changing norms, values and belief systems needed to create an increased awareness and urgency of CSF (normative learning), and trust building and appreciation of others' worldviews needed to create a shared understanding on the direction to head into (relational learning) (Lebel et al.2010). We can classify the competency building activities according to a gradient for decreasing engagement:

- 1-to-1 advise from the CFA (see next paragraph)

- Demo events organized by PDFs, LFs, and EFs in collaboration with CFA (which is happening in the boundary space at the encounter between PDF and Hub level)
- *Training* (face-to-face or online) on national level organised by NCs and CFAs, with the support of external experts. Training should provide sufficient and transparent information about a practice (Tran et al. 2017) and should focus on practical and action-based knowledge for farmers rather than conceptual or too scientifically oriented information (Nettle et al. 2022). Further, training events should be made flexible enough to allow to adapt the content the farmers' needs (Tran et al. 2017). Further, also the follow-up to training is very important, including individualized farm visits, ongoing engagement with the participants afterwards and come-back activities (Nettle et al. 2022). The involvement of advisers and researchers with farmers in the training can be beneficial.
- *Webinars* organized at EU level by TLs, task and WP leaders. Although they might in the first place target advisors because of language issues, such e-extension activities can be interesting for farmers who lack access to face-to-face training (Nettle et al, 2022). Similar webinars could be organised on national level, specifically in combination with the ClimateSmartExperiments project. Such e-extension activities are more successful when shorter and more frequent, and including some practical 'homework' (Nettle et al. 2022).
- Information provisioning through newsletters and the knowledge repository with testimonials, used cases, tools, videos. There is a big variety in the way information can be provided to farmers. For example, high quality best management practice guides are found to be useful for farmers, but are not effective for behaviour change on their own and require additional support and personalized advice (Nettle et al. 2022). The involvement of farmers and advisors and the inclusions of farmer data in the development of best management guidelines seems to be very important to guarantee their practical relevance (Nettle et al. 2022). This should be a guiding principle for the development of materials for the knowledge repository in Climate Farm Demo.

At the level of the PDF specifically, we envision two main relevant activities:

- The 1- on -1 interactions between the CFA and PDF. Including the monitoring of the farm based on audits and the development of the Adaptation and Mitigation Plans (AMP)
- The experiential learning process the farmer engages in when testing new practices and activities, based on the AMP.

4.3.1 1-on-1 interactions between PDF and CFA

One-on-one coaching and consulting is commonly recognised as effective for addressing individual challenges in implementing new practices, compared to small-group coaching (in hubs) which is recognized as providing an impetus for farmers to seek further individual support (Nettle et al., 2022).

For a CFA it is important to get to know the PDFs he/she is supporting. It is recommended to target messages carefully, since different farmers can respond very differently to interventions (Rose et al, 2018). Therefore CFA should identify well their audience, to understand their attitudes towards climate change, their values and their workflow. For example, in some areas advisors specifically choose not to mention climate change to avoid creating distrust among farmers (Wreford et al. 2017). Nettle et al. (2022) mention the success of coaching models as advisory service. This advisory model works "*with farmers' own knowledge and local context while supporting their autonomy, and coaches can operate as intermediaries between farmers and researchers (Cobon et al. 2021)" (Nettle et al. 2022, p. K).*

The audit that will be done in each PDF in the second year of the project, will be a great opportunity to get to know the PDFs. Because of the importance of knowing the farmers' attitude and location in the change process towards CSF, we believe this audit should not only focus on farm technical data, but also on behavioural aspects, to gain insights in the attitudes and barriers of PDFs towards CFA. This might require some soft skills from CFA to discuss this matter with farmers.

The audit will form the basis for the adaptation and mitigation plan (AMP) that will be built together with the PDF. The difficulty related to climate action, is that CFA has multiple dimensions to address and requires a holistic management approach. The AMP should take this into account. This might mean, for example, that a farmer is already quite progressed in his/her thinking and action on energy management, but is still sceptic about use of additives for reducing methane production. This means that the actions of farmers put forward in their next year's AMP can be related to the increase of skills on one topic to move into the "action/ability" stage of the change process, but for another topic their action is limited to further informing about the potential benefits of a specific CS practice to move into the desire/contemplation stage (cfr. Figure 5).

These AMP together with the audits, will form valuable input for discussion during demo events in the hubs (see next chapter).

Building a trust relationship between PDF and CFA is very important for a successful change process. Farmers tend to be quite critical to the person providing information. Nettle et al (2022) report that the effectiveness of one-to-one advice and thus the quality of knowledge exchange is dependent on the extent of trust, credibility and empathy between farmer and advisor. Sutherland et al (2013; in Nettle et al. 2022) found that the a long-term interaction between adviser and farmers is important in generating trust. Also Rose et al (2018) note that a long-term sustained engagement is needed to maintain change, because old behaviours are often returned to after interactions stop.

Wreford et al. (2017) stress the importance of the way in which information about climate change is provided. They mention increased success if information is targeted in a way that appeals to farmers' values, without beating other desirable behaviours. In general, people tend to respond better to messages that are put in a positive, gaining or empowering way compared to negatively framed messages stressing loss.

Another recommendation for changing behaviour given by Rose et al. (2018) is to prove to farmers the value and ease of adoption. Farmers should perceive that there is a value in adopting a new behaviour, otherwise they will not be inclined to change. We therefore suggest to focus first on the adaptation and mitigation measure that involve an improvement (or at least status quo) of the farm system (on economic and labour aspects).

4.3.2 Experiential learning process

For the project, peer-to-peer sharing of experiences amongst PDFs is key. The experiential learning theory (Kolb), which basically refers to learning by doing, nicely prescribes the 4 phases in this learning cycle:

1. Concrete experience, during which people have a personal experience that they could learn from
2. Reflective observation, during which people reflect on this experience to understand what actually happened and observe alternatives
3. Abstract conceptualisation, during which people decide upon what they will do differently next time

4. Active experimentation, during which people put into practice and test their previously generated ideas.

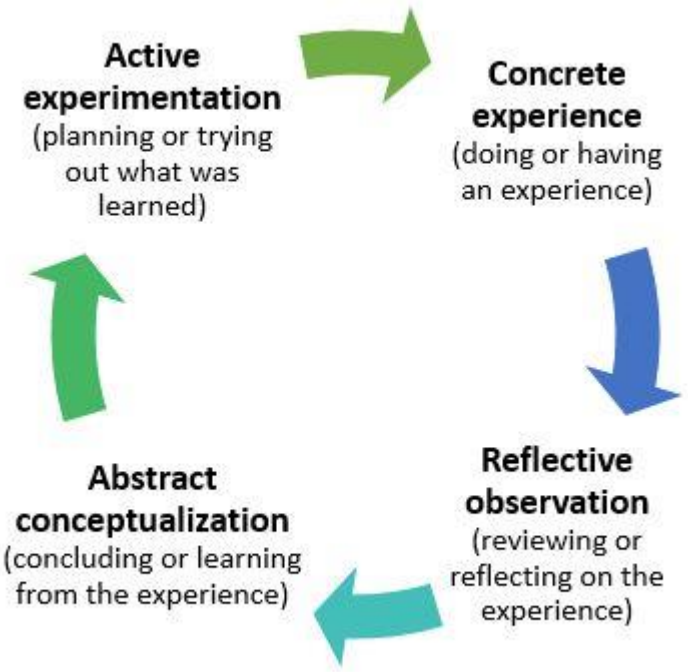

Figure 8. Kolb's Experiential learning cycle (https://educationaltechnology.net/kolbs-experiential-learning-theory-learning-styles/)

Referring back to Figure 5, this experiential learning cycle is mainly linked to the stage "ability/action" in the behaviour change process. These experiences are very important both for the own change process of the PDF, but also as input for the peer learning process in the hubs. To enhance the learning on implemented practices, a follow up throughout the season might be interesting, for example through documentation of the performance related to weather monitored by local schools (Tran et al. 2017). Discussing these monitoring results can be highly beneficial for discussion in groups of PDFs (see next chapter on the hubs).

4.4 Project activities at the level of the hub

Although not explicitly formulated in the Grant Agreement, we propose to define an additional level in the project referring to the group of PDFs supported by a CFA. Previous projects (NEFERTITI, IPMWORKS, …) and research have proven the benefits of such a small group of farmers around an advisor, with improved adoption, farm performance, profitability, and farmer empowerment as a result (Nettle et al. 2022). In their research, Nettle et al. (2022) conclude that facilitated small-group meetings are highly effective to support change, specifically when the changes are complex, uncertain and

involve long time frames, which is the case for CSF. Being connected to local farmer networks has the biggest impact on behaviour change regarding climate adaptation and mitigation (Wreford et al. (2017).

Peer-to-peer (or farmer-to-farmer) learning is a promising strategy for knowledge sharing and creation among farmers (Cooreman, 2020). Cooreman (2020) describes peer learning as "*people learning from and with each other on a scale anywhere between informal, spontaneous sharing and formal organised activities*". Peer-to-peer learning is characterized as more learner-centered, present-time focused, responsive to localized needs and less structured compared to formal educational settings (Taylor and Caldarelli, 2004) and better able to deal with the complexity of CSF. Farmer-to- farmer exchanges are highlighted as an effective mechanisms to scale out both adaptation and mitigation measures (Martinez-Baron et al. 2018).

4.5 Demonstration events: boundary activity linking PDF level with the hub level and national level

In the Climate Farm Demo, the demonstration events organised at the PDF will be the main activity taking place on this hub level to support peer-to-peer exchanges. One of farmers' most cited sources of information are other farmers (Oreszczyn et al. 2010) and other farmers explaining proven successful farming practices tend to influence farmers the most (Hamunen et al., 2015; Kilpatrick and Johns, 2003; Schneider, Ledermann, Rist, and Fry, 2009; Warner, 2007; in Cooreman, 2021). Cooreman (2021) in her PhD on on-farm demonstrations, came up with a new definition for embedded on-farm demonstrations as "*authentic learning space[s] where farmers and other stakeholders can explore and discuss agricultural practices together in a socially and physically embedded manner. "* For more information on how the farm demonstrations are defined within Climate Farm Demo, we refer to the guidelines for farm demonstrations developed by WP3.

Since the grant agreement refers to demonstration events as the main encounter for peer-to-peer exchanges, we suggest to include differentiation in terms of size and target audience, by distinguishing between "closed" and "open" demonstration events (referring to the distinction between farmers' closed and open networks by Cofré- Bravo et al, 2019). Literature has proven the importance of trust and building social capital within a group for effective peer-to-peer exchanges and increased adoption (Nettle et al. 2022). Closed demonstrations allow for this creation of trust and group building, by limiting the participants in the demo event to the other peer PDFs supported by a CFA. Preferably these groups are not too big (10-15 participants), so people are able to get to know each other. Such closed demonstration events would link to the concept of Communities of Practice (CoPs) defined by Wenger. CoPs are defined as informal learning communities characterized by a shared practice of its members, their engagement and a shared repertoire of communal resources (routines, norms, knowledge, vocabulary, styles, etc.) that members develop over time (Wenger, 1998, in Dolinska and D'Aquino, 2016, p. 123). Participation in such CoPs enable farmers to change their attitude, understanding and knowledge about (specific) CFA practices. Nettle et al (2022) refer to such smaller groups as being more conducive to learning and that regular coaching with a hands-on approach support farmers to gradually gain the knowledge and skills needed to implement practices. The combination of such group coaching and individual advice have been reported as highly valued by farmers (Triste et al. 2018; Rose et al. 2018), and have been found to influence farmers' attitudes, knowledge and practices (Nettle et al.

2022). It might be beneficial to focus on these closed demo events in the first years of the project, to build PDF's confidence and trust. Such group building can be beneficial for the CFA too, who can than involve in group coaching of the PDFs instead of being involved in more intensive one-on-one advice. In Figure 3, these closed demonstrations are situated in the boundary space between PDF and Hub level.

Open demonstration events target wider audiences, referring to stakeholders who are not participating in the project, including other farmers, advisors, agri-business enterprises, consumers, policy makers, researchers. They are of major value to increase the impact of the project and stimulate other farmers and stakeholders to engage in climate action, based on experiences and success stories within the project. This is supported by the concept of agricultural innovation systems, that stresses the role of multiple actors in the system have an influence on innovation and adoption. The non-adoption is not only to be sought to be a problem on farmers' side, but involves the learning of all actors in this agricultural innovation system (Rose et al. 2018). Once farmers understand how practices can increase resilience, they will more easily be able to incentivize their peers, communities and local institutions (Martinez-Baron et al. 2018). Showcasing the PDFs as role models towards a wider farming community, letting them explain the change process they went through, including the costs it involved and the results they achieved are successful ways to stimulate climate action (Wreford et al. 2017). Demonstrations can be a good way to underpin other forms of climate change interventions(e.g., financial incentives). If they are delivered face-to-face, in a sustained way (not one-off events), including facilitated dialogue amongst participants they are more successful than just providing information through leaflets (Rose et al. 2018; Cooreman et al. 2021). The demonstrations organised in the CFD can thus be an interesting way to highlight and support other climate change interventions set up in a region. In Figure 3, these open demonstrations are situated in the boundary space between PDF and national level, as they include other actors in the AKIS, such as other farmers, advisors, researchers, policy makers, industry, etc.

Martinez-Baron et al. (2018) highlights the lack of understanding of how co-benefits of adaptation and mitigation measures can be stimulated through social networks. This requires a deeper understanding of the dynamics of social networks and the interface between individuals and institutions involved in enabling a more rapid uptake of CSF. In addition, Nettle et al. 2022 mention that the results of group processes are difficult to measure, and they seem to be highly dependent on the quality of facilitation and the reflection stage during the learning process. These might be topics of interest to further study within the CFD project. Rose et al (2018) summarized that more research is needed into the role of social referents and other information sources on farmer behaviour and on the impact of working with farmers who know each other as they are likely to have an increased behavioural influence.

Chapter 5

Improving the enabling environment for climate smart farming

5 Improving the enabling environment for climate smart farming

5.1 Generating an enabling environment for scaling CSF

The adoption of CSF practices is not a binary decision that takes place on a given point in time. It rather involves a process of learning and uneven change, in which farmers can follow "*different adoption pathways that involve a diversity of social and behavioural changes"* (Nettle et al. 2022, p. A)". It requires the development of strategies to stimulate adoption by potential users through the building of partnerships, engagement, capacity development and learning to apply the research results in an enabling environment (Vermeulen and Campbell (2015), in Westermann et al. (2018)). To understand the variability in learning processes associated with adoption, we also need to take into account the diversity in individual and collective groups of people, farming systems and technologies, and this contextual factors earlier referred to (Nettle et al. 2022, p. A).

The work done and insights created at PDF and hub level should be scaled to the wider farmer community and AKIS. Evidence of learning by farmers does not necessarily result in changes in the field. Besides farmer characteristics, they can be related to the adaptation and mitigation measures or technologies themselves or to the lacking support from powerful institutions and governance contexts to change behaviour (the enabling environment). Climate Farm Demo will address both aspects through the creation of Living labs, through liaising with AKIS actors and through the research on rewarding systems.

Rose et al (2018) stress the importance to look further than the individual, and also influence the closer (friends, families, advisors, land owners) and wider (AKIS) network around farmers. Climate change adaptation is often related to promoting technologies and practices at farm level and is less likely to be associated with changing institutions and policies that govern agricultural production *(Leeuwis and Hall,*

2013; in FAO[5]*)*. To effectively promote CSF and generate a conducive enabling environment, new capacities have to be build amongst advisors and other stakeholders in the AKIS. According to Rose et al. (2018), such a social change approach requires the development of participatory approaches across networks that recognize that social change involves a social process. According to previous research, face-to-face meetings bringing together practitioner communities tended to be the most effective to for creating engagement, as it contributed to the creation of trust between practitioners and other actors (e.g., researchers, policy makers), social norms, peer support, and the feeling of being heard (Rose et al., 2018). Including farmers, Rose et al. (2018) argue, makes them feel more in control of decision-making and hence it is more likely that they adopt a particular behaviour. Influencing behaviours of farmers involves more than a one-off consultation of farmers in the process, and farmers should be engaged in an inclusive and iterative way with a trusted facilitator (Reed et al. 2017 in Rose et al. 2018). Advisory services should combine the testing, refinement and promotion of context-specific adaptation and mitigation measures with institutional innovations, such as the development of farmer organisations, new business models and pro-active policy engagement (FAO[6])

Scholz and Methner (2019) stress the need for large-scale transformations in the field of climate change adaptation, and advocate for "*linking top-down and bottom-up processes trough iterative learning processes"* to "*create opportunities for the upscaling of innovative and more sustainable alternative practices and processes"*. They argue that such interventions can change institutional structures, decision making processes and practices. Findings in adaptation literature stress the importance of "*building on local institutions to ensure adaptation and to enhance the capacity of local actors to adapt"* (Ensor and Harvey, 2015).

Linking of top-down and bottom-up processes, can be done at national meetings organized within the project during which other stakeholders are invited to hear about and experience the barriers and outcomes of the Pilot Demo Farmers in the project. Such encounters between practitioners and other AKIS actors, can contribute to the shared meaning making and understanding of what Climate Smart Farming means in a given (national) context and can contribute to creation of a more supportive enabling environment.

Ensor and Harvey (2015) reviewed research on social learning interventions for climate adaptation. They summarize some lessons and principles from social learning practice as prerequisites for successful engagement:

- Account for multiple worldviews and knowledge sources. This requires central attention to developing 'shared ways of knowing' between different actors in social learning processes.
- Establish processes for addressing differences (in power, aims, perspectives, knowledge systems, etc.)

[5] https://www.fao.org/climate-smart-agriculture-sourcebook/enabling-frameworks/module-c2-supporting-rural-producers/chapter-c2-2/en/ (22/03/2023)
[6] https://www.fao.org/climate-smart-agriculture-sourcebook/enabling-frameworks/module-c2-supporting-rural-producers/chapter-c2-2/en/ (22/03/2023)

- Pay attention to capacity and trust-building processes, through facilitation approaches addressing power imbalances and bridge diverging aims and interests.
- Ensure a scope for changes to follow from learning processes (e.g. through funding opportunities and opportunities for structural change) to make sure learning benefits are realized rather than frustrated.
- The use of experimentation to generate learning is common to both network- and system-wide learning, but less to individual-orientated approaches.
- The importance of generating clear vision of change for the design of the social learning approach. This includes the identification of the level at which social learning should take place (individual, network, system) and the expected pathway (and associated mechanisms) for promoting that change. Ensor and Harvey (2015) state that "*the desired learning must be situated within a broader set of assumptions about how change is expected to unfold".* This vision of change should frame the social learning approach, the tools used, evaluation approaches and the expected outcomes.

Scaling climate smart farming practices requires the development of explicit strategies that enable future users to apply innovations and understand what makes an enabling environment, through partnerships, engagement, capacity development and learning (Westermann et al. 2018). One -size-fits- all approaches hardly ever seem to work across different groups of farmers. This shows the importance of shaping policies, messages and approaches to different groups (Rose et al. 2018). There are multiple interventions possible to support the transition towards climate smart farming, ranging from *the development of technologies and practices to processes that can strengthen the institutional and political enabling environment (FAO, 2013; in Westermann et al. 2018, p.285).*

Westermann et al (2018) report on three scaling strategies that could meet this objective:

- *Scaling strategies based on value chains and the private sector*. Value chains are suitable for reaching a larger group of farmers because they (i) *"provide a mechanism for linking multiple actors around a common objective by creating space for dialogue, knowledge exchange and capacity building, and strengthening negotiation capacities",* and *(ii) "they provide market-driven demand (currently, often towards green and more organic products) that may provide a demand-led strategy for adoption of technologies and practices" (Westermann et al 2018, p284).* These strategies might however be less suited for addressing learning and equity concerns.
- *Scaling strategies utilising ICTs and agro-advisory services.* To avoid high transaction costs related to face-to-face interactions, information and communication technologies (ICTs) can be an interesting strategy. They are recognized as part of strategies to adapt to, mitigate and monitor climate change within agricultural innovation systems. It can also be an effective way to improve access to different types of information (e.g., market prices, weather information, advisory services and early warning information) and to increase the awareness of climate change and climate smart practices and technologies. Although ICT-based strategies can be well suited to reach large numbers of farmers, there might be trade-offs in effectiveness due the lack of adaptation to local contexts. WP5 in the Climate Farm Demo project is dedicated to the development of a knowledge repository providing access to relevant monitoring tools, climate smart practices and technologies.
- *Scaling strategies revolving around policy engagement*. Developing an enabling environment for scaling climate smart farming will require broad participation and harmonization of policies. This also involves overcoming existing barriers before designing new policy measures. Since meeting all objectives at once will probably not be possible, priorities will need to be set by weighing benefits and trade-offs depending on the regional context. Researchers from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and

the International Center for Tropical Agriculture (CIAT) have developed a Climate Smart Agricultural Prioritization Framework, which aims to provide decision-makers at multiple levels with a variety of tools to assist in planning processes and making informed decisions and which results in priority CSF actions at different operational levels. Pilots showed that the uptake of practices promoted as national CSF priorities occurs, but not always with high adoption rates mainly due to financial and technical barriers. This stresses the importance of including local actors' and farmers' priorities early on in the decision making process (Sala et al. 2016**)**. Policy engagement can be effective in overcoming barriers and address equity concerns, but are less suited to address farmers' challenges related to the policy goals.

Creating an enabling environment also involves the (behaviour) change at the level of other actors and institutions. For example, advisors might need increased capacities towards system thinking and develop their coaching skills, for supporting farmers in CSF management. This requires adaptations in the curricula educating these advisors. The privatisation of the advisory market in some countries, increase the reliance of farmers on the apparent free advice of advisors linked to commercial actors. Policy can have a big impact on this. Further, other actors in the value chain, like processors and buyers, can change their standards towards products and reward climate smart farming practices.

The table below gives an overview of elements of success for scaling climate smart farming interventions as described by Westermann et al. (2018), based on the work of Gillespie et al. 2015).

Table 2. Elements of success for scaling Climate smart farming interventions (based on Westermann et al. 2018 and Gillespie et al. 2015)

Elements of success for scaling CSA interventions	Description
Vision/goal	It is very important to have a clear vision and goal for the uptake of CSF with matching timescales of needs and outcomes. Be aware that there might be a misfit between relatively long periods of time needed for some CSF practices such as agroforesty and improving soil capacity and the shorter-term objectives farmers often have when designing interventions. Further, some CSF practices can be seen as conflicting with existing habits in farm management and livelihood systems.
What is being scaled	Climate smart farming is more than the implementation of a set of practices, but requires the integration of multiple interventions across a range of food systems, landscapes, value chains and government regulation or policy (Lipper et al., 2014). Moreover, scaling interventions should be aligned with farmers' needs or do not take into account existing power dynamics (Lundy, 2016).
Context	Adapting CSF technologies and practices to the local context is key for their adoption but can involve considerable transaction costs. This context specificity thus be a barrier to the wider uptake of CSF practices. Farmer groups and demonstration farmers collaborating with researchers and experimenting with new practices, such as the Pilot Demo Farmers and the Lighthouse farmers in the project can lower this barrier for other farmers.
Drivers and barriers	There is plenty of proof that a strong government support is crucial for successful interventions. The policy and regulatory framework, providing the rules, incentives and disincentives for adoption are critical in this. This may be related to land ownership, extension services, taxes or subsidies on agricultural inputs, credit and insurance schemes. Literature advocates for the direct engagement between researchers and decision makers to created such enabling environments. Interventions should pay attention and try to mitigate environmental and socioeconomic risks related to the adoption of climate smart farming, for example, by providing insurance schemes for novel practices that were previously not adopted because too risky (Franzel et al., 2001; Greatrex et al., 2014).
Scaling up processes, pathways	The complexity related to climate change requires action on and interaction between multiple levels (vertically) and between different sectors (horizontally). Thus a multi-dimensional and multi-actor approach is needed (Sayer and Campbell, 2004). Many different institutions on different levels (from local to national) might need to be involved

	and coordination might be needed to frame discourses in which decision making takes place (Linn, 2012; Franzel et al., 2001). It might be wise to team up with (powerful) actors who already have achieved scale, such as commercial parties, input suppliers, government programs, and add value to what is already there.
Financing	Effective scaling strategies targeted to farmers' needs and contexts are often related with high transaction cost. Specifically, participatory extension methods, that are highly adapted to local contexts, have high transaction costs and often don't work over larger areas beyond the pilot groups (Braun and Hocde, 2000). On the contrary, other agricultural extension providing generally formulated recommendations, have low transaction costs but do not address different farmers' objectives or contexts and thus do not achieve the expect results.
Monitoring and evaluation, learning, accountability	The complexity related to the transition towards CSF, requires a social learning process in which people with different perspectives and knowledges, use their collective wisdom, test new practices, evaluate and reflect on them and learn from these cycles of testing and reflecting together (Harvey et al. 2013). A context that allows this testing and reflecting is beneficial for this social learning process and for keeping everybody engaged in the process.
Addressing equity concerns	Scaling interventions should try to monitor and anticipate on potential winners and losers because of the scaling interventions. This is also related to the assets a farmer household has to make changes.

5.2 Project activities at national level

5.2.1 Co-innovation

Multiple researchers advocate for a bigger interaction between scientists, technology developers, farm advisors, and farmers for the (co) - development of innovations and support tools (Nettle et al. 2022). Such a close collaboration between developers and practitioners/end users has been found crucial to ensure that the developments meet farmers' needs, values and experiences (Kenny and Regan 2021; in Nettle et al. 2022).

Co-innovation processes can result in new business models or value chains, new products and services or changes in practices. They can involve multiple actors types, such as farmers, commercial parties, government, advisors, researchers, and consumers or other stakeholders (Fielke et al. 2018, in Nettle et al. 2022). Co-innovation processes are often directed to early stages in the innovation process, in which the problem and pathways for solving the problem is not yet clearly defined yet (Nettle et al. 2022).

In Climate Farm Demo 10 Living Labs will be set up, following such a co-innovation approach. The goal of the living labs is to promote the co-creation of climate-smart solutions, as well as to analyse the enabling environment around the LLs. The insights coming from these living labs will be very informative to better understand the needs for the transition towards a climate smart agriculture in a region or country. Five steps will be followed for setting up the Living Labs as shown in the picture below. A Community of Practitioners will be set up with the Living Lab facilitators to enable the exchange of experiences and build their competencies on facilitating living labs.

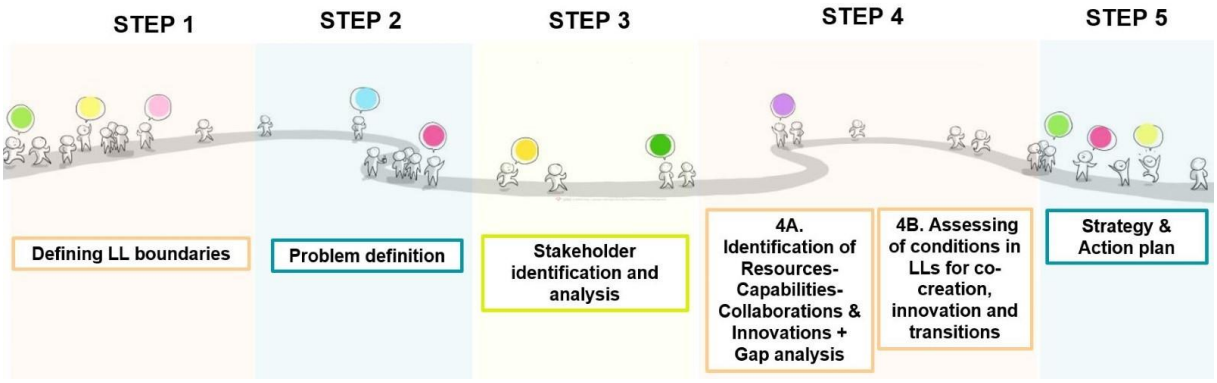

Figure 9. Summary of the 5 steps for setting up a Living Lab (source: Guidelines for setting up a Living Lab -T4.2)

It might be difficult to find farmers willing to be engaged in such a development process, but if combined with training, it improves the farmers' ability to access and use specific tools or practices (Nettle et al. 2022). In addition, farmers reported on the added value of being in direct contact with researchers (Nettle et al. 2022). In a climate learning network involving farmers, Nettle et al. (2022) describe that the dialogue between researchers and practitioners enhanced agricultural adaptation to climate change and higher adoption of climate-change mitigation practices. These findings are very interesting for the facilitators of the living labs in Climate Farm Demo. If they are able to link the participation of farmers to clear learning opportunities, they might be better able to hook the farmers to the co-innovation process.

5.2.2 Capacity building of advisors

Within Climate Farm Demo, the CFA will be trained on how to best support farmers towards climate action. The expertise developed in course of the project will be very interesting for other advisors. The collaboration with ClimateSmartAdvisors, a sister project of Climate Farm Demo specifically aiming at the improvement of advisors' capacity to support farmers towards climate action will be a great asset to increase the impact at national level. In ClimateSmartAdvisors, CoPs of advisors will be set up and trainings will be organised for the advisors involved in the project. In addition, these advisors will have to organise training to their peers not involved in the project to boost impact of the project. Exchange of findings and insights on the climate smart advisory between both projects is highly stimulated both at national and EU level.

5.2.3 Collaboration with other projects, initiatives and policy makers

To increase the impact of the project, collaboration with other projects and initiatives at national level could be very beneficial. In a lot of countries, a lot of initiatives are already related to the objective of increased climate action. These initiatives can be more research oriented or involve sector level initiatives. With the support of WP7 in Climate Farm Demo, an inventory of potentially interesting projects, flagship initiatives and policy makers (PIPs) will be made for each country. A flagship initiative is defined as having a specific aim or target group and be more substantial than a project.

5.2.4 Developing rewarding mechanisms for farmers

There are different ways in which institutions can stimulate behaviour change, so called "sticks" and "carrots". Sticks are linked to penalizing unwanted behaviour for example by setting quota's, quantitative limits, taxes, regulatory requirements and bans (Scheid et al. 2023, MS48). "Carrots" on the contrary

are characterized by rewarding farmers for implementing favourable behaviour and incentivize positive change (Scheid et al. 2023, MS48). Rose et al. (2018) also recommend to incentivize behaviour change by farmers. They found that incentivization of behaviour change, for example, by rewarding good behaviour in a long-term sustained way, was linked to positive change.

Within the Climate Farm Demo, WP6 is dedicated to research on rewarding mechanisms for on-farm emissions reductions and avoidance, carbon removals and climate adaptation. Rewarding mechanisms in this project "*are defined as mechanisms that reward farmers in return for implementing a desired action or delivering a desired outcome and can be sourced from public or private entities or a mix of both. Rewarding mechanisms are typified by aiming to induce a behaviour change, the use of positive incentives, and their voluntary nature. These rewarding mechanisms can take diverse forms, including regulatory obligations (that are rewarded), voluntary public funds, R&D, voluntary carbon markets and price premiums/labelling, among others (*Scheid et al. 2023, MS48, p. 5).

Motivation theory (self-determination theory) reports that behaviour change that is merely induced by the fear of punishment or the sake of getting a reward, is often less sustainable than behaviour that is supported by internalized motivation, such as changing behaviour because it underpins one's values (Ryan and Deci, 2000). For example, this means that when financial incentives are stopped the behavioural change also stops (Rose et al. 2018). Changing the motivation towards such a more sustainable behaviour, can be done by meeting their needs of autonomy (feeling in control of the own decisions), relatedness (feeling respected and understood by others) and competence (feeling competent to engage in a behaviour). This means that a mere focus on financial rewards should be combined with other forms of interventions, such as participatory processes, education and competency building, to achieve more sustainable behaviour changes towards climate smart farming. This principle is demonstrated in a study on increasing the adoption of small scale beekeeping in Vietnam. It showed that it is key to stimulate initial adoption (e.g. by providing beehives for free), but it has to be combined with education and competency building (e.g. through the formation of beekeeping clubs, training DVDs and workshops on beekeeping practices) (Rose et al. 2018).

Rewarding systems can thus be important to induce behaviour change. But for a more sustainable behaviour change, such rewarding mechanisms will have to be supported by other interventions, related to competency building of farmers.

5.3 Annual national meetings: boundary activity linking the hub level to the national level

The objectives of the annual national meeting will function as a platform to bring together experiences from PDFs, CFAs, EFs, LFs providing them with an opportunity to exchange ideas, experiences, and knowledge and discuss plans for future activities. Additionally, the meeting aims to enhance the skills and expertise of CFAs by providing them with training, enabling them to better assist and support the PDFs. The meeting can also be used as a platform to exchange with other stakeholders in the national CS-AKIS on the outcomes of the PDF activities. Specifically for the national level meetings, we propose strong collaboration with ClimateSmartAdvisors. Also for this project annual meetings will be organised, and in addition, national AKIS workshops will be set up, which will form an interesting

platform to discuss the project results of both projects with the CS-AKIS and try to create momentum for collective action to improve the enabling environment for farmers.
Similar to the hubs, we propose to limit the annual meetings in the first years to the project partners, so people can get to know each other. Later on, when project results are becoming more clear, other AKIS actors can be involved in the meetings.

5.4 Project activities at EU level

5.4.1 EU exchange wihtin the project

The EU level in the project is represented by the partners in 27 EU countries covering all EU pedoclimatic areas and agricultural sectors. The multiple actor types involved in the project (advisory organisations, farmer organisations, cooperatives, applied research, universities and research institutes, NGOs, enterprises, farmers journals, etc.) form a fruitful basis for cross-fertilisation and co-innovation across the network.

The EU exchange network will be organised according to 3 different dimensions:

- 12 adaptation and mitigation thematic areas, representing the main farm management measures that allow to address climate changes (**Erreur ! Source du renvoi introuvable.**).
- 4 pedoclimatic areas: Nordic, Atlantic, Continental, Mediterranean
- 3 main agricultural sectors: animal husbandry and mixed farming systems, specialised arable crops and horticulture crops, including organic farming) allowing to exchange on similar animal species or crop challenges

Besides and linked to the thematic networks, also a network of Climate Smart Lighthouse Farms will be developed in Climate Farm Demo, with at the end of the project at least one Climate Smart Lighthouse farm per country. Lighthouse farmers are farmers who inspire local farmers by showing that the impossible is possible, and inspire policy makers, agri-business industry leaders, and other actors in the food system to think differently about how we envisage future farming systems. During the course of the project candidate lighthouse farms will be selected and trained to become a CS lighthouse farm and be part of a European Lighthouse farm network.

5.4.2 Exchange with the EU CS-AKIS

Although the thematic networks can be interesting structures to actively bring together other actors of the CS AKIS (active outside the project), it will not be their main focus to actively facilitate collaboration between them. They can invite other projects, researchers, policy makers, etc. to testimony and give presentations in the exchanges within the thematic networks. But the actual search for collaboration and synergies will be actively done in Work Package 7 “Linking and coordinating with other projects, initiatives, and policy makers (PIPs)”. The objectives of this WP are formulated as follows (Source: Mira da Silva et al., 2023, Strategic Plan For Work Package 7):

- Give visibility to the project
- Create cooperation

- Integrate research and knowledge from other projects
- Produce common policy and operational recommendations
- Prepare a sustainability strategy for the whole Climate Farm Demo network.

Collaboration will be done in different types of activities: online meetings and workshops, participation on events of other PIPs, invite PIPs to CFD events, EU level workshops. Thematics for exchange will be technical knowledge (related to the thematic areas), policy needs within the EU community, collaboration formats (networking, living labs, cooperation) and project outputs and findings based on the PDF data.

A main outcome of these exchanges will be the development of policy briefs. These will be focussed on networking, demos, living labs, rewarding mechanisms and cooperation.

The communication and dissemination towards these CS AKIS actors will be done in WP8 “Dissemination, Exploitation and Communication”.

5.5 Thematic networks and lighthouse network meetings: boundary activity between hub level and EU level

In the first year, the 12 thematic areas will function as the main unit of exchange between countries, by connecting actors from different countries around common topics. These thematic networks are also interesting constructions to liaise with other projects working on this topic. The thematic leaders will be the facilitators for knowledge exchange on thematic level. The exchanges and outputs of the exchanges can take multiple forms, such as face-to-face exchanges (e.g., cross visits and GA meetings), webinars, videos, making use of fora/social media groups, email exchanges, posts on the knowledge repository, practice abstracts, etc. Interesting inputs for the exchanges can be farmer or advisor testimonies from different countries, testimonies of the 10 living labs in the project (if related to thematic area at stake), testimonies from the lighthouse farms, presentation of new scientific research, presentation of related projects, materials developed in other WPs, … . The pedoclimatic areas can be added as a structuring component to the exchanges on thematic level. The climate challenges can be very different across pedoclimatic areas, for example, water management will be very different in the Mediterranean area compared to Nordic areas.

Later in the project, exchanges can be organised on a more integrative level (pedoclimatic areas and agricultural sectors). The focus on exchanges on agricultural sectors will be important for incorporating the integrative/systemic aspect of climate smart farm management and to avoid the risk of narrowing the climate smart farming too much to the implementation of a single practice. Demo visits linked to the GA meetings, could be interesting formats to exchange across thematic areas and discuss the interlinkages, synergies and trade-offs between multiple thematic areas of adaptation and mitigation measures.

The Lighthouse farms can be actively integrated in meetings of the thematic areas, and can be visited during GA meetings. They will also form a separate network and exchange that can exchange both on technical aspects as well as about what it involves being a lighthouse farm to learn from their peers.

A challenge within the thematic areas will be to capture practices within the national PDF networks and make them shareable on EU level. The FAO Compendium on Climate Smart Agriculture extension reported on an interesting participatory video approach as a promising tool for sharing experiences on CSF. They use short videos, produced by advisors and farmers, featuring farmers demonstrating and testimony about their improved CFA practices. These videos are shown in advisor-led farmer groups (but can equally be shared within a group of advisors), followed by a facilitated discussion, during which the advisor records the farmer feedback, their questions and the practices they adopt. This recorded feedback then informs the production of new videos progressively addressing the needs and interests of a community. These videos supports the promotion of CFA, as they feature local individuals showing how they adapt practices to their own context, which is critical in climate action. The videos also allow to show different farmers in different conditions. This could be an interesting approach to adopt in the CFA project to share experiences between different farmer groups across Europe.

5.6 Synergies with other projects Boundary activity between EU and national level:

At the EU level, stimulated by EU policy directives and regulations, multiple activities, projects and initiatives related to climate change adaptation and mitigation are undertaken across Europe. This means that the Climate Farm Demo project is not working in a vacuum, and thus it is interesting to search for synergies between these activities and initiatives for achieving the objectives towards more Climate Smart Farming in Europe and increasing their impact. A first step is to inventory other related and potentially interesting projects, initiatives and policies, that can feed the network and in a broader sense to get a view on the Climate Smart AKIS (CS-AKIS) at EU level. The network set up in Climate Farm Demo can support the dissemination of the results of both our own project as well as interesting outcomes of other projects. In addition, the impact can be increased by actively liaising with other actors in the EU CS-AKIS. It is known that social networks allow for facilitating strategic interchanges of knowledge and expertise amongst different actors at local, national, but also international level to promote scaling processes (Martinez-Baron et al. 2018). It will be important to invite and involve national coordinators and CFA in activities at this level, to make sure the information of other projects can also reach the national level.

Chapter 6

Implications for the project

6 Implications for the project

6.1 Learning from previous project experiences

A very similar set up as Climate Farm Demo was developed in the finished H2020 project NEFERTITI-Networking European Farms to Enhance Cross Fertilisation and Innovation Uptake Through demonstration (2018-2022). NEFERTITI comprised 32 partners that established 10 interactive thematic networks, bringing together 45 regional clusters of demonstration farmers (hubs) across 17 countries. At the end of the project an evaluation and reflection on the tools, processes and discourses provided by the executive committee of the project was performed which resulted in some interesting insights for Climate Farm Demo.

Networks in EU projects are different from other networks in the way that they can benefit from additional support from the project to stimulate social learning but that it also adds an additional layer of management and complexity to fit within the project logic (including uniform reporting requirements etc.). This means that there might be some tensions between the 'top down' approach to facilitate collaboration between different networks and diverse partners in a project, and the need for organic, bottom-up network creation, that embeds network ownership with the participants from the outset. One of the key messages from this analysis performed on the NEFERTITI project was to safeguard the important balance between being prescriptive and stimulating creativity, initiative and ownership within the networks.

Network needs change in course of the project, and this requires the development of different types of boundary objects related to the phase there in. At the outset of NEFERTITI (i.e. during Year one), there was a need for clarity on expectations from the project, a the need for ownership building, team building and trust building; and a need to build network relationships. During this phase it appeared that all project participants were searching for clarity on the project direction, to find their place within the project and their network, and to try to establish the expectations of the project. Boundary objects provided by the project were guidelines on how to set up a network within the boundaries of the project, creation on shared languages for example on what a demonstration event was in the context of NEFERTITI and guidelines on how to develop the main purpose of their network and give direction to there activities. After the first year when expectations, network structures and processes were clarified, the identified needs shifted towards the need for knowledge exchange activities and methods to capture the knowledge exchanged, the need for capacity building on network facilitation and knowledge exchange methodologies, and a need for network management tools. Examples of boundary objects created were guidelines for knowledge exchange procedures (e.g. cross visits, virtual demonstrations, etc.) Only in the final years of the project, the networks expressed a need for a network sustainability approach, which resulted in the development of a process to think about network sustainability.

However, this process of developing boundary objects was highly defined by the way NEFERTITI was set up, namely with an ExCom responsible for developing project procedures, and practitioner partners applying the procedures in the field. Because the project had to report about 10 networks in a coherent way, top-down procedures were imposed on the networks. Such an approach involves a risk of over-structuring the networks, thus limiting the creation of ownership within the networks. This was also seen in course of NEFERTITI, evidenced by the limited initiative within the networks to deal with some of the needs they detected, such as the need for ways to capture the knowledge exchanged and learning within the networks. They often expected that the ExCom took the initiative in responding to this need. This could be related to the networks becoming reliant on the ExCom to deliver such boundary objects, and to the networks' budget.

However, in times of crisis (cfr. The COVID crisis), top-down governance was highly appreciated. It started with the development of quite prescriptive guidelines on what was and what was not counted as a virtual demonstration. Training sessions were organised for all hub coaches, and once they got more experienced themselves, the hub coach experiences were compiled in new guidelines for on-farm demonstrations.

In the case of Climate Farm Demo, networks will be built in very different contexts. Based on the lessons learned from NEFERTITI, the ExCom will have to find a balance between providing boundary objects that supports networks in all these different contexts, while not ending up being hollow documents that are so general that they do not support the local actors at all. The boundary objects developed will also have to include tools that support processes for networks to find their own reality and help them to understand how they can use the project activities to have an impact in their own local contexts.

6.2 Knowledge exchange logic: linking the different levels

The table below gives an overview of the different levels in the project and how knowledge between this levels will be produced and exchanged through so-called boundary activities. The challenge will be to make the tacit knowledge and local experiences of PDFs and CFA explicit and relevant to other actors in the network. Sufficient attention should be given to making reflection and reporting conclusions and insights part of the boundary activities.

Table 3. Overview of the boundary spaces created in the project for exchange between different levels in the project

Boundary space	Boundary activities	Inputs	Boundary worker	Boundary objects
Demo events	Farmer-to -farmer exchanges of experiences.	Audit Adaptation and mitigation plans Experiences from farmers Expertise of advisors Guidelines for demo events on CSF	CFA	Learning and conclusions, shared understanding of problems, solutions, … Conclusions captured in practice abstracts, videos, … fit for uptake in the knowledge repository of further dissemination through national and thematic networks
National (annual) meetings	Farmer hubs (and living lab if relevant) meet and exchange experiences, define priorities and set an exchange program. Learnings are shared with other AKIS actors. Trainings are organized on learnings from the project.	Guidelines for annual meeting Experiences and learnings from farmer hubs and living labs. Training modules and learnings from the ExCom	National coordinator	Shared understanding of CSF in the national context. Learnings and conclusions from exchanges between different actor types and hubs. Improved understanding of CSF and improved skills for scaling CSF. National knowledge exchange plan.
Thematic network meetings	Exchanging experiences on a specific thematic area between advisors and lighthouse farmers (and other interested PDF) Updating on novel research or work done in related projects	Guidelines for knowledge exchange on EU level. Learnings from hub meetings (captured in videos, practice abstracts, etc.) Connections with existing projects and research.	Thematic leader	Shared understanding of the benefits and challenges related to the thematic area Inspiration from other countries in the form of testimonies, videos, practice abstracts,

Boundary space	Boundary activities	Inputs	Boundary worker	Boundary objects
PIP interactions	Encounters (meetings, joint workshops, joint webinars, etc.) with other projects, initiatives and policy makers	DAP for PIP interactions Learnings and insights from our project (from ExCom). Practice abstracts, videos and testimonials of PDFs and CFA. Connections with other PIPs.	WP7 contributors	Meetings, joint workshops, joint webinars Policy recommendations and advice

6.3 Creating impact through knowledge exchange activities

All activities set up in the project serve the purpose of strenghtening the farmers' capacities to implement, demonstrate and uptake CSF practices. The project aims to achieve this impact on EU's farmer community through different pathways:

1. By directly supporting PDFs through the assistance of the climate farm advisor, testing and implementation of CSF practices is stimulated. Through demonstration activities and peer-to-peer exchange they will both increase there own capacity on the CSF practices, as well as inspire the wider farming community to engage with CSF practices. To reach this wider farming community, thus involves that the project before all takes care of the support of PDFs as they will become the face of CSF action in their region. The impact of the project activities on PDFs will be measured along the project with both quantitative indicators, such as the farm (carbon) audits, and qualitative indicators, capturing the impact of project and advisory activities on the development process of farmers.

2. Through the organisation of capacity building activities for the CFA, supported by the participation in thematic networks, training, and the development of a knowledge repository, and the collaboration with Climate Smart Advisors, CFA will be stimulated to reflect and learn on how to advise on CSF. Through their involvement in activities on national level, their anchoring in the region, and the organisation of dissemination activities, they will reach and inspire other advisors not directly involved in the project. The capacity development of the CFA will monitored through the evaluation of activities.
3. Through the organisation of activities on national level, by collating the experiences of PDFs and CFAs, reflecting on the barriers and stimuli for advancing potentially impactful CSF practices and bringing these insights to other CS-AKIS actors, National Coordinators (NCs) can play an important role in the creation of an enabling environment at regional and national scale.
4. Through the organisation of joint activities and collaborations with other projects, initiatives and policy makers, the ExCom of the project can play an important role in creating an EU enabling environment that is more supportive for CSF. These activities will be monitored and evaluated along the project lifetime.

6.4 To remember from this document

6.4.1 To remember for WP1

- It is important to adapt AMM to the local contexts. When presenting AMM during international and national exchange moments, sufficient reflection and discussion should be related to the required adaptations for other contexts.

- Evaluation of the knowledge exchange and network activities could involve how social networks can stimulate co-benefits of adaptation and mitigation measures.
- NCs should liaise with ClimateSmartAdvisors for setting up their national meetings and interactions with the AKIS.
- (in collaboration with WP1-3-5-8) Set up a mechanism that allows to make explicit the knowledge shared during the demos and national meetings, so they can be easily shared and discussed across the network. For example, by making videos, information sheets, …. These will also form useful input for the knowledge reservoir.

6.4.2 To remember for WP2

- Adaptation measures are often more easily adopted by farmers compared to mitigation measures, because they more often result in quick wins and return on investment. This means that the suggestions of implementing adaptation measures by CFA's could be the best entry point for farmers.
- CFA and NCs should have insights in the local (social network) context, the livelihoods and capital bases of farmers as it determines their capacity to adopt AMM.
- CFA should have insights on the context farmers are working in and to gain insights in the barriers for adopting CSF practices.
- CFA should gain some insights in the beliefs,values and motivations of the farmers they are supporting, including on what seem to be defined as „good/normal" farm management by the local farmer community. These will define which arguments can be used to propose AMM to farmers and which AMM fits best their beliefs.
- CFA can support farmers in their decision making, but they should give them the feeling of control of their own decision making and make them feel confident that they will be supported in implementing the practices. Information provisioning, education and training on AMM are very important to make farmers feel more in control of their decision making.
- CFA and PDFs, when proposing or demonstrating AMM, they should pay significant attention to the relative advantages of the AMM, including potential market or compliance based awards.
- CFA should use positive language and scenario's as it is more conducive for behaviour change.
- To know which type of interventions are needed for farmers, it might be interesting to know where the PDF places him/herself in the ADKAR process.
- CFA should first assess the complexity of the context and impact of specific AMM and strategies, to define which intervention activities are most conducive for achieving change. For unknown, complex and uncertain strategies, facilitated groups and co-innovation processes are more interesting. For known contexts and impacts and uncertain implication, facilitated groups and one-on-one advise are most interesting. For known and uncontested contexts and impacts, information provision, training, best management practices, etc. are seen as effective.
- CFA should focus first on AMM that involve improvement (or at least status quo) of the farm system (on economic and labour aspects).
- The audit that will be done in each PDF in the second year of the project, will be a great opportunity to get to know the PDFs. Because of the importance of knowing the farmers' attitude and location in the change process towards CSF, we believe this audit should not only focus on farm technical data, but also on behavioural aspects, to gain insights in the attitudes and barriers of PDFs towards CFA.
- CFA should be trained in the soft skills to discuss the PDF's attitude and barriers towards CFA.

6.4.3 To remember for WP3

- It is important to adapt AMM to the local contexts. Therefore, during demonstrations sufficient attention should be given to this aspect, so farmers can estimate what they can do to adapt a measure to their own farming context
- A differentiation between open and closed demo events might be beneficial to stimulate the adoption of CFA by PDFs. Closed demo events are then limited to a fixed group of PDFs supported by a CFA. Having such a group, might form a additional asset for farmers to stay in the project as they will become a valuable information source. Open demo events are made open to the wider farming community and can share results of the hubs and increase the impact of the project.

6.4.4 To remember for WP4

- If Living Lab facilitators are able to link the participation of farmers to clear learning opportunities, they might be better able to hook the farmers to the co-creation process.

6.4.5 To remember for WP5

- Since adaptation measures are more likely to be easily adopted by farmers, it would be beneficial to provide CFA's with insights on synergies between adaptation and mitigation of a given practice. In this way they can rather suggest adaptation measures with higher mitigation co-benefits and thus increase the overall impact on GHG emissions.
- When developing a list of AMM it might be interesting for the CFAs to provide information on how these AMMs contribute to the adaptation and mitigation goals, how they are linked to the 12 thematic areas and at which level they require changes (farm production, farm management, technological innovations, farm financial management, government programs).

6.4.6 To remember for WP6

- Highlighting possible economic gains through rewarding mechanisms is undoubtedly one of the most powerful drivers of change for farmers, but it is not the only one, and in some cases, it is not even the priority #1 driver. It will therefore be very interesting to make the link between rewarding mechanisms and the other factors supporting change, as in WP2.

6.4.7 To remember for WP7

- Involve national project actors, such as national coordinators and CFA in the interactions with the CS AKIS at EU-level, to make sure the information can be used at national level.

6.4.8 To remember for WP8

- Our impact hypotheses and the pathways in which we can contribute to sustainable changes will depend on the target audience: PDFs, all-farmers, CFAs, all-advisors, national-AKIS, EU-

AKIS, etc. Dissemination and communication plans will benefit from the work carried out on the drivers of change and will be able to build on the work undertaken in WP2 and WP3 in particular.

6.4.9 To remember for WP9

- The general management of CFD will have to take into account the various knowledge creation levels and will have to develop a subtle balance between them, in particular to leave room for complementary "top-down" and "bottom-up" approaches

Chapter 7

Glossary

7 Glossary

Adaptation measures
Adaptation measures are part of the process of adapting to the current and future effects of climate change. Adaptation measures are those agricultural practices that anticipate the negative effects of climate change and take appropriate measures to prevent or minimise the damage they might cause or to exploit the opportunities they might present.

Adaptation and mitigation plan
A plan that brings together a series of on-farm adaptation and mitigation actions over a period of time. An effective plan have to be adapted to the specific conditions of the farm, in terms of investment, technical and management capacity.

(Climate Smart) AKIS: a system linking people and institutions engaged in mutual learning and who together generate, share, and utilise agriculture-related technology, knowledge, and information. The system integrates farmers, advisors, agricultural educators, researchers and innovation support providers to harness knowledge and information from various sources, with farmers at the heart of this knowledge square.
A Climate Smart Agriculture Knowledge & Innovation Systems (CS-AKIS) is a group of actors, stakeholders and organisations at regional, national or EU levels who join together to promote mutual learning, to generate, share, and use climate smart agriculture-related knowledge and information.

Audit
Each farm will be audited at the start and end of the project to define its climate baseline. Based on these audits adaptation and mitigation measures will be proposed and an adaptation and mitigation plan will be made.

(Farm) Climate Baseline
a counterfactual against which the impact of a GHG emissions reduction or carbon sequestration project is compared, i.e.., the baseline describes the GHG emissions and carbon sequestration that would have occurred in absence of the carbon project.

Carbon Assessment tools
tools that gauge the environmental performance of farm production. The environmental performance is determined through the assessment of various criteria which usually consist of GHG emissions, carbon sequestration, biodiversity, energy consumption, nitrogen balance, etc.

Carbon sequestration
Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. Carbon dioxide (CO2) is naturally captured from the atmosphere through biological, chemical and physical processes. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change.
In agroforestry the main carbon pits are soil and biomass. The changes in carbon sink can be accelerated by changes in land use and agricultural practices, such as no tillage, organic matter distribution on soils.

Climate Farm Advisor (CFA)
A CFA is a farm-advisor specialised in climate issues and adaptation and mitigation advise and operating at national/regional level. The CFA advises and regularly supports the PDFs along the journey towards climate smart transition and for the organisation of demo-events. The CFA exchanges knowledge with other CFAs, all farms and all actors at national & EU level

Climate Smart Farming practices
Climate-smart agriculture (CSA)
It is an approach that can help farmers and foresters increase productivity and incomes in a sustainable way. It also helps to build resilience and adapt to the effects of climate change, and contributes to climate change mitigation by reducing or removing greenhouse gas emissions.
Climate-smart practices can focus on ways to reduce emissions in livestock production, to reduce farm inputs (such as fuels, energy, pesticides, mineral fertilisers) for more resource-efficiency, or to keep carbon stored in the soil. Making farming systems more diverse can also make them more resilient in the face of climate change.

Cross visit (CV)
When farmers and advisors from one region visit and participate in a demo event of a farmer group in another region.

Demonstration event
Demonstrations are an advisory method that lies at the heart of agricultural advisory services and the modern AKIS. There are one activity – among many – embedded in the AKIS and mobilised by AKIS actors to facilitate farmer learning. They play a supporting role in the wider advice landscape and should not be seen as an activity for their own sake; the co-ordination of demonstration activities with respect to other advisory approaches, is therefore important. The primary purposes of on-farm demonstration are to communicate explicit knowledge, and to make tacit knowledge more explicit. The European Commission has previously defined a demonstration project/activity as a: “practical session to illustrate a technology, the use of new or significantly improved machinery, a new crop protection method or a specific production technique. The activity can take place in a farm or in other places such as research centres, exhibition buildings, etc.”. Ingram et al. (2018) defined a demonstration activity (or event) as: “the diverse means for providing farmers with “an explanation, display, illustration, or experiment showing how something works” (Collins English Dictionary) that can be subsequently applied in their own farming practices to bring about positive changes on their farm”. They are planned around achieving a different outcome for: agronomy, animal husbandry, farm business, farm diversification, compliance with regulations, and good farm practice, and sustainability, to name a few, and coordinated and delivered by actors such as farmers, advisers, facilitators, technical experts, researchers, industry actors.

Dynamic action plan for farm demonstrations
Each year the an dynamic action for demonstration events will be made at national level. This will be integrated in the national plan for knowledge exchange activities.

Experimental farmer (EF)
An EF is not a commercial farm and is managed by a R&I organisation with scientific & innovation purpose. The EFs act as training centre and national meeting place in WP1, organise demo events in

WP3 and experiment new solutions in WP4. The EFs exchange knowledge with other EFs, PDFs and LFs at national & EU levels.

GHG emissions
Greenhouse gases (GHG) are responsible for global warming, and those emitted by agricultural production are: methane (CH4), which is derived from enteric fermentation, especially of ruminants, and the (mainly anaerobic) transformation processes that take place in manure; nitrous oxide (N2O), which is derived from the nitrification-denitrification processes that take place in the soil and from manure management systems; and carbon dioxide (CO2), which is derived from combustion processes. Nitrous oxide is a greenhouse gas that is considered 265 times more potent than CO2, while methane is 27.75 times more potent (IPCC, AR5, 2013); these are the multiplication factors used to convert N2O and CH4 emissions into corresponding units of CO2-equivalent: this is the unit of measurement that expresses the carbon footprint, a summary indicator of the global warming potential attributed to a unit of product , e.g. 1 litre of milk.

Lighthouse farmer (LF)
A LF is a commercial farm managed by a sustainability-oriented farmer who test, innovate and implement new solutions: taking risk, acting as pioneer to pave the way of the future of farming. The LF organise demonstration activities for PDFs and exchanges knowledge with other LF, PDFs and EFs at national & EU level. At least 1 exemplary LF will be labelled in each country.

Mitigation measures
Mitigation is a human intervention that reduces sources of greenhouse gas emissions and/or strengthens carbon sinks. Mitigation measures in agriculture prevent or decrease the emission of greenhouse gases (GHG) into the atmosphere. Mitigation is achieved by reducing the sources of these gases (e.g. by limiting enteric emissions from ruminants) or by enhancing carbon storage (e.g. in soils and biomass).

MRV framework
Refers to the mechanism or methodology's process, methods, and requirements for quantifying, reporting and verifying GHG emissions reduction and carbon sequestration.

Multi-actor approach/network
Climate Farm Demo involves a wide range of relevant actor types to achieve the its objectives (farmers, advisors, applied researcher, academia, policy makers, NGOs, industry, SMEs) from the early initial concept of the project to the operational implementation of the project. Each partner has a clear role in the project in order to ensure complementarities as well as synergies among partners

National action plan for knowledge exchange
Each national network should yearly draft an action plan for knowledge exchange for the upcoming year. The national coordinator is responsible for leading this process.

National coordinator (NC)
The NC is the leading person that supervises and organises the farm related activities at national level. Depending on the country organisation, the NC is a CFA or manages the national CFAs. The NC is responsible for the Knowledge Exchanges (KE) at national level and for the Dissemination and Communication activities in his/her national CS-AKIS.

Pedoclimatic area
The EU counts 4 main pedo-climatic areas: Nordic, Atlantic, Continental and Mediterranean. These areas will be used to structure knowledge exchange within the Climate Farm Demo network.

Peer to peer learning (P2P learning)
P2P learning is when a person learns from his/her peers through exchanging experiences. For example, farmers learn from other farmers or advisors learn from other advisors. It is important that the peers have the same status and that there is not hierarchical difference between them.

Pilot Demo Farmer (PDF)
PDF is a commercial farm managed by a sustainability-oriented farmer engaged in an innovation process and in demonstration activities. The PDF implements existing or new climate smart solutions and hosts on-farm demonstration towards other farmers. The PDF exchange knowledge with other PDFs, EFs and LFs at national & EU levels.

PIPs
Referring to the other Projects, Flagship initiatives and Policy makers, with which it might be interesting to liaise and collaborate with to increase the impact of our project.

Rewarding mechanism
Rewarding mechanisms are defined as mechanisms that reward farmers in return for implementing a desired action or delivering a desired outcome and can be sourced from public or private entities or a mix of both. Rewarding mechanisms are typified by aiming to induce a behaviour change, the use of positive incentives, and their voluntary nature. These rewarding mechanisms can take diverse forms, including regulatory obligations (that are rewarded), voluntary public funds, R&D, voluntary carbon markets and price premiums/labelling, among others

Thematic action plan for knowledge exchange
Each thematic network should yearly draft an action plan for knowledge exchange for the upcoming year. The thematic leader is responsible for leading this process.

Thematic leader (TL)
A Thematic Leader is an outstanding European expert in one of the Adaptation & Mitigation thematic areas selected by the project to cope with climate change impact. The TL is the leading person organising knowledge exchange between CS-AKIS actors, PDFs & CFAs at EU level and who capitalise on new & innovative knowledge in his/her thematic area for wider dissemination.

Chapter 8

References

8 References

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