UNISECO

UNDERSTANDING & IMPROVING THE SUSTAINABILITY OF AGRO-ECOLOGICAL FARMING SYSTEMS IN THE EU

Deliverable Report 3.4: Report on Key Barriers of AEFS in Europe and Co-constructed Strategies to Address Them

AUTHORS	Gerald Schwarz (TI), Jaroslav Pražan (UZEI), Jan Landert (FiBL), David Miller (HUT), Francesco Vanni (CREA), Johannes Carolus (TI), Rainer Weisshaidinger (BOKU), Ruth Bartel-Kratochvil (BOKU), Andreas Mayer (BOKU), Rebekka Frick (FiBL), Andrea Hrabalová (Bioinstitut), Alba Linares Quero (GAN), Uxue Iragui (GAN), Carlos Astrain Massa (GAN), Janne Helin (LUKE), David Huismann (LUKE), Emmanuel Guisepelli (ISARA), Philippe Fleury (ISARA), Audrey Vincent (ISARA), Alexandra Smyrniotopoulou (AUA), George Vlahos (AUA), Katalin Balázs (GEO), Alfréd Szilágyi (GEO), László Podmaniczky (GEO), Oriana Gava (CREA), Andrea Povellato (CREA), Francesco Galioto (CREA), Andis Zīlāns (BEF-LV), Kristīna Veidemane (BEF-LV), Justas Gulbinas (BEF-LT), Gražvydas Jegelevičius (BEF-LT), Elvyra Myškyté (BEF-LT), Mihaela Frățilă (WWF), Mara Cazacu (WWF), Kajsa Resare Sahlin (SLU), Elin Röös (SLU), Chiara Pia (SLU), Carol Kyle (HUT), Kate Irvine (HUT), Fabrizio Albanito (UNIABN), Pete Smith (UNIABN)
APPROVED BY WP MANAGER OF WP3	Jan Landert (FiBL)
DATE OF APPROVAL:	18.06.2021
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Table of Contents

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ACRONYMS

AEFS	Agro-ecological farming systems
CAP	Common Agricultural Policy
CS	Case Studies
CUMA	Coopératives d'Utilisation du Matériel Agricole
MAP	Multi-Actor Platform
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MPI	Market and policy instrument
NGO	Non-Governmental Organisation
SES	Socio-Ecological Systems
SNA	Social Network Analysis
UNISECO	Understanding and Improving the Sustainability of Agro-ecological Farming Systems in the EU

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EXECUTIVE SUMMARY

This document is Deliverable D3.4 in Work package "Assessment at farm level" of the EU Horizon 2020 project UNISECO. Work Package 3 aims to analyse the environmental and socio-economic performance of agro-ecological farming systems (AEFS), and the reasons for why drivers and barriers to the implementation of agro-ecological practices can or cannot be overcome, and how future strategies can address drivers and barriers of agro-ecological transitions in the context of specific social-ecological systems (SES). This report includes the results of Task 3.3 "In-depth analysis of drivers and barriers in AEFS and co-construction of innovative strategies".

The overall objective of this Deliverable (D3.4) is to summarise the analysis of barriers and drivers hindering or facilitating the implementation of agro-ecological practices, and the strategies identified that address the barriers and drivers of agro-ecological transitions in the context of the 15 UNISECO case studies. The co-construction of the transition strategies with the local actors aims to propose changes in the governance of the farming system to address the key barriers and drivers of implementing the practices, and to identify market and policy incentives that are expected to support an agro-ecological transition. Particular attention is paid on how cooperation between actors can help to address the key drivers and barriers. Building the co-constriction of the strategies on the application of the SES framework has advantages in the context of the UNISECO project of: i) a detailed consideration of the specific local context of each farming system in the proposition of suitable concrete actions to initiate or enhance agro-ecological transitions; ii) improved understanding of the processes behind the barriers and drivers that need to be addressed.

The co-construction processes provided insights into the governance of the farming system and the roles of different local actors in the strategic pathways to address different barriers and drivers of agro-ecological transitions. The aim of the deliverable was also to analyse how cooperation between actors can help address key drivers and barriers to transitions to agro-ecological farming systems. This was to explore how the actors could cooperate to support the implementation of agro-ecological practices, and what changes in formal and informal rules are required to facilitate the desired cooperation (both internally between the key actors in the farming system, and externally with actors influencing the settings of the farming system).

The assessments of the social-ecological systems in the case studies identified a wide range of barriers that hinder the implementation of agro-ecological practices. The focus of the UNISECO project was on socio-economic and policy factors and three broader main themes of barriers and drivers which were identified: i) a lack of knowledge and social capital; ii) the lack of added value, processing and market access; iii) ineffective policy design. Specific attention was paid to the complexity of the relationships between different factors which could impact on the success or failure to initiate or enhance transitions, and inform the types of key actions and changes in governance required in future transition strategies.

Key aspects for successful agro-ecological transitions are improved knowledge on the benefits of agro-ecological practices and economic opportunities, the importance of education, training and life-long learning, and mature social capital and strengthened collaborative action and collective institutions in agro-ecological value chains. This would enable higher prices to be charged for agro-ecological products and utilise the potential of agro-ecological farming to be economically viable. Such processes need to be supported by policy and the public sector, to address issues of economic exploitation and power relations as well as problems of over-consumption and food waste in food chains, with implications for public health, social justice and food security.

The outcome of the co-construction of the strategies has informed: i) the assessment of trade-offs at farm level (Deliverable D3.5, Albanito *et al.*, 2021) by providing information on the farm management changes and agro-ecological practices that are seen as effective and acceptable; ii) the multi-criteria assessment of policy instruments and incentives (Deliverable D5.4, Galioto *et al.*, 2021) by identifying innovative market and policy incentives that are suitable to promote agro-ecological transition; and iii) the lessons learnt for agro-ecological transitions reflecting the different local and place-based context of the story maps from each case study (Deliverable D3.6, Landert *et al.*, 2021).

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1. INTRODUCTION

This document is Deliverable D3.4 in the Work package "Assessment at farm level" of the EU Horizon 2020 project UNISECO (Understanding and improving the sustainability of agro-ecological farming systems in the EU). Work Package 3 aims to analyse the environmental and socio-economic performance of agro-ecological farming systems (AEFS), and the reasons for why drivers and barriers to the implementation of agro-ecological practices can or cannot be overcome, and how future strategies can address drivers and barriers of agro-ecological transitions in a specific social-ecological system (SES) context. In particular, this report includes the results of Task 3.3 "In-depth analysis of drivers and barriers in AEFS and co-construction of innovative strategies".

The analysis carried out for Task 3.4 focused on the barriers and drivers of agro-ecological transitions and how these can be overcome through co-constructed strategies that take into account the complexity of interactions and processes between actors within the examined SES. It builds on the conceptual framework developed by Guisepelli *et al.* (2018) and Prazan and Aalders (2019) in Work Package 2, and based on the description and assessment of the SES in the case studies (outputs of Task 3.1), and the social network analysis (SNA) in Task 5.2 (Vanni *et al*., 2019),

The overall objective of this Deliverable (D3.4) is to summarise the analysis of barriers and drivers that hinder or facilitate the implementation of agro-ecological practices, and the strategies identified that address the barriers and drivers of agro-ecological transitions in the context of the 15 UNISECO case studies.

The specific objectives of Deliverable 3.4 are:

- To summarise the analysis of barriers and drivers that hinder or promote agro-ecological transitions in the case study farming systems. Guided by the structure of the SES framework, the analysis of the barriers and drivers considers factors in relation to the resource system, the interactions amongst actors, the governance of the farming system and the wider social, economic, political settings. It focuses on the ways that transition barriers could be overcome and drivers promoted, and why other farming systems were locked in the initial stage of the transition, and the barriers which could not be overcome and drivers which could not be promoted.
- To analyse the strategies for agro-ecological transitions in the case study farming systems that are targeted towards addressing the key dilemmas and related sustainability issues of the case studies, and to synthesise lessons learnt for supporting agro-ecological transitions in the EU. The strategies consider a selection of agro-ecological practices at field, farm and landscape scale that are seen as effective and acceptable. They report on changes required in the governance of the farming systems for addressing the key barriers and drivers of implementing the agro-ecological farming practices, and identifying market and policy instruments that have the potential to support the implementation of the practices, i.e. support an agro-ecological transition.

The report is structured as follows:

- Section 2 provides an introduction to the topic with particular attention to the role of cooperation enabling the transition towards AEFS.
- Section 3 provides definitions on key terminology and describes the research methods and data collection in the context of the 15 UNISECO case studies.
- Section 4 outlines the case study contexts in more detail, including an overview of the SES which were assessed, explanations of key barriers and drivers, and the strategic pathways identified and changes in governance of the transition strategies.
- Section 5 provides a comparative analysis of the different barriers and drivers, differentiating between case studies initiating and enhancing agro-ecological transitions.

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- Section 6 synthesises the co-constructed strategies to address transition barriers and drivers, and explores the roles of cooperation between actors in the case studies initiating and enhancing agro-ecological transitions.
- Conclusions are reported in Section 7.

2. CO-CONSTRUCTING STRATEGIES FOR AGRO-ECOLOGICAL TRANSITIONS

2.1. Background

The main objective of UNISECO is to strengthen the sustainability of EU farming systems. It aims at analysing socio-economic and policy barriers and drivers for the further development and adoption of agro-ecological approaches in farming systems.

The UNISECO project has carried out case study analysis in 15 European countries covering farming systems that are in different stages of initiating or enhancing agro-ecological transitions to improve the sustainability of these systems. A key contribution and role of the case studies was to promote the co-creation of knowledge with stakeholders in the different farming systems. This was achieved through the participatory engagement of stakeholders in workshops, focus groups and interviews in the various activities of the co-construction of the transition strategies.

Co-construction is a key element of the transdisciplinary approach in UNISECO and is used for integrating and managing interactions between individuals, and collective and scientific knowledge. A dynamic and iterative process of progressive adjustment and learning was used which was informed by theory, modified by practice. The approach reflected the diversity of values or visions of actors, producing outputs that reflected a balance between the opinions of the actors involved, which is likely to facilitate progress over the long term (Akkari and Bryant, 2016). For more information on the transdisciplinary approach and decisions in relation to purpose, timing and efforts of the co-construction activities consult Deliverable D7.1 (Budniok *et al.*, 2018) and Deliverable D7.2 (Irvine *et al.*, 2019).

To analyse the transition of farming systems, the theoretical framework used in UNISECO is that of socio-ecological systems (SES) developed by Ostrom (Deliverable D2.1; Guisepelli, *et al.*, 2018). This framework provides a holistic approach to integrating both the natural and the social aspects when analysing a complex situation or problem, and its application gives the possibility to improve the targeting of strategies and policies. In the context of UNISECO, it enables: i) the integration of the dimensions of agro-ecological transitions of farming systems (technical, environmental, social, economic or political); ii) an analysis of the processes behind drivers and barriers that have led to the current state of the sustainability of the farming system; iii) and an improved understanding of possible changes in the governance of the farming system that could facilitate transition towards agro-ecological farming systems (AEFS).

For each case study the key challenges to sustainability in the farming system, and the key dilemma associated with the transition to AEFS, have been identified and a status quo assessment of the sustainability performance of the farming systems was done (Deliverable D3.1, Landert *et al.*, 2019a; Deliverable D3.2, Landert *et al.*, 2019b). The analysis in each case study identified the most relevant actors for addressing the key dilemmas, how barriers were overcome in the past to reach the status quo, and why some barriers have not been overcome (Deliverable D5.2, Vanni *et al.*, 2019; Deliverable D3.3, Prazan *et al.*, 2020). This report synthesises the social-ecological assessments of each case study farming system, explains and classifies key barriers and drivers of agro-ecological transitions, and analyses which co-constructed strategies have the potential to overcome these existing or remaining barriers to initiate or enhance transitions. The analysis of the key barriers and drivers considers the results of the review of existing market and policy instruments in the case studies and the improved understanding of policy factors that

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enhance or limit agro-ecological transition in the UNISECO case studies (Deliverable D5.1, Zilans *et al.*, 2019, Deliverable D5.3, Linares *et al.*, 2020).

The outcome of the co-construction of the strategies has informed: i) the assessment of trade-offs at farm level (Deliverable D3.5, Albanito *et al.*, 2021) by providing information on the farm management changes and agro-ecological practices that are seen as effective and acceptable; ii) the multi-criteria assessment of policy instruments and incentives (Deliverable D5.4; Galioto *et al.*, 2021) by identifying innovative market and policy incentives that are suitable to promote agro-ecological transition; and iii) the lessons learnt for agro-ecological transitions reflecting the different local and place-based context of the story maps from each case study (Deliverable D3.6, Landert *et al.*, 2021).

The co-construction of the transition strategies with the local actors aims to propose changes in the governance of the farming system to address the key barriers and drivers of implementing the practices, and to identify market and policy incentives that are expected to support an agro-ecological transition. Particular attention is paid on how cooperation between actors can help to address the key drivers and barriers. Building the co-constriction of the strategies on the application of the SES framework has advantages in the context of the UNISECO project of providing:

- Detailed consideration of the specific local context of each farming system in the proposition of suitable specific actions to initiate or enhance agro-ecological transitions;
- Improved understanding of the processes behind the barriers and drivers that need to be addressed.

2.2. Barriers and Drivers of Agro-ecological Transitions

A large body of literature exists in which factors that hinder or facilitate the implementation and adoption of sustainable practices in agriculture are explained (e.g. Slee *et al.*, 2006; Rodriguez *et al.*, 2009; Karali *et al.*, 2014; Schiller *et al.*, 2019; Iles, 2020; Anibaldi *et al.*, 2021). Fewer studies exist specifically on barriers and drivers for agro-ecological transitions in a European context, but recently a number of new studies have been published (e.g. Schoonhoven and Runhaar, 2018; Anderson *et al.*, 2019; Aare *et al.*, 2021).

The implementation of agro-ecological practices shares similarities with the adoption of climate-friendly and agri-environmental measures, many of the aims of which are closely aligned. Many studies over the last 50 years have established that the goals and values of farmers are complex, and that simple profit maximising assumptions are not sufficient to explain their behaviour (Burton and Farstad, 2020; Dessart *et al.*, 2019; Stupak *et al*., 2019; Burton and Paragahawewa, 2011; Floress *et al.,* 2011). In addition, barriers and drivers do not only originate from individual farmers, but also occur throughout the farming and food system subject to agro-ecological transition as well as the wider socio-economic and policy settings at the regional, national and European level. Such complexity means that there is no simple formula to explain which barriers and drivers will be most important in a given case.

Co-constructing strategies to overcome barriers and drivers to agro-ecological innovation and changes in agricultural practices requires a good understanding of the specific context of the farming systems and in which those barriers and drivers occur (Schoonhoven and Runhaar, 2018; Knowler and Bradshaw, 2007). The application of the SES framework with its different subsystems (e.g. actors, governances, transformation, interaction, etc.) enables a detailed analysis of the local context at the systems level in each case study. However, a challenge is that the analysis of the context-specific barriers and drivers in each case study needs to be compared and synthesized into higher-order findings that provide insights into how contextual factors modify general insights informing a systematic causal explanation for addressing barriers and drivers (Eisenack *et al.*, 2014).

A first step in co-constructing strategies was to conceptualise barriers and drivers, and to derive a definition of barriers and drivers applicable to the UNISECO project. Many studies apply generic definitions for barriers and drivers and refer to technological, political, and financial factors that may support or hinder an

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agro-ecological transition, such as a lack of knowledge about, political will to push for, or financing opportunities to support agro-ecology (Schiller *et al.,* 2019; Altieri and Nicholls, 2012; Silici, 2014; Wibbelmann *et al*., 2013). The definition of barriers used by some authors (e.g. Moser and Ekstrom, 2010; Gruere and Wreford, 2017) is 'the factors that adversely impact on the effectiveness of adaptations or transitions resulting in higher costs, both for farmers and society'.

Barriers can be judged differently by different actors. A barrier might be judged as being problematic by one actor and beneficial by another actor. Eisenack *et al*. (2014) argue that barriers are relative to the specified adaptive actions being considered, to the actors that may exercise those actions, and to the specific situation in which they may be taken. In principle, barriers can be reduced or overcome by the actors. The example of barriers considered by those authors were of adaptation to climate change, but the importance of specified actions, the actors, the specific context and being considered as surmountable or mutable also applies to barriers to agro-ecological transitions.

Taking into account these considerations, barriers are defined in UNSIECO as:

"The subjective interpretations or collective understanding of actors of sequentially or simultaneously operating factors and conditions that emerge from the sub-systems and settings of the social-ecological system (e.g. actors, governances, transformation, interaction, etc.), which the actors assess as having a negative influence on addressing the key dilemma, and reducing the prospects of successful agro-ecological transitions, but which can be overcome with concerted efforts, or by creating strategies and seizing opportunities."

Thus, barriers are factors which prevent a farming system reaching the next step in enhancing its sustainability (i.e. the next step in the transition toward agro-ecological farming system). Drivers are understood to be the factors that enable or help the transition process.

Several different classifications of barriers and drivers to sustainable agricultural practices have been reported in the literature (Jones and Boyd, 2010). The classification of barriers and drivers was a key requirement of UNISECO to then enable the achievement of its aim of improving the understanding of socio-economic and policy barriers and drivers hindering or supporting the implementation of agro-ecological practices. The classification used builds on those developed by Jones and Boyd (2010) and Gruere and Wreford (2017). In the identification of barriers and drivers, a differentiation was made between technological, knowledge, economic, normative and cognitive (social), institutional (social), policy-related and bio-physical factors (Table 1).

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Table 1 Definitions of the different types of barriers and drivers

Type of Barrier / Driver	Description
Technological	Technological requirements and capacity to implement agro-ecological practices (e.g. specific machinery needed to implement certain practices, level of mechanisation).
Knowledge	Knowledge needed to implement agro-ecological practices, and understand gaps and constraints (e.g. lack of agro-ecological practice-specific knowledge and/or know-how).
Economic	Economic barriers to, and drivers of, the capacity for investing in resources and technology for sustainable land management of a profitable business. These include barriers and drivers in relation to cost structures, product prices, product differentiation, creation of added value, capital requirements and financial resources.
Social – normative / cognitive	Barriers and drivers relating to: a) cultural factors of normative nature, cultural norms that discourage change and innovation and lead to an unwillingness to adopt new practices (e.g. attitude of farmers towards agro-ecological farming or tradition of certain conventional practices); b) beliefs about agro-ecology, perceptions of sustainability issues, and the relative benefits, costs and risks, and uncertainty of related issues (e.g. biodiversity loss not yet seen as a problem).
Social - institutional	Barriers and drivers that restrict or facilitate access to land, networks, information and market knowledge, and that influence the way farmers are able to adopt changes (e.g. lack of cooperation, limited AKIS coordination, conditions of land rental agreements).
Policy-related	Barriers and drivers that relate to the design, implementation and monitoring of policies (e.g. high bureaucracy of policy support or prescriptions in policy measures that hinders the implementation of agro-ecological practices).
Bio-physical	The natural dimensions of barriers, relating to the bio-physical constraints that hinder the implementation of agro-ecological practices.

Barriers and drivers do not operate in isolation. They may have causal relationships that are linked with each other and form clusters that need to be addressed jointly in the co-constructed transition strategies. The strategies proposed could be ineffective if they ignore causal interdependencies. To initiate or enhance agro-ecological transitions, it may be necessary to address several interdependent barriers at the same time.

Strategies also need to consider that barriers and drivers are not static but are subject to dynamic processes. For example, the value judgements of actors might change, as may the actors involved in addressing the barriers and drivers.

The dynamics may also be the result of specific interdependencies amongst barriers. Some barriers and drivers might strengthen or weaken other barriers and drivers over time. Causal interdependencies between barriers and drivers may lead to loops of barriers and drivers that reinforce each other, hindering initiation or progress towards agro-ecological transitions (Eisenack *et al*., 2014, Weber and Rohracher 2012, Schiller *et al*., 2019).

The application of the systemic approach identified clusters of multiple barriers and drivers, and facilitated the finding of specific entry points for actions in strategies to initiate or enhance agro-ecological transitions of particular farming systems in local contexts.

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2.3. Strategies for Agro-ecological Transitions

The co-constructed transition strategies are targeted at addressing the key dilemmas of the case studies. As explained in Section 2.1, they reflect the results of the previous analyses done in the case studies and the different priorities and perspectives of the members of the Multi-Actor Platforms who participated in the co-construction process. The transition strategies identify and propose key actions reflecting changes required in the governance of the farming systems. They focus on involving the internal and external key actors of the social-ecological system (farming system) who were identified in Vanni *et al*. (2019; D5.2), and changes in the formal and informal rules that foster their cooperation that address the barriers and drivers of agro-ecological transitions identified. Overall, the strategies are designed to facilitate the implementation of suitable agro-ecological practices.

A set of different agro-ecological practices were identified in each case study through interviews with participating farmers. These practices are expected to be effective and acceptable for initiating or enhancing the transition, and have the potential to address the key dilemma and improve the sustainability performance of the farming system in the case study. This builds on the status quo assessment in Task 3.2 (Landert *et al.*, 2019a; Landert *et al*., 2020), and the assessments of the sustainability impacts, trade-offs and synergies of these agro-ecological practices are reported in Albanito *et al*. (2021; D3.5).

The strategies identify the roles of the different actors within and outside of the social-ecological system, and how they can cooperate to address transition barriers and drivers, and facilitate the implementation of the agro-ecological practices by the farmers. Changes in rules are explored that can foster the cooperation of actors. Such changes can include changes in formal rules, such as formalised contracts of collaborations, and changes in informal rules such as sharing or agreeing on common values amongst the different actors. In addition, the strategies consider changes in market institutions and external policy-related rules such as changes in laws and regulations, and identify candidate market and policy incentives that facilitate and support the implementation of agro-ecological practices. These can be incentives that are provided to the farmer directly, or for promoting the generation of social capital, value chain development and market creation for agro-ecologically produced goods. Further analysis of the market and policy incentives in the form of a multi-criteria assessment is reported in Galioto *et al*. (2021).

The co-construction of the strategies for agro-ecological transitions builds on previous studies exploring strategic pathways for transitions. Strategies need to have concrete goals and lead to concrete actions (Runhaar, 2021). For many local actors the concept of agro-ecology is not sufficiently concrete and results in different interpretations and expectations. Common and more concrete boundary objects were defined in the case studies to act as shared references that are meaningful for actors with different backgrounds to facilitate a common and shared understanding of the concrete goals of the strategies. Key sustainability issues (for example biodiversity loss or poor water quality) were identified, discussed and agreed, reflecting the key dilemma of the case studies that the strategies aim to address.

UNISECO does not focus on individual farm strategies, but rather it identifies strategic pathways to initiate or enhance agro-ecological transitions by pinpointing key actions and the required governance changes of the farming systems. In the context of the French Caribbean, Fanchone *et al*. (2020) differentiate between strategies for farming systems of large farms with high levels of production factors which are, mainly, oriented towards a light transition for improving the existing agricultural models, and farming systems of small family farms with high levels of diversification that already implement agro-ecological practices.

Duru *et al*. (2015) argue that strategies for agro-ecological transitions have the challenge of designing and implementing governance structures that promote the social and collaborative learning required to develop local-level coordination between the activities of farming systems, value chains and natural resource management. The collaborative learning processes of the local actors participating in the UNISECO Multi-Actor Platforms guided the scope and extent of the strategies agro-ecological transition (Dendoncker *et al*., 2018). The learning processes throughout the engagement with actors in project workshops, and other interactions, increase the capacity of members of the Multi-Actor Platforms to propose actions and

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changes in governance, recognising trade-offs that are inherent to the management of social-ecological systems (Galafassi *et al*., 2017).

Further important factors that require consideration in strategies are the level and extent of agro-ecological transition already in place, the strength or marginality of local actors (in particular farmers), and the level of social capital in the settings of the case studies (Lopez-Garcia *et al.*, 2020). Diverse, collaborative groups (e.g. including farmers, advisers, value chain actors and ministry representatives) have the potential to help building social capital, as a basis to co-construct and implement strategies for sustainable farming systems (Rust *et al.*, 2020).

Hubeau *et al.* (2017) defined a set of criteria for strategic pathways for agro-ecological transitions comprising: i) actions are taken by farmers and other value chain actors. ii) policy, scientific actors or NGOs can support the transformation pathway, but the area of action should remain within the agri-food system; iii) transformation pathways should stimulate actions that contribute towards sustainability; iv) pathways should be chain-wide pathways, i.e. different components of the agri-food system should be involved. The co-construction of strategies for agro-ecological transitions in the 15 European case studies in UNISECO applies a similar set of criteria within the adapted social-ecological systems framework developed by Guisepelli *et al.* (2019). The criteria include:

a. The strategies for agro-ecological transitions are co-constructed with the aim of addressing the key dilemma and improving the main sustainability issues of the farming systems in the case studies.
b. Transition strategies address key barriers and drivers hindering or enhancing the implementation of agro-ecological practices that can be influenced by the actors within the social-ecological system.
c. Key actions that constitute the proposed changes in the governance changes of the farming system required to be done by farmers and other actors within the social-ecological system.
d. The transition strategies include value chain-wide pathways and propose changes to market institutions and, if relevant within the specific local context of the case study, new forms of market incentives.
e. The transition strategies pay attention to possible supporting roles of agricultural and other relevant policies and propose changes in policy design and / or new policy instruments that have the potential to foster the transition processes.

The transition strategies cover actions that can be carried out by actors internal to the SES (e.g. common storing or processing of farmers), and actions that can be initiated by actors in a social-ecological system but with a reach that goes beyond the boundaries of the system (e.g. regional associations initiated by farmers). The strategies also cover changes in governance carried out by external actors, including changes in market institutions and in the policy environment.

2.4. The Role of Cooperation in Agro-ecological Transitions

The co-constructed transition strategies will pay particular attention to how cooperation between actors can help address key drivers and barriers to transitions to agro-ecological farming systems. Given the diversity in the nature of cooperation across the UNISECO case studies, here the term is used to refer to the broader concept covering a spectrum of collaborative and coordinated approaches which reflect different degrees of joint working between the actors (Boulton *et al*., 2013). Coordination is characterised by actors working towards the same objective but in isolation. Joint working between participants is not necessary for the strategy to deliver its desired outcomes. External facilitation is a common feature of this approach. Collaboration is taken to mean actors meeting, working together and maintaining a dialogue. They need to engage with each other on the strategy to deliver its desired outcomes. Both approaches (coordination and collaboration) can be top-down (driven by a government agency or government-funded adviser), evolved

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(initially driven by local actors, but eventually brought together and led by government agency or government-funded adviser), or and bottom-up (driven by local actors) (Prager, 2015).

The engagement with the Multi-Actor Platforms also considered if the formation, and membership, of collaborative groups, sometimes referred to as steering groups (e.g. Penker *et al*., 2013), was identified as an important element in the cooperation amongst key actors for the successful tackling of barriers to, and drivers of, agro-ecological transitions. The diversity of actors who might be included in such collaborative groups would depend upon the scope of the dilemma and sustainability issues they sought to tackle.

The composition of a collaborative group can range from single actor membership (e.g. mainly comprising farmers), to mixed actor membership including, for example, farmers, landowners, advisors, value chain actors, conservationists (NGOs), local administrations and community representatives. A number of studies emphasise the role and importance of an intermediary or champion in successful agri-environmental initiatives. Such a person acts as a broker with the remit and ability to bring together actors from different sectors to build coalitions with common objectives to enable collaboration (e.g. Matzdorf *et al*., 2014).

The cases studied range from almost no cooperation (e.g. farmers market produce individually), to coordinated actions with loose links between farmers and other stakeholders, and collective actions in which substantial changes in system institutions (e.g. formal rules) or governance changes occur and cooperation should be very close.

The role of coordinated and collaborative approaches in the transition to agro-ecological farming systems is based upon the assumption that these actions are needed to overcome key barriers. Several factors could determine the levels of cooperation, such as which actors do not even consider some forms of cooperation as a way to overcome some barriers, explained by immature social capital.

The factors for success in cooperation were reviewed in the context of other studies on collective action. The short overview of selected key factors was based on studies of Ostrom and the OECD (Ostrom, 1990; Ostrom, 2005; Ostrom, 2010).

Examples of factors for success are:

- Communication is well established or developing (e.g. there should be a “place to meet”, which can be difficult if actors are distributed nationally).
- Apportionment of outputs of cooperation (i.e. there should be clearly defined ownership and share of the outcomes between actors).
- Number of actors (e.g. the greater the number of actors the more difficult it can be to agree on cooperation).
- Similarity of interest (if actors have very different interests, the cooperation is not easy to establish).
- Change in property rights (the more property rights are influenced by changes the more demanding is to agree on cooperation, for example sharing facilities with a high risk of losing shared funds is more difficult than to agree on sharing knowledge).
- Reciprocity (e.g. if cost/benefit sharing is not fair and not pursued by a coordinator from the outset, the cooperation would face difficulties in being successful).
- Good coordination, which is a key factor for success in collective actions.

In coordinated actions, some of the factors listed above are unlikely to occur in full (e.g. clear apportionment of outputs, changes in property rights), but their relevance could increase if the level of cooperation deepens over time.

The cooperation level was assessed in each case study in relation to the barriers of transition. Proposed changes in cooperation were collected from the case studies, and assessed for their implications for the strategies to address the barriers to transitions.

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2.5. Introduction to the Case Study Context for Co-constructing Transition Strategies

The case studies in UNISECO were conducted in 15 European countries. They operate at different spatial levels (from NUTS 3 to that of whole countries), and focus on different productions systems, sustainability issues and dilemmas. Each of the case studies identified a key dilemma to be addressed in the analysis of how to enhance the sustainability of the farming systems. The case studies are at different stages in transition pathways and consist of some cases where the focus of the co-construction process was on initiating transitions, and in others it was on enhancing transitions.

The case studies are differentiated based upon the transition levels defined by Gliessmann (2007), and the use of a generalised adaptation of transition stages. Past studies have shown that the transition stages are rarely sequential stages (e.g. Padel *et al.*, 2020). This also applies to the case studies in UNISECO. Agroecosystem redesign did not necessarily follow from efficiency or substitution measures. For example, in the Swedish case study transitions were initiated by directly moving towards redesigning a more complex mixed-farming system. The generalised adaptation of the transition stages reflects the heuristic nature of the classification and suits the purpose of the co-construction process to initiate or enhance transitions, and to consider the differences between incremental and transformational change.

The meanings of case studies focusing on Initiating and enhancing transitions are as follows:

Initiating: Case study focused on how to initiate transition in a conventional system by implementing mainly incremental changes in farming systems.

Enhancing: Case study focused on enhancing transitions in systems that already implement agro-ecological practices, through transformational change of the redesign of the farming system and / or enhancing transitions to food systems level.

The case studies are differentiated into those in which the principal issues of sustainability are socio-economic (CZ, ES, LT, LV, RO), environmental (CH, DE, FI, FR, HU, IT, SE) or socio-economic and environmental (AT, GR, UK) in nature. Case studies in which the main issues of sustainability are socio-economic nature focussed on enhancing transitions. Amongst the socio-economic issues of sustainability, the economic viability of the farm was the most common concern, followed by issues of biodiversity, soil quality and water related issues.

Summaries of the assessment of the social-ecological system of each case study are provided in Section 4, with descriptions of the barriers and drivers to be addressed in the transition strategies.

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Table 2. Overview of UNISECO Case Studies, adapted from Prazan et al. (2019).

Country Code	Case Study	Scope	Main Farming System	Dilemma	Transition Stage
AT	Mitigation of climate change by humus formation in arable farming (Ökoregion Kaindorf)	Local	Arable and livestock	How to tackle impacts from climate change (e.g. water stress), increase carbon sequestration in soils, prevent soil degradation and reduce soil fertility loss while maintaining or improving the farm's social and economic sustainability and contributing to climate change mitigation.	Initiating
CH	Intensive animal farming (Lucerne Central Lakes Region)	Local	Livestock	How to reduce the high animal densities and at the same time remaining profitable against the backdrop of important path dependencies (barn constructions, depths, up- and downstream market, knowledge system).	Initiating
CZ	Arable land management on organic dairy farms (Vysočina Region)	Sub-national	Livestock	How to maintain the good performance of arable land management in organic dairy farms in Vysočina region to reduce arable soil degradation and water pollution by pesticides while ensuring economic viability.	Enhancing
DE	Developing strategies for agro-ecological transition in arable farming systems (Nienburg County, Lower Saxony)	Local	Arable	How to integrate agro-ecological practices on arable land in highly market-oriented farming systems to reduce biodiversity loss and water pollution without significant negative impacts on the economic viability of farms.	Initiating
ES	Agro-ecological farming systems (Basque Country and Navarra)	Sub-national	Mixed	How to reduce the fragility of agro-ecological farms while maintaining the social, economic and environmental sustainability.	Enhancing
FI	Planning a dairy sector driven bio-product plant (Nivala)	Local	Livestock	How to reduce harmful climate, soil and water impacts of dairy farming in Nivala region without sacrificing economic viability of the dairy sector, by means of envisioning and implementing a multipurpose bio-product plant along the lines of circular bioeconomy, with the aim of producing bioenergy and organic fertilizers from manure.	Initiating
FR	Connecting CUMAs to foster adoption of agro-ecological practices for viticulture (Auvergne Rhône Alpes)	Sub-national	Permanent crops	How to reduce dependency on external fertilisers and to reduce pesticides use (especially glyphosate) through agro-ecological practices increasing soil ecological services (soil biology) while maintaining the economic profitability of farms.	Initiating
GR	Collective implementation of alternative plant	Sub-national	Permanent crops	How to sustain the long-term economic viability of farms whilst protecting the natural resources? How to protect biodiversity and water quality in	Initiating

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	protection practices in peach trees (Imathia)			orchards whilst also improving competitiveness and market access.	
HU	Soil conservation farming	National	Arable	How to integrate agro-ecological practices on arable land in highly market-oriented arable farming systems to maintain and improve soil quality without significant negative impacts on the economic viability of farms.	Initiating
IT	Diversifying specialised winegrowing areas (Chianti Biodistrict)	Local	Permanent crops	How to promote cropping system diversification in a highly specialised and market-oriented winegrowing area via the adoption of agro-ecological practices, to increase biodiversity and improve landscape management while maintaining the profitability of farming through local value chains.	Enhancing
LT	Small scale dairy farmers and cheesemakers	National	Livestock	How to maintain and encourage extensive management (grazing) of grassland habitats? How to become (or remain) competitive in the market without intensifying the farming practice.	Enhancing
LV	Organic dairy farming	National	Livestock	i) How to increase the economic viability of conventional and organic, largely grass-based, dairy farms while preserving biodiversity in grasslands and water resource quality; ii) How to ensure that all organic milk is processed into organic dairy products.	Enhancing
RO	Hotspot of biodiversity and healthy food (Transylvania)	Sub-national	Mixed	How to increase the economic viability of small-scale farming while preserving the cultural landscape and biodiversity.	Enhancing
SE	More food from ruminant farms	National	Livestock	What are the challenges and possibilities to diversify specialised ruminant farms to include more crops for direct human consumption, while simultaneously integrating more agro-ecological principles to enhance sustainability performance in an economically strained production sector?	Initiating
UK	Mixed farming and general cropping (North-east Scotland)	Sub-national	Mixed	Producing public goods whilst maintaining viable production of private goods, and securing economic and social sustainability at a farm level.	Initiating

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3. RESEARCH METHODS AND DATA

3.1. Overview of Research Design and Integration within the Overall Project Concept

The specific objectives of the co-construction of transition strategies at the case study level can be synthesised as follows:

- **To analyse drivers and barriers enhancing or hindering agro-ecological transition** taking account of interdependencies between these and the complexity of interactions and processes between actors within the social-ecological systems examined.
- **To analyse how cooperation between actors within and engaging actors outside the social-ecological system** can help to address the key drivers and barriers.
- **To co-construct strategies with key actors of the agro-ecological transition proposing actions and required governance changes** that foster the implementation of agro-ecological practices in EU farming systems.

To achieve those objectives, the research questions for co-constructing transition strategies in UNISECO were targeted at the case study level, focusing on the key dilemma for each case (which corresponds to the Focal Action Situation in the social-ecological systems analysis) and its particular context. The analysis of the local context was in recognition of the need to understand the range of potential agro-ecological practices, impacted upon by different barriers and drivers, and involving a variety of types of actors, embedded in various institutions that can diversely interact at different scales. Specific contexts of the case studies provide useful examples of the dynamics between different barriers and drivers of implementing different practices, and how to address those in different strategic pathways.

The co-construction of the transition strategies built on several project steps is summarised in Figure 1.

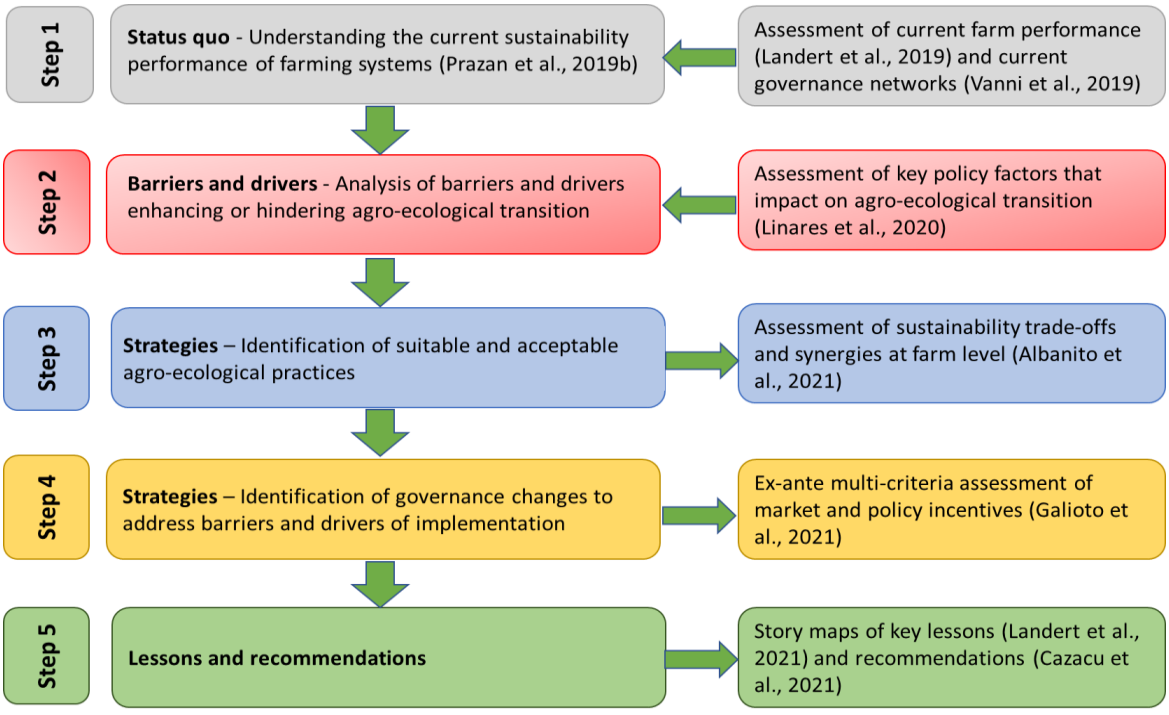

Figure 1. Co-construction of transition strategies in UNISECO

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Step 1: Based on the **adapted social-ecological systems framework** developed by Guisepelli *et al*. (2018) each case study carried out a **status quo assessment** to understand the current sustainability performance of the farming systems (step 1), and the barriers which make the transformation towards agro-ecological farming systems difficult or impossible. Data for the social-ecological systems assessment were collected through interviews and workshops with actors, from existing databases (e.g. FADN data), projects, and publicly available data for the regions concerned. Where appropriate, use was made of the results of the sustainability assessment using the Decision Support Tools (Landert *et al*., 2019a, b), and the social network analysis (Vanni *et al.,* 2019). The methodological approach for the social-ecological systems assessment is explained in detail in Prazan *et al*. (2019a), which also provided guidance to ensure consistent data collection across the case studies, including questions to be asked of different actors involved in the social-ecological system; ii) how partners should store the data collected; iii) explanations and examples of how to prepare and upload story maps in ArcGIS (Prazan *et al*., 2019b). The story maps were designed to present the summary of results of the assessment of each social-ecological system for public audiences, farmers, and key actors in agro-ecological transitions.

Step 2: The social-ecological systems assessment was the basis for identifying key **barriers and drivers** of agro-ecological transitions. It structured the enquiry into why certain barriers and drivers could be addressed, why in other systems certain barriers and drivers could not be overcome, and to improve the understanding of the interdependencies between different barriers and drivers (step 2). The analysis of barriers and drivers was also informed by the participatory assessment of existing policy instruments with the case study MAPs, and how these impact on agro-ecological transitions (Linares *et al*., 2020).

Step 3: In the first part of the co-construction of the **transition strategies,** a **set of agro-ecological practices** was identified with farmers and advisors as being suitable for implementation in the farming systems of the local case study (step 3). Phone and online interviews were carried out with a small number of farmers (representing farms for which the status quo assessment was done with the DSTs), and advisors who were also members of the multi-actor platforms. Summaries of the results of the status quo assessment of the farm performances were provided to the interviewees as a basis for discussing selected agro-ecological practices. To further facilitate the discussion with farmers and advisors, candidate agro-ecological practices were selected by the case study partners that, from a research perspective, have the potential to improve the performance of farms of the case study farming system.

In line with the typology of agro-ecological practices developed by Prazan and Aalders (2019), based on Wezel *et al.* (2014), each case study partner provided a list of candidate practices and resulting farm management changes and trade-offs that are of particular interest and importance for the project. Each case study partner then provided a summary table with a list of selected innovative agro-ecological practices including information on the:

- Type of agro-ecological practices;
- Scale of agro-ecological practices;
- Resulting changes in farm or land management;
- Trade-offs and synergies in performance.

The participatory assessment of the potential changes in farm management and trade-offs and synergies, undertaken with the farmers and advisors, provided a basis for the subsequent quantitative trade-off analysis with the DSTs (see Albanito *et al*., 2021 for more details).

Step 4: The agro-ecological practices identified provided a farm level context of specific practices that could initiate or enhance agro-ecological transitions of the farming systems if the barriers and drivers of their implementation were addressed through **changes in the governance** of the farming system (step 4).

The proposed changes in governance build on information on: i) the actors with roles in addressing a barrier or driver; ii) how these actors could cooperate to support the implementation of agro-ecological

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practices; iii) the changes in formal and informal rules which are required to facilitate the desired cooperation (both internally between the key actors in the farming system, and externally with actors influencing the settings of the farming system).

The implementation of the agro-ecological practices can be promoted through changes in market institutions and external policy-related rules (e.g. changes in regulations and laws), and market and policy incentives, the latter of which is assessed in Galioto *et al*. (2021).

The process of co-construction of strategies was developed at a case study level. Each case study partner prepared a summary of the barriers and drivers identified that needed to be addressed in the transition strategies, and of the key actors and their roles. Due to the COVID-19 pandemic, co-construction workshops which were planned to take place with all participants in the same venue, were substituted by interviews, online meetings in small groups and online workshops involving farmers, advisors and other members of the Multi-Actor Platform.

The barriers and drivers selected for the co-construction of the transition strategies were explained to the participants in the workshops, together with why they could not be addressed in the farming system previously, and why they had been selected (i.e. the potential for being addressed through the transition strategies). Each case study partner prepared a list of examples of possible innovative market and policy incentives, taking into account the results of assessments of existing instruments. These provided a basis of discussion with participants to identify and agree on candidate incentives that could contribute to addressing the barriers and drivers, and for promoting the implementation of the agro-ecological practices.

Table 3 provides an overview of the guiding questions that were discussed in the interviews and workshops carried out in the co-construction of the transition strategies in the case studies (Steps 3 and 4 in Figure 1).

Table 3. Guiding questions and expected results for the co-construction process with stakeholders

Dimension	Questions
PRACTICES	• Q1 - Which agro-ecological practices are suitable for implementation in the case study farming system? (Which practices are not suitable, and why?)
	• Q2 - What are the expected farm management changes and what are the potential implications for the environmental, economic and social performance of the farms?
	• Result: Short list of practices with rationale (expected benefits for farm performance) and explanation of the expected resulting farm management changes and potential trade-offs and synergies in farm performance
GOVERNANCE: Actors	• Q1- Which actors should be involved in addressing the barrier(s) and driver(s)?
	• Q2- What is their expected role, and which actions can be done by and with whom?
	• Result: Roles of the key actors and actions identified that address the barrier / driver
GOVERNANCE: Cooperation	• Q3 - How can cooperation amongst these actors help to address the barrier(s) / driver(s)?
	• Q4 – What informal and formal rules of cooperation are suitable and feasible?
	• Result: Analysis of forms of cooperation approaches from coordination to collective actions, related rules, and insights on social capital in different socio-economic, cultural and policy contexts
GOVERNANCE: Markets & policy	• Q5 - What changes in market institutions address the barrier(s) / driver(s)?
	• Q6 – What changes in external policy related rules and policy incentives help address the barriers and drivers?
	• Result: Identification and understanding of the potential of changes in market institution and policies to facilitate cooperation and agro-ecological transitions in different local contexts

The overall aims of the interviews and workshops were to:

i) discuss ideas about how cooperation can be initiated or strengthened (e.g. through actors in the social-ecological systems, or through external actors such as government agencies);

ii) address the barriers and drivers;

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iii) explore the roles of intermediaries in bringing together different actors and how existing trusting relationships can facilitate the process

iv) identify informal and formal rules of cooperation (e.g. formation and membership in producer associations, regional associations or individual planning of activities).

Particular attention was paid to changes in market institutions and vertical cooperation across the value chain to generate added value for farms producing agro-ecologically, and to changes to external policy-related rules such as laws and regulations (e.g. to reduce the bureaucratic burden of farmers).

The focus of the co-construction was on identifying and agreeing strategic pathways that reflect different key actions and changes in governance that can foster implementation of agro-ecological practices. Such practices had to be feasible from the different perspectives represented in the Multi-Actor Platforms so as to achieve the buy-in of key actors within the local socio-economic, cultural and policy contexts of each case study.

The outputs of the co-construction process was a **table of the transition strategies** (see Sections 4.1 to 4.15 for each case study) which includes the set of agro-ecological practices, key barriers and drivers and the strategic pathways by which they can be addressed. Each case study partner has provided a more detailed report, the structure of which follows the key elements of the transition strategies as indicated in Table 3, and provide the basis for the cross-case analysis of the barriers and strategies in Sections 5 and 6.

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3.2. Engagement and Data Collection with the Multi-Actor Platforms in the Case Studies

The co-construction of the transition strategies was likely to be most effective if farmers (representing the farms for which the sustainability assessments were made), and members of the Multi-Actor Platform, who covered the range of key actors of the case study farming system, were all involved in the process. Amongst the invitations to participate were key actors identified in the social network analysis (Vanni *et al.,* 2019), but who had not been part of the case study Multi-Actor Platform. Easy to read summaries of key results of the previous tasks and MAP engagements in the case studies were provided before the interviews and workshops. These were to facilitate effective discussions between the different types of actors (with their different levels of knowledge about the case study work and results).

Engagement with the Multi-Actor Platforms was carried out in two main parts, each of which reflect the practice and governance dimensions of the transition strategies (Table 3). Initially both parts were meant to be handled within a single co-construction workshop. However, the approach had to be adjusted, and flexibility was given to case study teams, in terms of the timing and form of engagement to account for availability, technical and health issues during the COVID-19 pandemic.

Guidance was provided to case study partners on how to carry out online engagements to co-construct the transitions strategies with the Multi-Actor Platforms most effectively (Schwarz *et al.,* 2020). The guidance covered:

- Planning and preparing online engagement;
- Planning and running the workshop;
- Assigning and fulfilling roles and facilitating during the workshop;
- Reminders to participants of the rules of engagement for the online workshop;
- Use of chat box and other tools for engaging participants;
- Handling any lack of active participation;
- Feedback and evaluation of the engagement with the Multi-Actor Platforms.

There was active engagement of participants in all of the online activities. However, there is the possibility that some discussion may not have been as in-depth in the online engagements as would have been possible at workshops held *in situ*.

The first part of the engagement with the Multi-Actor Platforms (Practices, Table 3) was by telephone or online interviews with farmers and advisors. The recommendation was to involve at least 3 to 5 farmers and 1 to 2 advisors (see Table 4 for an overview of the number of interviewees). The interviews could be done individually or in small groups to provide flexibility in terms of responding to differences between, or and limited availabilities of, farmers and advisors. If farmers and advisors were comfortable using online communication tools, such as Skype or Zoom, then it was recommended they be used instead of the telephone, so enabling the sharing of screens and joint the collaborative working functions of the tools. Few interviews could be conducted *in situ* due to the specific COVID-19 rules and laws of the country or region.

The second part of the engagement was on the topic of governance (Table 3). This used online workshops with the case study with the Multi-Actor Platforms, which included farmers, advisors, value chain actors, NGOs, local and regional authorities and administrations and government ministries. The aim was to involve as many of the types of key actors as possible who have an influence on addressing the dilemma of the case study. Subject to the availability of farmers and advisors, the case study teams ensured that farmers and advisors who were involved in the interviews and discussions of the agro-ecological practices also participated in the workshop of the governance dimension of the strategies.

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To increase the potential contributions by all attendees, the recommended approach was for discussions in small groups, followed by a plenary meeting of all participating members of the Multi-Actor Platforms. The dates of the two parts of the activity could be on the same or separate days.

- OPTION 1: Individual interviews with farmers and advisors on agro-ecological practices followed by a workshop with the Multi-Actor Platform including plenary and break-out sessions;
- OPTION 2: Individual interviews with farmers and advisors on agro-ecological practices followed by workshops in small groups and a plenary workshop with the Multi-Actor Platform.

Table 4 provides an overview of the engagement with the Multi-Actor Platforms and data collection methods used in the 15 case studies. Table 5 summarises the distribution of the types of actors, using the classification developed by Vanni *et al*. (2019), who were engaged in the co-construction of the transition strategies.

Table 4. Case studies: overview of data collection methods.

Country Code	National Case Studies	Option	Data Collection
AT	Mitigation of climate change by humus formation in arable farming (Ökoregion Kaindorf)	1	7 interviews (5 farmers, 2 advisors) followed by a workshop with 8 MAP members
CH	Intensive animal farming (Lucerne Central Lakes Region)	1	8 interviews (6 farmers, 2 advisors) followed by a workshop with 11 MAP members
CZ	Arable land management on organic dairy farms (Vysočina Region)	2	7 interviews (5 farmers, 2 advisors) followed by 2 meetings with small groups and a workshop with 9 MAP members
DE	Developing strategies for agro-ecological transition in arable farming systems (Nienburg County, Lower Saxony)	1	5 interviews (4 farmers, 1 advisor) followed by a workshop with 9 MAP members
ES	Agro-ecological farming systems (Basque Country and Navarra)	1	4 interviews (3 farmers, 1 advisor) followed by a workshop with 8 MAP members
FI	Planning a dairy sector driven bio-product plant (Nivala)	1	4 interviews (3 farmers, 1 advisor) followed by a workshop with 9 MAP members
FR	Connecting CUMAs to foster adoption of agro-ecological practices for viticulture (Auvergne Rhône Alpes)	2	9 interviews (5 farmers, 4 advisors) followed by 2 meetings with small groups and a workshop with 12 MAP members
GR	Collective implementation of alternative plant protection practices in peach trees (Imathia)	1	4 interviews (4 farmers, 2 advisors) followed by a workshop with 6 MAP members
HU	Soil conservation farming	1	1 workshop with 10 MAP members
IT	Diversifying specialised winegrowing areas (Chianti Biodistrict)	1	13 interviews (8 farmers, 5 advisors) followed by a workshop with 12 MAP members
LT	Small scale dairy farmers and cheesemakers	1	6 interviews (4 farmers, 2 advisors) followed by a workshop with 9 MAP members
LV	Organic dairy farming	1	5 interviews (5 farmers) followed by a workshop with 14 MAP members
RO	Hotspot of biodiversity and healthy food (Transylvania)	1	5 interviews (3 farmers, 2 advisors) followed by a workshop with 12 MAP members
SE	More food from ruminant farms	2	2 workshops with 10 and 26 MAP members
UK	Mixed farming and general cropping (North-east Scotland)	2	8 interviews (8 farmers) followed by 2 engagements with 5 MAP members

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Table 5. Case studies: overview of engagement of different types of in the co-construction of the strategies (legend of the types of actors provided at the foot of the table.)

Country Code	Case Studies						
AT	Mitigation of climate change by humus formation in arable farming (Ökoregion Kaindorf)	5	(2)		3		
CH	Intensive animal farming (Lucerne Central Lakes Region)	11			2	1	2
CZ	Arable land management on organic dairy farms (Vysočina Region)	5		1	2		3
DE	Developing strategies for agro-ecological transition in arable farming systems (Nienburg County, Lower Saxony)	4	1		2	1	3
ES	Agro-ecological farming systems (Basque Country and Navarra)	3	1		2	2	1
FI	Planning a dairy sector driven bio-product plant (Nivala)	3	3		3		
FR	Connecting CUMAs to foster adoption of agro-ecological practices for viticulture (Auvergne Rhône Alpes)	9			10	2	
GR	Collective implementation of alternative plant protection practices in peach trees (Imathia)	2	1		2		1
HU	Soil conservation farming	2	1		4		3
IT	Diversifying specialised winegrowing areas (Chianti Biodistrict)	9	2		5		2
LT	Small scale dairy farmers and cheesemakers	5		(1)	3		3
LV	Organic dairy farming	5			2	2	4
RO	Hotspot of biodiversity and healthy food (Transylvania)	3			2	3	2
SE	More food from ruminant farms	10	12		3	3	
UK	Mixed farming and general cropping (North-east Scotland)	8					

Values in parenthesis () are of the number of farmers who are also directly involved in value chain activities (e.g. AT) or joint producer-consumer organisations (e.g. LT).

The legend of the icons and types of actors from Vanni *et al*. (2019) is:

Farmers

Agri-food value chain

Consumers

Science, innovation, advisory, capacity building

NGOs, civic society organisations, local community representatives

Authorities and Administration

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4. THE CASE STUDIES

This section provides a short summary of the case studies as the basis for the cross-case analysis reported in Sections 5 and 6. This overview includes the key dilemma, a schematic overview and narrative of the SES, the barriers and drivers identified and analysed, and an overview of the key elements of the co-constructed strategies to address those.

4.1. AT - Ecoregion Kaindorf

KEY DILEMMA: HOW TO TACKLE IMPACTS DUE TO CLIMATE CHANGE, INCREASE CARBON SEQUESTRATION IN SOILS, PREVENT SOIL DEGRADATION AND REDUCE SOIL FERTILITY LOSS FROM ARABLE LAND WHILST MAINTAINING OR IMPROVING THE FARM'S SOCIAL AND ECONOMIC SUSTAINABILITY AND CONTRIBUTION TO CLIMATE CHANGE MITIGATION.

The main challenges and **sustainability issues** in the Ökoregion Kaindorf (i.e. Ecoregion Kaindorf) are the decrease in soil fertility and climate altering greenhouse gas emissions and loss of biodiversity caused by intensive agricultural practices. The "humus farmer" concept has the potential for increasing sustainability and contributing to the transition towards agro-ecological farming systems. The concept is implemented outside the region by more than 250 farms in Austria. Almost 20% of humus farmers are managing their farms organically with few farms having established a close relationship with customers through direct marketing. The humus farmer concept has internal and external limitations which require a wider interpretation and understanding of the **boundaries of the social-ecological system.** Its boundary is extended beyond the farm gate to capture and analyse the interactions and contributions of the key actors identified for overcoming the barriers to agro-ecological transitions through the implementation of humus farming.

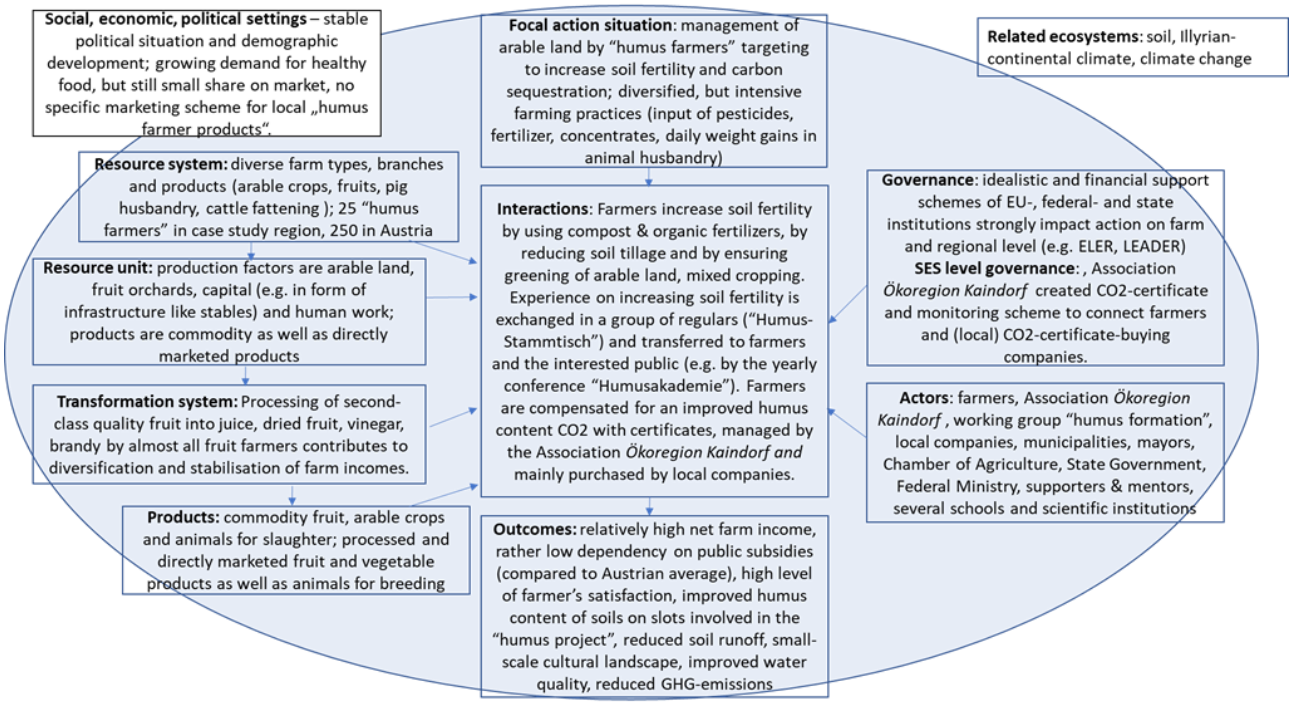

Figure 2. Overview of the social-ecological system - Austrian case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

Farms in the Ökoregion Kaindorf manage arable land and fruit orchards (RU), producing arable crops and fruits, with livestock of mainly pig husbandry and cattle fattening systems (R). On-farm processing is common amongst fruit producing farms (T). Farms applying the humus farmer concept exchange

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experiences of improving soil quality at regular meetings, the aim of which is to transfer the concept to other farmers and to raise awareness of the concept amongst interested members of the public (consumers) (I). Farmers are compensated for an improved humus content, with CO_2 certificates purchased mainly by local companies. The process is managed by the association Ökoregion Kaindorf (G). The founders of the association quickly realized that the possible success of the overall initiative and the working groups (e.g. humus) depends on sufficient resources, and individual persons who drive the different agendas and progress. Local municipalities provided a basic budget of 10 Euros per inhabitant per year. This enabled the initiative to hire personnel who could focus on what was described as the key challenge and dilemma. However, the participation of wider society, entrepreneurs, associations, science and farmers is required for the initiative to achieve a more widespread adoption of the concept (A). Although there is a high level of trust between the participating humus farmers, relationships between actors are better described as rivalry than cooperation (A).

The humus farmer concept investigated in the case study has been shown to have internal and external limitations. These hinder the adoption of the concept on farms with intensive agricultural practices, and thus hinder the initiation of agro-ecological transitions on those farms and the more wide-spread adoption at farm and regional level respectively. Initially, large amounts of compost (50 to 100m^3) were applied to experimental plots and arable land. Problems quickly arose regarding nitrate leaching, for which the farmers had to pay fines under a water regulation. This problem was mitigated in cooperation with research, since nitrogen is present in stable compounds in the compost and especially in the biochar. However, a very high level of carbon enrichment in the soil through the spreading of compost is not appropriate, since medium and heavy soils in the region have a risk of leaching from a humus content of above 4.5% to 5%, above which N mineralization rises sharply.

A barrier to successful carbon sequestration is **insufficient knowledge** of the soil and humus system amongst farmers. Various activities were carried out to counter this, notably on-farm research and experimental projects on soil fertility, and essential research knowledge collected and provided to farmers through information and training. Important findings on soil fertility and carbon sequestration are exchanged in a monthly group of regulars (“Humus-Stammtisch”). Of particular importance is the **positive influence of committed humus farmers**. Multiplication then takes place, primarily between "humus farmers" and farmers, which is seen by many actors as more successful than multiplication by an advisory service or research community. However, there is an issue regarding the **lack of agro-ecological knowledge in official advisory services**. The Agricultural chamber could have a significant positive impact on the agro-ecological transition, but has been a hindrance to this in the larger region(s) and in Austria in general (although with exceptions, such as the Soil and Water Protection programme in Upper Austria). However, the local branch of the Agriculture chamber has been cooperating more recently, but often views the Humus-working group as competition. The increasing pressure to adapt to the effects of climate change means that more farmers are considering an agro-ecological transition (i.e. a de-intensification of agricultural practices).

Another key barrier relates to **cooperation between actors**. Although soil protection is a major issue in Austrian agriculture, many actors in agriculture are still sceptical, or the relationships between actors are more defined by rivalry than cooperation. This was highlighted between conventional and organic agriculture, and is also apparent between different initiatives and organisations.

Research and science continue to be involved in the humus activities of the eco-region. However, such is not free of friction. People from the eco-region have repeatedly referred to the challenge posed by "silo thinking" of science, and that research lacked **insufficiently system-oriented approaches** to cover the complex topic of humus formation. The interviews with scientists also indicated – albeit only weakly – that those responsible struggle to accept other scientific opinions.

The Association manages the CO_2 certificates for compensating farmers, but a more target-orientated promotion of humus formation is required through agricultural policy, especially the Austrian agri-

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environmental program ÖPUL. Measures are needed to provide a clear strategy to promote humus formation (for both agricultural systems, conventional and organic). Among the actors of the SES, a considerable majority were in favour of an improved incentive scheme to support the building up of humus. The ÖPUL was described as **insufficiently results oriented**.

Table 6 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 6. Key barriers and drivers to be addressed in the transition strategy in the Austrian case study

Type of Barrier / Driver	Barrier / Driver
Social – institutional	• Lack of cooperation and rivalry between farmers and between different organisations
Technological	• "Humus farmer"-concept refers to single field plots • Risks linked to composts from urban organic waste due to contamination of the bio-waste with other types of waste
Knowledge	• Limited knowledge about agro-ecological practices and lack in (system) knowledge of farmers • Lack of agro-ecological knowledge in official advisory services • Lack in practice relevant research
Policy-related	• Agricultural policy measures not well targeted to results with respect to agroecology and environmental sustainability issues • Driver: EU research integrating farmers (e.g. EIP-AGRI, H2020 research and innovation projects)

*Characteristics of **transition strategies** identified*

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the members of the Multi-Actor Platform, involving farmers and different actors who can influence the decisions of farmers to implement agro-ecological practices (AE practices). The objective of the co-constructed transition strategy was to address the social, technological, knowledge and policy-related barriers of initiating an agro-ecological transition through a more wide-spread adoption of the humus farmer concept to raise soil humus content, and the soil fertility of arable and perennial soils in the Ökoregion Kaindorf and more widely in Austria. Strategic pathways on **strengthening knowledge networks and cooperation, supporting humus formation at systems level urban waste management and improved action research** were proposed to address the different social, technological and knowledge related, and policy related barriers.

The strategic pathways identify key actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers, the changes envisaged in cooperation and the governance of the social-ecological system, and the changes in market institutions and policy instruments that have the potential to support the transition process. The pathways and elements of the transition strategies are summarised in Table 7.

Although pathways have been co-constructed to address different bundles of barriers, it is recognised that the different transition barriers are not independent of each other, and need to be addressed jointly to enable a successful agro-ecological transition. It will be challenging to implement all parts of the strategy. However, major improvements in soil fertility systems can be expected if even only some parts of the strategy can be implemented.

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Table 7. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Austrian case study

Suitable Agro-ecological Practices	Site-specific seed and year-round greening options, Reduced (plough less) tillage with mulch or direct sowing methods, Use of compost from urban organic waste, Establishing agro-forestry systems, Integrated Plant Protection and blacklist hazardous pesticides			
Strategic Pathways	**Strengthening knowledge networks and cooperation**	**Supporting humus formation at systems level**	**Improving urban waste management**	**Improving action research**
Barriers / Drivers of Implementation to be addressed	Limited knowledge about agro-ecological practices Lack of innovation of farmers and lack in (system) knowledge of farmers Lack of cooperation and rivalry between farmers Lack of agro-ecological knowledge in official advisory services	"Humus farmer"-concept refers to single field plots *Multiplication effects in case of positive experience*	Risks linked to composts from urban organic waste due to contamination of the bio-waste with other types of waste ((e.g. plastics, batteries).	Lack in practice relevant research *EU research integrating farmers (e.g. EIP-AGRI, H2020)*
Actors Required in the SES to Address Barriers	Farmers Advisors, Agricultural schools	Association Ökoregion Kaindorf	Farmers Public organic waste management	Agricultural research Farmers
Changes Envisaged in Cooperation and Governance of the SES	Establish more innovative knowledge networks with an (agro-ecology) advisor as an intermediary (from the Ökoregion and Agricultural Chambers) Introduce a farmer-to-farmer approach as shown by the Upper Austrian Soil and Water Protection	No cooperation needed as it is an internal process	Foster a reduction in the level of problematic materials in urban organic waste	Establish closer relationship to practice research and integration of research questions for sustainable soil management and agro-eoclogy
Changes Envisaged in Market Institutions	None	Improvements to the CO_2 certification scheme	None	None
Policy Instruments to Support the Transition	CAP II PILLAR – Advice and training Official Advice (Chamber of Agriculture, Organic Association "Bio Austria") Upper Austrian Soil and Water Protection CAP II PILLAR - Agro-environmental measures: Organic farming	Soil organic carbon certification Ökoregion Kaindorf	Soil organic carbon certification Ökoregion Kaindorf	No Market and Policy Instrument for research on practices, and improvements in integration of EU research Upper Austrian Soil and Water Protection

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4.2. CH - Intensive Animal Farming in the Lucerne Central Lakes Region

KEY DILEMMA: HOW TO REDUCE THE HIGH ANIMAL DENSITIES AND AT THE SAME TIME REMAINING PROFITABLE AGAINST THE BACKDROP OF IMPORTANT PATH DEPENDENCIES (BARN CONSTRUCTIONS, DEPTHS, UP- AND DOWNSTREAM MARKET, KNOWLEDGE SYSTEM).

The case study area "Lucerne Central Lakes Region" with a pre-dominant share of grasslands (66% of the agricultural area) and features a long history of animal husbandry such as milk, beef, and pork production.

Previous research suggests that reducing animal densities is a crucial element to mitigating negative environmental impacts of water quality and biodiversity. However, this means that decades long, officially supported, development of increasing animal production intensity needs to be reversed. In turn, this requires a change in the knowledge system and that farmers and the local food industry find new ways to use the existing infrastructure for new production and processing activities.

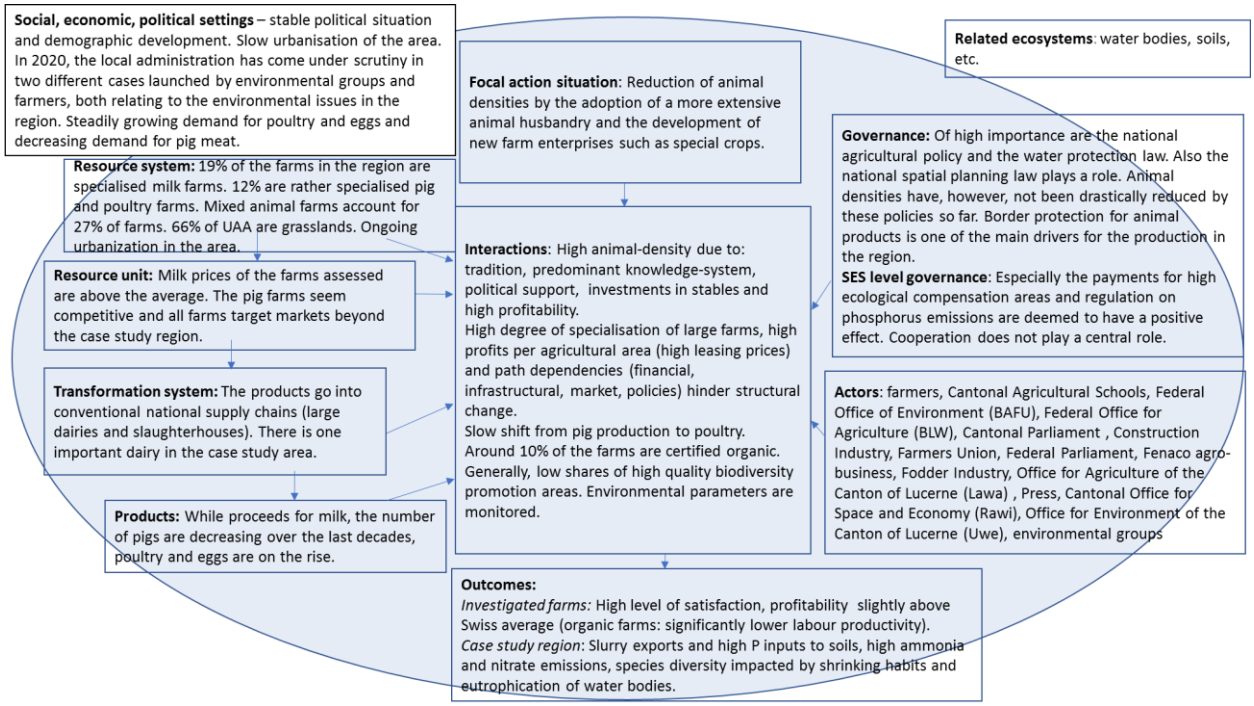

Figure 3. Socio-ecological system of the Lucerne Central Lakes case study are. (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

Animal husbandry (R) plays a crucial role in the region, accounting for 70% of the approximately CHF 1 billion value of regional agriculture per year. Nineteen percent of the farms are specialised milk farms (RU), 12% are specialised poultry and pig farms, and 27% are mixed farms (R). Despite the high price pressure on, for example milk, the region has proved to be more resilient due to the traditional knowledge system related to animal husbandry and the high degree of specialisation (I). However, the consistently high densities of animals have significant effects on the environment (ECO), such as nutrient excess in lakes and harmful ammonia emissions.

The agriculture in the region is geared towards national, larger supply chains (TS), and the share of organic farms is below the national average (I). The system is mainly governed by the national agricultural policy and enforced by strong border protection enabling domestic animal products to compete with the

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international market (G). The cantonal legislation also impacts agriculture by limiting P emissions to a certain extent (G). However, farmers are fiercely contesting a revision to this legislation (S).

Environmental groups, which are not among the most powerful actors in the region (A), have filed a case against the local administration arguing that it did not enforce the environmental regulation in the region (S). This situation will only change in small steps since various local actors (A) stress that reducing animal densities is difficult if the profitability of the current system is as high, and that alternatives, such as special crops, are not economically competitive.

This also leads to one of the main barriers of transition, which is the **high economic importance**, for farmers and for the rural economy as a whole. For the latter, three different strategic pathways have been identified: (1) either directly extensifying the system by e.g. a conversion to organic, (2) including new farm enterprises (such as special crops) or (3) increase direct marketing to be able to extensify the system thanks to a higher value added or to make new farm enterprises economically more attractive.

With regard to the first strategic pathway, one barrier is that there is **market saturation** for certain products (such as pig meat) which makes conversion to organic economically impossible for those products. In general, the uncertainty in sales is high for labelled products: in 2018, one of the two large retailers in Switzerland (Coop) suddenly decided to buy 50'000 less animal welfare- certified pigs (Coop Naturafarm) on the Swiss market. On the other hand, actors agreed that organic products are generally suitable for direct marketing, which creates synergies between two of the three strategies. Although there is a market saturation for some organic products, in general, the market of organic products is growing which is perceived as driver for the transition and stresses the need for the farmers to receive informative market reports to identify organic products with market potential.

When it comes to the second strategic pathway (new farm enterprises), one barrier is the **traditional knowledge system** of the region which is heavily focussed on animal husbandry. While there are advisory services being offered e.g. with regard to special crops, it is being perceived by actors as less accessible then advisory on animal husbandry. Another barrier is that farmers need to be convinced about the added value of alternative crops. However, it is difficult to identify new farm enterprises, which have the potential to substitute intense animal production economically. Yet, with decreasing meat consumption in Switzerland, there is a potential external driver for the transition towards a region with a lower animal density.

With regard to the third strategic pathway (direct marketing), there is the barrier that with an increasing number of on-farm shops in a village, the more competition there is and after a while, a certain **saturation** with regard to the number of on-farm shops is reached. Additionally, food safety regulations are perceived as a barrier to transition since it causes **administrative burden and requires a lot of knowledge**. Also, actors perceive direct marketing as uncertain with regard to the amount which can be sold through that channel. On the other hand, and similarly to the decreasing demand for meat, **consumer awareness is rising** for the agro-ecological farming in the region, which is a driver for future direct marketing.

Table 8 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

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Table 8. Key barriers and drivers to be addressed in the transition strategy in the Swiss case study

Type of Barrier /Driver	Barrier / Driver
Social – normative / cognitive	• Traditional knowledge system of the region which is heavily focussed on animal husbandry
Knowledge	• Lack of know-how with regard to alternative farm enterprises • *Driver: Increasing consumer awareness for the agro-ecological farming in the region*
Economic	• Low labour productivity and lower profitability of farms with fewer livestock • Market saturation for on-farm direct marketing
Policy-related	• New food safety laws and enforcement (high administrative burden)

*Characteristics of identified **transition strategies***

The co-constructed strategy for the agro-ecological transition aims at defining a shared perspective and pathway to the transition amongst local actors to address the dilemma of the case study. Key characteristics of the co-constructed strategy include a menu of relevant agro-ecological practices, that reflect a re-design of the conventional livestock farming system, the actors to be involved, and how they can cooperate to address the barriers to, and drivers of, the transition as well as changes in market and policy instruments that have the potential to support the transition process.

Table 9 summarises the proposed main characteristics of the co-constructed strategic pathways for an extensification of the livestock systems through **conversion to organic farming**, **diversification with new farm enterprises** and an **increase in direct marketing** for higher value added to make new farm enterprises economically more attractive. While specific characteristics of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 9. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Swiss case study

Suitable Agro-ecological Practices	Organic farming (including extensification of animal husbandry)	Diversification through permanent crops such as fruit, berries, nuts, wine and conversion to arable farming	
Strategic Pathways	**Conversion to organic agriculture (including extensification of animal husbandry)**	**Diversification with new farm enterprises**	**Increasing direct marketing**
Barriers / Drivers of Implementation to be addressed	Market saturation – organic market Sales uncertain of labelled products Low labour productivity and lower profitability of farms with less livestock Organic products well suited for direct marketing Increased demand for organic products	Lack of know-how with regard to alternative farm enterprises Low labour productivity and lower profitability of farms with fewer livestock Slowly decreasing meat consumption	Market saturation for on-farm direct marketing New food safety laws and enforcement Sales uncertainty Consumer awareness of the benefits of agro-ecological farming is rising
Actors Required in the SES to Address Barriers	Farmers, Organic producer organisation, Federal state Retail, Public administration (permits for on-farm direct marketing and processing), RegioFair (platform for organic products)	Famers, Advisory Services, Regional marketing initiatives Consumers Farmer schools Contracted workers Producers	Farmers, FARMY (online platform), Agri-Tourism institutions, Advisory Service Regional food processing industry, Consumers, Media, Farmers association, Federal state
Changes Envisaged in Cooperation and Governance of the SES	The organic producer organisation informing farmers where there is still demand; long term sales guarantees, and capabilities to advertise to consumers RegioFair is a good platform for niche products	Collective marketing berries/fruits/nuts Farmers could cooperate with marketing initiatives such as the Alpomaten Advisory Services support farmers marketing. Advisory Services and farmers schools could place more emphasis on alternative farm enterprises and collaborate with a network of innovative farms Farmers could work off-farm to compensate for the loss of income; the potential for this approach could be increased by engaging contracted workers Discussion of strategies at roundtable events for farmers including both, public and private advisory services	Farmers without on-farm marketing could provide products to already existing on-farm direct marketers Farmers could work together in tourism, or host events to create synergy effects with direct marketing Advisory services could provide more help to farmers on how to comply with the law when doing processing on-farm Farmers association and advisory services promote media relations of farmers
Changes Envisaged in Market	More sales security for labelled products, e.g. through long term contracts	Regional labels (such as RegioFair) need more support in the form of promotion events to	Promotion of existing regional marketing initiatives Changes in spatial planning to - enable direct

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Institutions	Increase added value, e.g. using dual purpose breeds Implement awareness raising campaigns for increasing the consumer demand Market bulletin by the organic farmers organisation	increase consumer awareness Implement awareness raising campaigns for increasing the consumer demand	marketing and on-farm processing Commonly run shops to sell local produce Establish more subscription models (such as vegetable-basket Current farm tours organized by farmers associations and advisory services could be extended to the target group of consumers
Policy Instruments to Support the Transition	Federal state should promote special crops (to compete with imports), closed nutrient cycles and fodder crops Promotion of closed nutrient cycles Advertisements to increase demand Financial incentives to reduce stocking densities Restrictions on livestock intensity	Financial incentives / restriction to stop high animal density farming Modified training curriculum which places more emphasis on special crops Support to establish a network of innovative farms for training purposes Extend advisory services on topics of special crops Climate label Tax on CO_2 intensive products	Support for collective on-farm marketing infrastructure Support for setting up (Agri-)-Tourism Offer coaching to farmers interested in direct marketing Climate label Support for media training for farmers by advisory services and farmers association

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4.3. CZ- Dairy Farms in Vysočina region

KEY DILEMMA: HOW TO MAINTAIN THE GOOD PERFORMANCE OF ARABLE LAND MANAGEMENT IN ORGANIC DAIRY FARMS IN VYSOČINA REGION TO REDUCE ARABLE SOIL DEGRADATION AND WATER POLLUTION BY PESTICIDES WHILE ENSURING ECONOMIC VIABILITY

The main sustainability issue behind this dilemma was identified as the economic fragility of the farming system, mainly stemming from lower economic efficiency than in conventional farming, and unstable price premiums for organic milk and milk sales in general. It implies a danger of reconversion of some farms to conventional farming and the potential loss of the improved environmental performance on arable land which has already been achieved.

Other pillars of sustainability were found to be satisfactory (living conditions are socially acceptable and organic farms have better environmental performance than conventional).

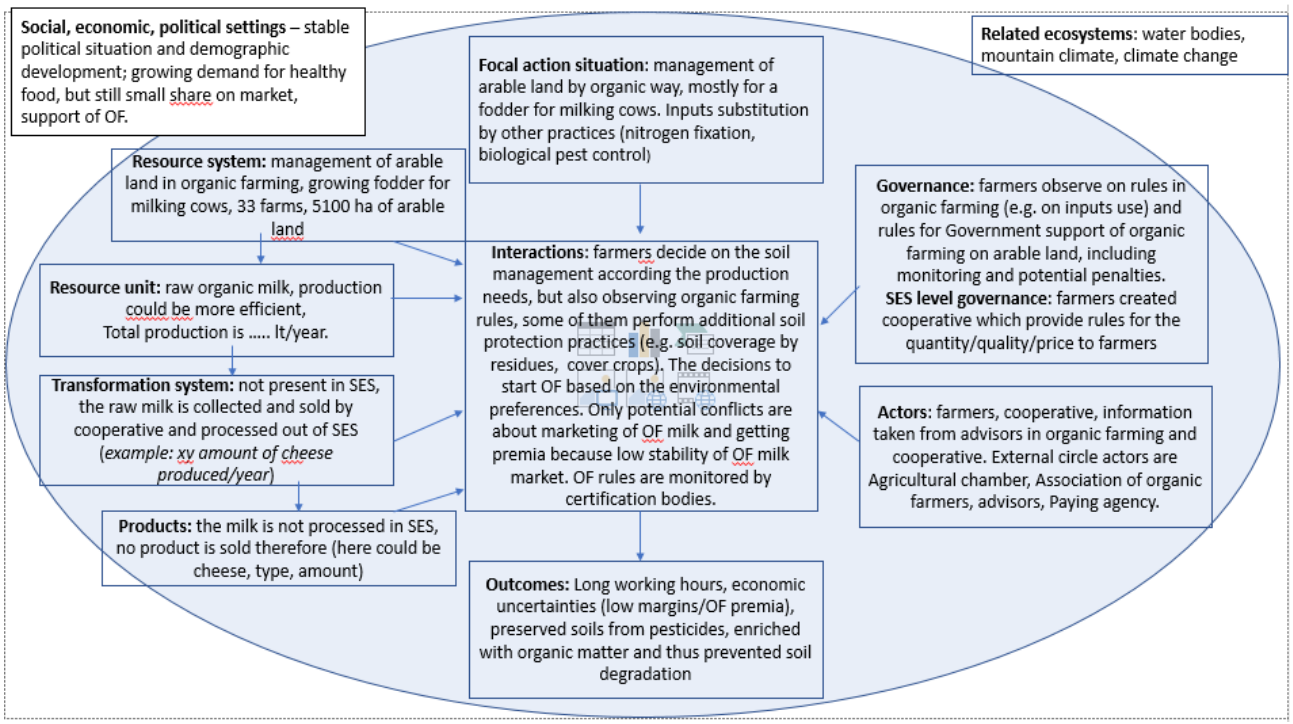

Figure 4. Overview of the social-ecological system - Czech case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

Over recent decades, some conventional farms have gone through a transformation to organic farming. Organic farmers produce fodder on arable land (R) for milking cows. The main commodity is raw organic milk (RU), the processing is limited (T) and currently not important for the sustainability of the system. The key actors are farmers (A) who decided to create cooperative (33 members) in order to increase the level of stability in the price premiums they can obtain for organic milk, so overcoming a key barrier of economic fragility. However, willingness for cooperation is between farmers quite weak and is limited only to common sales (I), which are coordinated by a strong leader of a cooperative (A). This means there is a very low level of information exchange and low social capital. Internal governance is based, mainly, on cooperative rules (G) so ensuring milk quantity, and supported by external rules for milk quality. This external governance is provided by milk processing units, which are independent external actors (apply quality checks and pay according to the quality levels). The key rule for the cooperative is the distribution of

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revenues according to milk quality and based on the average price received from different dairies across the national territory (G). The cooperative accumulated capital to buy milk from its members and then sell it to dairies under contract. Other external rules are applied under organic farming certification and compliance checks under CAP policies.

The **weak economic sustainability** of organic farms, and related reasons, are ongoing barriers to transition. Another barrier is the **gap in farmer knowledge** about how to produce more efficiently on organic land, and how to improve their sustainability. This is explained by a **low willingness to cooperate** which was expressed by the statement of one farmer, "Our cooperative was created only for common sale and not for other purposes!" A similar barrier is that of the **attitude of employees of large farms** who usually follow conventional practices, and whom it is difficult to persuade to change. The cooperative does not use the potential to promote behavioural change.

There is a general barrier of **low access to land** which is not specific to organic farming. However, the effect on organic farming is that when organic farms lose access to land it can be difficult to keep it protected against influences of conventional practices in the neighbourhood (e.g. pesticides drifts). Small farms in particular have to overcome a barrier of **difficulties to invest to meet all organic standards** (e.g. to build or renew stables). Other levels of investment are not high and can be managed by most of the farms.

Other barriers were regarded as marginal to the main sustainability issue. Access to organic seeds and fodder is gradually improving, exceptions to which could be provided under a certification system. An issue raised by farmers was one of inhabitants not accepting them in the village. This does not appear to influence directly the main barrier to transition, or to sustain the stage reached in the transition towards agro-ecological farming systems.

Table 10 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 10. Key barriers and drivers to be addressed in the transition strategy in the Czech case study

Type of Barrier /Driver	Barrier / Driver
Social – normative / cognitive	• Limited willingness to cooperate • Employees of large farms do not have right attitude and have difficulty in learning or changing their attitudes
Social - institutional	• Low and limited access to land
Knowledge	• Lack of knowledge of agro-ecological practices and their benefits
Economic	• Fragile economic sustainability and lack of added value from production systems with agro-ecological practices • Difficulties with sales and logistics

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices, focussing on different forms of cooperation. The objective of the co-constructed transition strategy is to address the social, knowledge and economic barriers of enhancing an agro-ecological transition of organic dairy farms to strengthen their economic sustainability. Different strategic pathways on **improving market access and added value**, **enhancing knowledge and cooperation** and **improving access to land** are proposed that address these barriers.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the

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potential to support the transition process. The economic barriers were identified as being of particular importance to be overcome.

Table 11 summarises the proposed elements and pathways of the transition strategies. While specific characteristics of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 11. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Czech case study

Suitable Agro-ecological Practices	On arable land: No pesticides, no chemical fertilisers, reduction of cash crops in favour of fodder crops improving soils (e.g. clover)		
Strategic Pathways	**Improving market access and added value**	**Enhancing knowledge and cooperation**	**Improving access to land**
Barriers / Drivers of Implementation to be addressed	Fragile economic sustainability (not stable contracts with dairies, hence no guaranteed sales and milk price premiums) Difficulties with sales and logistics (some farms are scattered across the national territory)	Lack of knowledge to farm more efficiently Employees of large farms do not have the right attitude and have difficulty in learning or changing their attitudes	Lack of access to land
Actors Required in the SES to Address Barriers	Farmers, cooperative Dairies, traders	Farmers, cooperative Advisors, dairies, research centres	Farmers, cooperative Land owners
Changes Envisaged in Cooperation and Governance of the SES	Increase in cooperation between farmers in a cooperative (currently limited). When the cooperation matures it could have the capacity to attract other actors, who could become part of SES (e.g. joint venture with dairies or traders with milk)	Increase in the cooperation between farmers in a cooperative (currently limited), designing a strategy for knowledge sharing. Shared decision to attract advisors from whom farmers can learn, and changing attitudes of employees	Increase in cooperation within a cooperative to design a common approach towards land owners (e.g. showing advantages of renting land to organic farmers), and ensuring land quality. This could be carried out as a common campaign at a regional level
Changes Envisaged in Market Institutions	Market chain integration (involvement of some dairies in the SES, with new contracts inside the SES with new actors) Increase processing, obtaining added value and having contracts directly with local or regional consumers or retailers Better contracts could be agreed by increasing the effectiveness of the logistics	New rules concerning sharing knowledge and the financial means to pay external advisors	Changing property rights (e.g. increase the property rights of farmers by educating land owners on the benefits of renting land to organic farmers)
Policy Instruments to Support the Transition	Enabling producer groups to sell milk to traders, not only to processors Introducing rules in the public procurement of purchasing some minimum share of organic goods	Introducing innovative ways of supporting the provision of advice, including support for the design of organisational innovation under EIP Agri	Introducing new rules in renting the land and ensuring the maintenance of soil quality

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4.4. DE - Developing Strategies for Agro-ecological Transitions in Arable Farming Systems in Nienburg County, Lower Saxony

KEY DILEMMA: HOW TO INTEGRATE AGRO-ECOLOGICAL PRACTICES ON ARABLE LAND (CONVENTIONAL AND ORGANIC) IN HIGHLY MARKET-ORIENTED FARMING SYSTEMS TO REDUCE BIODIVERSITY LOSS AND WATER POLLUTION THREATS WITHOUT SIGNIFICANT NEGATIVE IMPACTS ON THE ECONOMIC VIABILITY OF FARMS.

The Nienburg County in Lower Saxony comprises an intensive agricultural area with **sustainability issues** relating to biodiversity loss and water pollution. The case study area is adjacent to intensive livestock regions with high land prices, the latter of which particularly exposes farmers to a high degree of economic market pressures. The German case study provides an example of the analysis of what is required to initiate a transition process to agro-ecological farming in cases of highly market-oriented farming with low level of agro-ecological innovation. Initiating agro-ecological transitions in arable farming systems in the Nienburg County requires a wider interpretation and understanding of the **boundaries of the social-ecological system** beyond the farm gate to capture and analyse the interactions and contributions of the key actors identified to overcome the barriers to agro-ecological transitions

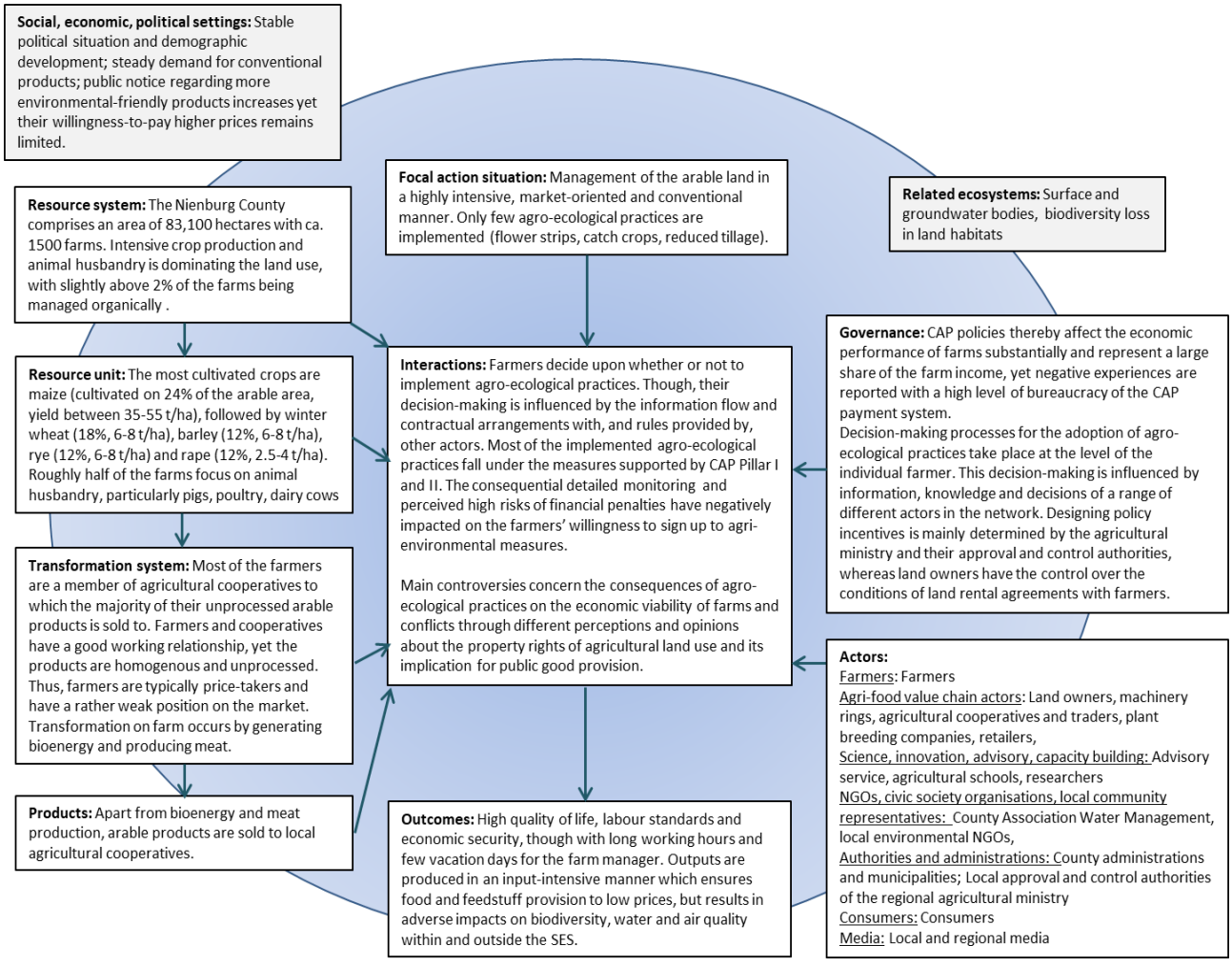

Figure 5. Overview of the social-ecological system - German case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

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Barriers *and* ***drivers*** *of transition*

Farms are mainly conventional, implementing few agro-ecological practices, and are at the beginning of a transition process to agro-ecological farming. Arable land (R) is the dominant agricultural land use in the case study area. Farms produce crops are for food, feed and energy (R), and the main commodities are maize, winter wheat, winter barley, winter rye and winter rape (RU). Crop outputs are sold unprocessed to local agricultural cooperatives, and livestock is mainly sold to large meat processors (T). The key actors are farmers (A) who decide whether or not to implement agro-ecological practices. Cooperation exists, in particular, with respect to water quality, with the involvement of farmers, advisors, waterworks and water management associations. In addition, cooperation exists on actions with limited direct connection to agro-ecological practices, but which have impacts on the economic dimension of the case study dilemma. These include the share of machinery, and the exchange of substrate, manure and crop products. Their decision-making process on adopting agro-ecological practices is driven by their understanding of nature and nature protection and its integration in farm business aspects (I).

The decision-making process of farmers is influenced by the information flow and contractual arrangements with, and rules (G) provided by, a range of different actors (A). These include actors providing advice and promoting capacity building, value chain actors that include landowners, plant breeders, retailers, consumers, NGOs and local community associations representing environmental concerns and interests of specific groups. The set of actors also includes local and external regional administrations and authorities responsible for the implementation of policy, and monitoring policy measures and the legal framework of agricultural land management (A). The level of trust between farmers and the advisory services is often high, providing a good basis for enhancing the exchange of information and knowledge on the adoption of agro-ecological practices. The main property rights system reflected in governance arrangements of the land use in the SES concerns the ownership of land. Landowners have control over the conditions of land rental agreements with farmers. External rules of the CAP payment system and regulations govern the role of the CAP in the implementation of agro-ecological practices (G).

Barriers to agro-ecological transitions are the **attitude of farmers towards agro-ecological farming** and their **beliefs of environmental sustainability issues**. These attitudes originate from **traditions of conventional practices** and strong market orientation, that create an unwillingness to adopt agro-ecological practices. Biodiversity loss is perceived as being less of a problem than the economic viability of the business, which is reinforced by uncertainty about whether their individual actions might positively impact biodiversity. The attitude and beliefs of farmers towards agro-ecological farming practices and environmental sustainability issues are also driven, in part, by gaps in the knowledge of the range of agro-ecological practices that suit a particular farm, and the benefits of the practices. The barrier of **gaps in agro-ecological knowledge** of farmers (A) is explained by low levels of cooperation, low levels of implementation of agro-ecological practices, and a lack of awareness of their benefits and opportunities for funding and sources of suitable advice.

Another important barrier to transition is a **concern over losing access to land** (G), if agro-ecological practices are implemented that might reduce the economic value of agricultural land. This fear is explained by the control landowners have over the conditions of land rental agreements with farmers. Often, the main goal of landowners is to secure the economic value of the agricultural land. They can restrict what farmers can grow and how they manage the land. The significance of this barrier is increased by the scarcity of agricultural land due to its use for non-agricultural purposes, and demand from intensive livestock systems in adjacent areas.

Lack of added value from production systems with agro-ecological practices are a barrier to economic transition. Current channels of processing and trading do not identify arable crops that were produced on farms that implement and follow agro-ecological or sustainability principles (other than organic farming certification). As a consequence, there are no market incentives or remuneration for “additional” agro-ecological benefits certified by a specific standard (G). Negative experiences of a **high level of bureaucracy**

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of the CAP payment system, detailed monitoring at a level of a square metre, and perceived high risks of financial penalties have all negatively impacted on the willingness of farmers to sign up to agri-environmental measures supporting the adoption of agro-ecological practices (G). Instead, there is increased interest in learning more about, and consequently trial initiatives outside, the CAP framework.

Table 12 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 12. Key barriers and drivers to be addressed in the transition strategy in the German case study

Type of Barrier / Driver	Barrier / Driver
Social – normative / cognitive	• Beliefs of environmental sustainability issues. • Attitude of farmers towards agro-ecological farming
Social - institutional	• Risk of losing access to land due to the conditions of land rental agreements
Knowledge	• Knowledge of agro-ecological practices and their benefits
Economic	• Lack of added value from production systems with agro-ecological practices
Policy-related	• Bureaucracy of policy support and control mechanisms associated with support for implementing agro-ecological practices

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the members of the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices, focussing on different forms of cooperation. The objective of the co-constructed transition strategy is to address the social, knowledge, economic and policy-related barriers of initiating an agro-ecological transition in market-oriented arable farming systems. Different strategic pathways on **setting up and strengthening knowledge networks**, **engaging landowners in agro-ecological transitions**, **creating markets**, **generating added value,** and **increasing the effectiveness of policy support** are proposed. Key changes in governance of the proposed pathways are: i) formal knowledge networks of farmers with trusted and trained agro-ecology advisors as a local permanent network manager to address combinations of social and knowledge barriers; ii) regional food associations; iii) food policy councils and school programmes to address economic barriers; iv) result-based payments to address policy-related barriers.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 13 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 13. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the German case study

Suitable Agro-ecological Practices	Reduced tillage, crop diversification (beyond EU Greening requirements), strip cropping, intercropping, precision/single seeding			
Strategic Pathways	**Setting up and strengthening knowledge networks**	**Engaging landowners in transitions**	**Creating markets and generating added value**	**Improving the effectiveness of policy support**
Barriers / Drivers of Implementation to be addressed	Attitude of farmers towards agro-ecological farming Beliefs of environmental issues Limited knowledge of agro-ecological practices and their benefits	Risk of losing access to land due to the conditions of land rental contracts	Lack of added value from production systems with agro-ecological practices	Bureaucracy of policy support and control mechanisms associated with support for implementing agro-ecological practices
Actors Required in the SES to Address Barriers	Farmers Advisors, agricultural schools, Local Network Manager	Farmers Land owners, local and regional authorities, advisors	Farmers Agricultural traders, (local) retailers, consumers, advisors, schools, local and regional authorities	Farmers Authorities and administration, advisors, Local Network Manager
Changes Envisaged in Cooperation and Governance of the SES	Formal knowledge networks of farmers with trusted and trained agro-ecology advisors as a permanent, local, network manager and intermediary in a practice-policy-science nexus Trusting relationships between some farmers and advisors facilitate the network development Peer-to-peer engagement through farmers already involved in cooperation	Due to the legal framework of land rental contracts, agreements with landowners are required. Proposals for coordination and moderation led by local and regional authorities Education and awareness raising of benefits of agro-ecological practices to land owners (including new generation of urban based land owners)	Regional food association and food policy councils with memberships of farmers and the listed key actors Creating processing infrastructure for agro-ecological products (including malthouses and roasting facilities) Cooperation between farmers and schools to educate, and to enhance public awareness	Formal knowledge networks of farmers with trusted and trained agro-ecology advisors as a permanent, local, network manager and intermediary in a practice-policy-science nexus Involve trusted peers (farmers) in the monitoring and controlling of policy measures
Changes Envisaged in Market Institutions	Not directly applicable	Not directly applicable	Direct sales via farmers' markets or local caterers and food retailers Supply of local produce to public canteens and schools Introduction of AE trading standards	Not directly applicable
Policy Instruments to Support the Transition	Results-based approaches, advice, information and training Support for implementing and educating local network managers Support to enhance the technical know-how of the advisors and controllers	Tax reduction for landowners to compensate for opportunity cost and enhance their willingness to enable implementation of agro-ecological practices	Regional labels and certification Regional and rural development plans Public procurement and school programmes Regulation for enhanced biodiversity standards in value chain	Result-based approaches to enhance the flexibility of implementation and controlling Support for implementing and educating local network managers Enhance the technical know-how of the advisors and controllers

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4.5. ES - Agro-ecological Farming Systems in the Basque Country and Navarra

KEY DILEMMA: HOW TO REDUCE THE FRAGILITY OF AGRO-ECOLOGICAL FARMS WHILE MAINTAINING SOCIAL, ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY

The Spanish case study is located in the regions of Basque Country and Navarra, and is based on the experience of the farms that are part of EHKO association. These farms include a wide range of production types, sharing the objectives of promoting agro-ecology. Those objectives are organic farming systems with crop diversification and additional environmental practices, local marketing with short marketing channels, and principles of solidarity economy and small farms. The farmers in the case study are already in the re-design stage of the agro-ecological transition. The key **sustainability issues** to be addressed are the fragile social and economic sustainability of the farming systems. Due to this fragility, the proportion of conventional farmers who consider implementing changes towards an agro-ecological transition is low. The case study sought to support farmers at the re-design stage of agro-ecology to encourage those who are still in conventional systems to successfully enter and progress on the transition pathway. With the Multi-Actor Platform, transition strategies were co-constructed which aim to provide pathways to support local, organic and small sized rural farms.

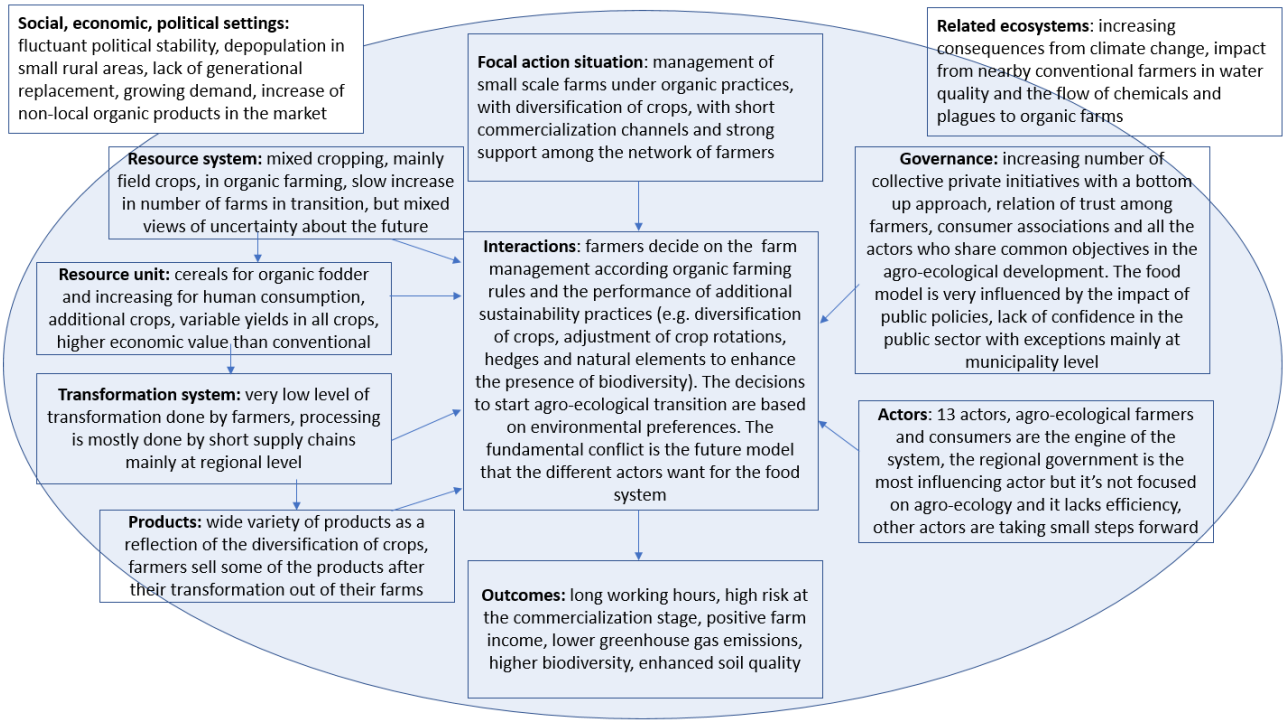

Figure 6. Overview of the social-ecological system - Spanish case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

A general systems based sustainability approach (environmental, social and economic) is addressed by the farmers of the case study (Focal action situation), in which the main reasons for farmers to start agro-ecological transition are environmental preferences (I).

One of the obstacles to begin the transition is the initial fear of change. There is a **psychological barrier** due to farmers not knowing what they are facing and the process which will be required. Producers feel helpless and the lack of institutional support creates a sense of loneliness (G and A). This fear is reduced by networking, and when synergies and collaboration with other farmers occur. Associations such as the EHKO

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have played a fundamental role in overcoming this initial barrier, enabling different actors to meet and share their experiences (Focal action situation and G).

Another barrier for farmers during the agro-ecological transition stage is the **lack of technical knowledge and advice**, for example on the substitution of fertilizers and phytosanitary products, good soil management, knowledge of which varieties are most appropriate, and effective pest management. In the case of organic cereal crops, weeds and pests control is a very important aspect for which farmers find little support (I and R). Educational institutions responsible for training agronomists and conducting research are not yet responding to the part of society that is demanding organic food (G and A). Farmers in an advanced stage of agro-ecology have overcome the lack of knowledge through their own experimentation, based on trial and error, despite the time required and associated economic losses (I). Knowledge transfer and the establishment of relations and trust amongst farmers has helped to improve results. In this way, the input substitution achieved by agro-ecological farmers in the case study, together with other practices, have contributed to lowering greenhouse gas emissions, and improve biodiversity and soil quality (O).

Agro-ecological farmers with mixed cropping, mostly field crops in organic farming (R), implement very low levels of transformation. The processing mostly takes place in short supply chains often at a regional level (T). The **lack of organization and infrastructure** in the commercialization chain has been identified as a major barrier for the system (T and P). For several crops, after the transformation process, the products return to the farmers who then participate in the distribution and marketing stages, often on their own (P). This means that to get the same benefit as a conventional farmer, agro-ecological farmers have to spend longer time due to the requirement for them to participate in different tasks (O). At this stage, farmers need to group together to be more influential. However this may cause conflicts between agro-ecological farmers who want to continue with a multi-functional profile, and those who decide to be producer only, leaving the processing, distribution and marketing to other companies (I).

Generally organic products have a higher economic value than conventional ones (RU). They are experiencing a growth in demand (S), with customers willing to pay a higher price. But that value is different depending on the type of product. Cereal is a primary input with low visibility in the final product (such as bread for human consumption or fodder for organic livestock) and therefore has a lower added value than other products which can be easily identified (for example, vegetables) (P).

Crop diversification partially helps to overcome economic barriers (R), since some crops compensate for a loss of value in another product in a specific year (e.g. loss of harvest of an entire crop due to late frosts) (ECO). The reduction in production costs, the higher price of products, and public aid through the CAP, compensate for the loss of production compared to conventional production.

There is an increasing number of collective private initiatives for the promotion of agro-ecological transitions through a bottom up approach (G). Relationships have been established, and there is a high degree of trust amongst farmers, consumer associations and actors who have common objectives. However, the food model is greatly influenced by the impact of public policies, which are not focused on agro-ecology and generally lack efficiency. This creates an overall lack of confidence in the public sector, with exceptions mainly at a municipality level, where there have been some positive experiences. In the public sector farmers face barriers in the **complexity of bureaucratic paperwork**, administrative management and regulatory compliance, and in the lack of flexibility for their adaptation to small-scale projects.

Several external factors affect agro-ecological farming systems (S). From the socio-economic perspective, depopulation in small rural areas, and the difficulties to land access, are having an adverse impact on rural development and generational replacement. Moreover, there is increasing competition between locally produced products and national and international products. From the environmental perspective, climate change, which is having increasing consequences on farm management and economic performance, is a major challenge for all farmers (ECO). Furthermore, nearby conventional farmers create negative impacts on water quality and the flow of chemicals to organic farms.

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Table 14 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 14. Key barriers and drivers to be addressed in the transition strategy in the Spanish case study

Type of Barrier /Driver	Barrier / Driver
Social – normative / cognitive	• Psychological aspects including fear, isolation or loneliness, especially of farmers who start the transition • Negative attitudes towards, and low awareness of, the benefits of agro-ecology
Social - institutional	• Weak social structure and organisation of the agro-ecological sector • Limited access to land for new farming entrants and problems of generational replacement
Knowledge	• Lack of technical knowledge and advice (for example on the substitution of fertilizers and phytosanitary products, good soil management)
Economic	• Lack of financial and investment conditions and insufficient economic support • Undeveloped value chain, and thus individual management of post-harvest activities and high workload
Policy-related	• Bureaucracy of policy support, and lack of regulatory flexibility

*Characteristics of identified **transition strategies***

The co-constructed strategy for the agro-ecological transition aims at defining a shared perspective and pathway to enhancing the transition amongst local actors, to address the dilemma of the case study. The strategy includes a menu of relevant agro-ecological practices (AEPs) that reflect the comparatively advanced stage of agro-ecological transition, and proposes pathways to address the different social, knowledge, economic and policy-related barriers. Different strategic pathways on **strengthening farmers' cooperation and networks**, **supporting collectivization of services and infrastructures** and **Improving conditions of access to land** are proposed.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 15 summarises the proposed main characteristics of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 15. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Spanish case study

Suitable Agro-ecological Practices	Conversion to organic methods, use of local crop breeds/seeds, inclusion of legumes / N-fixing crops, intercropping, longer rotation, integrated biodiversity (with beekeeping), integrated biodiversity (with livestock), linear features (hedgerows)		
Strategic Pathways	**Strengthening farmers' cooperation and networks**	**Supporting collectivization of services and infrastructures**	**Improving conditions of access to land**
Barriers / Drivers of Implementation to be addessed	Negative beliefs about agro-ecology and fear to start the transition Weak social structure and organisation of the agro-ecological sector Lack of technical knowledge and knowledge of the benefits of agro-ecological practices	Lack of investment and insufficient economic support during transition Undeveloped value chain	Lack of access to land for new farming entrants Bureaucracy of policy support and lack of regulatory flexibility
Actors Required in the SES to Address Barriers (existing and new)	Farmers Farmers associations; advisory services; Agri-food value chain actors; public sector, researchers and schools; consumers	Farmers Agri-food value chain; private investors; public sector	Farmers Public sector
Changes Envisaged in Cooperation and Governance of the SES	Formal and informal networks established by actors with equal power relations and common interests. Once collective structures are established, other actors can be incorporated. Peer-to-peer mentoring for farmers in their first years Coordinated approach between authorities, research, advisory, educational/training institutions and farmers Training of advisory services and farmers to increase specialized and traditional knowledge in agro-ecology	Coordinated approach under the lead of regional authorities Collaborative projects across value chain actors, particularly between organic farmers, and to share machinery and infrastructure Collective structures for common post-harvest activities and develop sector Creation of collection and sale centres for small-sized organic farmers The role of the administration is to support these projects facilitating infrastructure and management	Facilitate transitions of farmers Improved understanding of government staff Bottom-up initiatives or proposals (from organic farmers) to better understand and adjust to their needs Farmer participation in political decision-making processes
Changes Envisaged in Market Institutions	Direct sales and contractual arrangements between value chain actors that generate added value of agro-ecological products	Use of existing market infrastructures (avoid duplication) Change of mentality or paradigm (local focus; Green Pact) needed with organic food and farmers better valued	Not directly applicable

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Policy Instruments to Support the Transition	Mentoring of transitional farmers providing psychological support Projects and initiatives creating collective structures and group skills (e.g. “Ekoalde”, “Cereal sorter group”, APPINA) Support for peer-to-peer mentoring to young farmers (and of all ages) providing technical support Creating substitution services to facilitate the participation of farmers	Farm investment support for the creation of private and public farm investment groups or funds “Ekoalde” small farm collection centre supported by Government of Navarra Public procurement and awareness initiatives with school and public canteens (public tenders for organic food)	Enhanced flexibility of regulations implementation and controlling of instruments Territorial farming contracts to improve access to land Land banks facilitating access to public or private land for new farming entrants

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4.6. FI - Planning a Dairy Sector Driven Bio-product Plant in Nivala

KEY DILEMMA: HOW TO REDUCE HARMFUL CLIMATE, SOIL AND WATER IMPACTS OF DAIRY FARMING IN THE NIVALA REGION WITHOUT SACRIFICING ECONOMIC VIABILITY OF THE DAIRY SECTOR, BY MEANS OF ENVISIONING AND IMPLEMENTING A MULTIPURPOSE BIO-PRODUCT PLANT ALONG THE LINES OF A CIRCULAR BIOECONOMY, WITH THE AIM OF PRODUCING BIOENERGY AND ORGANIC FERTILIZERS FROM MANURE.

The need to simultaneously mitigate and adapt to climate change, while feeding an increasing amount of people is a great challenge for people and science. Finland has declared that by 2035, the country should have transitioned to a carbon neutral model, which poses challenges for all sectors of the economy. It is envisaged that Finnish agriculture will recycle its nutrients better, cut its emission to air and to water, whilst also providing food for at least its current share of the Finnish diet.

In a country that treasures technological success stories, there is a will for engineering a solution that would fit the trends directing the future of agriculture, such as growth in farm size and automation. Converting agricultural by-products to biogas is not a new idea, but the societal context for it is evolving and increased attention is being paid on the transformation of the fossil fuel-based transport sector and fertiliser manufacturing. However, the current prices of fossil fuels are not sufficiently high to make the investments in these technologies economically attractive. While existing policies have sought to correct this problem, the majority of the technical potential that could cover the energy demand of agriculture is not yet utilised.

For improving understanding of barriers for development of novel biogas concepts, and recognising the lack of information considering aspects of biogas projects as one of the barriers to transitions in the case study area, the Finnish case study followed the plans and interacted with actors of a project to build a biogas plant with fertiliser production in the municipality of Nivala, which belongs to one of the most intensive regions of milk production in Finland. Thus, the main research question was how to reduce main **sustainability issues** such as harmful climate, water and soil impacts of dairy farming in the Nivala region without sacrificing the economic viability of the local dairy sector. This research question also recognises that the largest dairy company in Finland, and consecutive Finnish governments, have prioritised biogas projects for tackling such questions.

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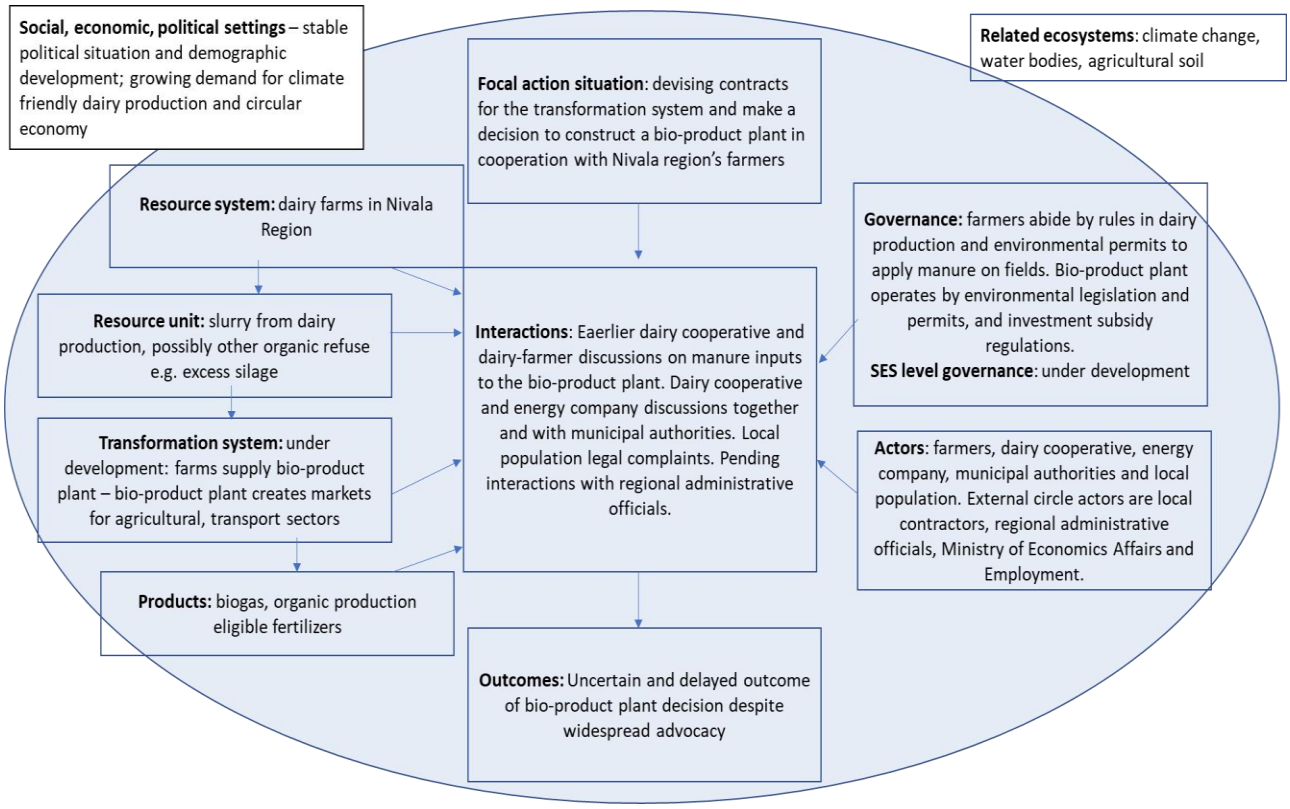

Figure 7. Overview of the social-ecological system - Finnish case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

The **economic incentives** for the participation of farmers were not clearly defined and the impact on the **economic viability** of farmers was unknown. While these could act as significant barriers for realising a biogas project, it was recognised that **uncertainties concerning the policies were a greater obstacle**.

Based on the interviews with stakeholders, there is evidence that the investment subsidy for constructing the plants has a key role since it accounts for a high share of costs. However, in the case of Nivala, the decision for the investment subsidy was positive, yet the construction did not happen, the subsidy application was withdrawn, and both the scale and the scope of the plant were re-evaluated. Some of the publicly contested aspects of the envisioned plant was its location in close proximity to the town centre, and the impacts on the water quality of the river running through the municipality. The decision of the regional environmental authorities regarding the environmental permit could have forced the relocatation of the plant, changing the economic and environmental fundaments of its concept.

The logistics of the plant for transporting the manure for the feedstock of the plant were to rely on direct pipelines from, and potentially back to, farms for the liquid fraction of the digestate from the plant. The feasibility of the pipelines depends on the close proximity between farms and the plant, which seems to have been a factor in the decision about the original location of the plant since few of the big farms interested in supplying manure were located nearby. The move in plant location might have damaged its profitability, and fighting to retain the original location might have damaged the reputation and the brand of the company. An in-depth account of the decision has not been published (as of April 2021), with some media coverage suggests the main reason is that of local public resistance.

Although local resistance might have halted the original concept, a new one has emerged. This second concept is based on another location for the plant, operation at an increased scale, and changes in the composition of the companies behind it. The reformulated concept would liquify the gas so enabling its use

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in heavier vehicles such as the milk transport trucks of the dairy company. This, and the increase in size of plant, seem to have led to the involement of the national energy company which specialises in natural and biogas delivery in Finland. However, this concept has not materialised, and the UNISECO interviews indicated that some farmers are starting to have doubts whether such plant would serve their interests. The joint venture which was launched with high expectations, is now delayed awaiting government decisions on investment subsidies. The waiting for the decisions on biogas subsidies was mentioned in many of the UNISECO interviews as a reason for postponing the decision-making, along with uncertainty of the demand for the end products demand.

Table 16 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 16. Key barriers and drivers to be addressed in the transition strategy in the Finnish case study

Type of Barrier / Driver	Barrier / Driver
Economic	• Economic valuation of manure input. • Unclear definitions and requirements of economic incentives for farmers to participate. • *Commercialization and added value from recycled nutrients (Driver)*
Policy-related	• Uncertainties about policy developments and available policy measures

*Characteristics of identified **transition strategies***

The overall objective of the co-constructed strategy is to address the economic and policy-related barriers of implementing a multi-purpose bioproduct plant, to reduce the environmental impact of agriculture by means of biogas plants that would include valorisation of the digestate nutrients to fertiliser products. This can be construed as substituting fertilisers manufactured from non-renewable sources with organic sources, and substituting fossil traffic fuels with by-product-based fuels. It entails a system level change that would affect how manure nutrients would be redistributed between farms. The approach could create conditions for linking the excess nutrients from the intensifying farm systems to the extensive systems, enabling economically feasible improvement of water quality without adverse impacts on the climate of such exchanges.

Table 17 summarises the proposed main pathways of the transition strategies on **improving economic valuation of manure input**, **supporting valorization of biogas digestates** and **creating a supportive and consistent policy framework for investments in biogas plants**. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful transition.

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Table 17. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Finnish case study

Suitable Agro-ecological Practices	Biofertilizer production		Biofuel production
Strategic Pathways	**Improving economic valuation of manure input**	**Supporting valorization of biogas digestates**	**Creating a supportive and consistent policy framework for investments in biogas plants**
Barriers / Drivers of Implementation to be addressed	Economic valuation of manure input	Commercialization and added value from recycled nutrients (Driver)	Unclear definitions and requirements of economic incentives for farmers to participate Uncertainty regarding future policy developments and policy measures
Actors Required in the SES to Address Barriers	Farmers Agri-food value chain, Authorities, Administration, Politicians	Farmers Agri-food value chain, consumers, Science	Farmers Authorities, Administration, Politicians and Science
Changes Envisaged in Cooperation and Governance of the SES	Deliberations between actors in the Agri-food value chain, Farmers, Authorities, Administration, Politicians	Collaboration, and research and development initiatives, amongst actors in the Agri-food value chain and Science	Lobbying, deliberation between Authorities, Administration, Politicians and Science
Changes Envisaged in Market Institutions	Not applicable	Not applicable	A more progressive policy scenario in which the incentives for biogas are strengthened
Policy Instruments to Support the Transition	Subsidy for applying organic fertilizers (part of the agro-environmental support scheme) Establishment of markets for circular economy products (e.g. fertilizer products)	Adjusting national implementation of the common agricultural policy to support the valorization of nutrient in the biogas digestate to fertilizer products	Allowing energy sales from farm biogas plants that have received investment subsidy to agriculture Energy investment subsidy for facilities in which 80% of the produced energy is sold out (30% to 40% of investment cost) Investment subsidy for rural enterprises (30% of investment costs) Investment subsidy to agriculture for on-farm use only (change from 40% to 50% of investment costs)

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4.7. FR - Connecting CUMAs to Foster the Adoption of Agro-ecological Practices for Viticulture in Auvergne Rhone Alpes

KEY DILEMMA: HOW TO REDUCE DEPENDENCY ON EXTERNAL FERTILISERS AND TO REDUCE PESTICIDE USE (ESPECIALLY GLYPHOSATE) THROUGH AGRO-ECOLOGICAL PRACTICES INCREASING SOIL ECOLOGICAL SERVICES (SOIL BIOLOGY) WHILE MAINTAINING THE ECONOMIC PROFITABILITY OF FARMS.

Given market pressures, farmers are not willing to take the risk of reducing economic sustainability by implementing practices that favour biodiversity and the environment which are often considered as less productive and more extensive. Environmental concerns expressed by society are increasingly perceived by farmers as an economic opportunity, providing them with access to new markets, and sometimes to achieve better value added. This trend is weak because the differentiation and the qualification of wines remains based on the notions of “terroir” (the place) and the certification of origin (Protected Denomination of Origin, Protected geographical indication certifications). The multi-level governance is efficient for policy implementation and marketing strategies; however, there are insufficient link between these levels.

The case study is network based, involving several French farm machinery cooperatives (CUMAs) which aims to work together. An innovative aspect of the case study is the aim to interconnect different territorial groups. The process of building this network has commenced. Some farmers sell grapes to cooperatives, and others do on-farm wine processing and direct sales. The farming practices are currently conventional with the extensive use of pesticides, although already with lower doses than recommended by pesticide suppliers. Locally, some farmers are already implementing agro-ecological practices, but the majority of farmers intend to start implementing agro-ecological practices such as the use of green manure, to reduce the level of use of external fertilisers, and of combined cropping to reduce pesticides use (vine shrubs and other crops).

The network was launched by the regional federation of CUMAs which will act as an extension service and facilitators to farmers involved in the CUMAs. The level of cooperation between farmers at a local level is very high which shoul;d aid the process of developing the networks. Reducing the use of pesticides or chemical fertilisers is not easy, with most farmers face technological lock-ins, e.g. a lack of agricultural machinery suitable for use on steep slopes to replace chemical inputs.

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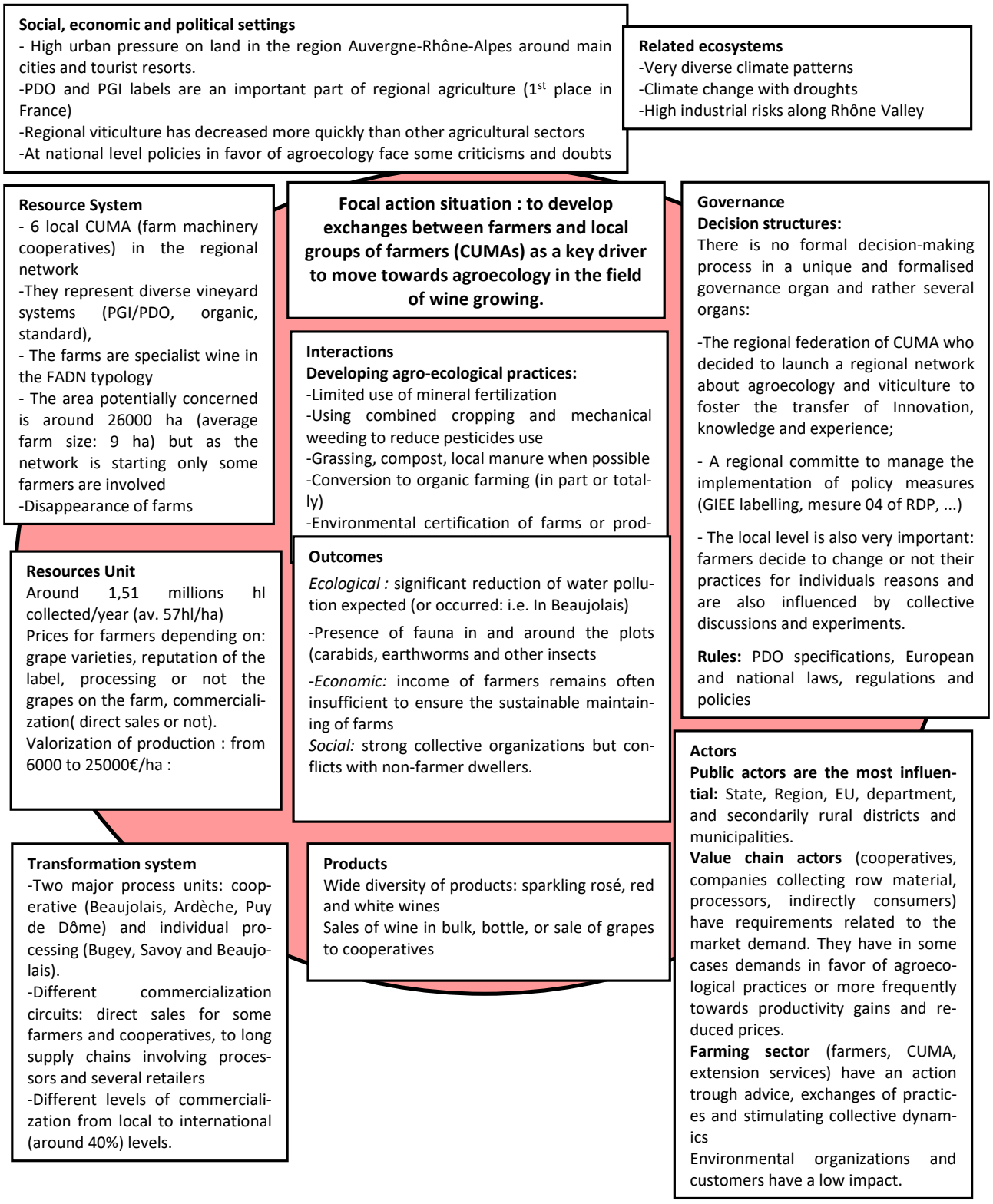

Figure 8. Overview of the social-ecological system - French case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773901.

Barriers *and* ***drivers*** *of transition*

Vineyards are the prevailing resource sub-system in the case study area, which is in long term decline (R). Most of the farms are conventional (small to medium decrease of use of inputs) with a few organic (R). Some farms produce grapes which are processed off-farm by processors (RU), and others process them on farms or in their cooperatives (TS, P). The key actors are farmers (A) who decide upon whether or not to implement agro-ecological practices, and participate in machinery cooperatives CUMAs and other local cooperatives. Both types of cooperatives participate in discussions and decisions about agro-ecological farming and relevant learning processes (I).

The cooperatives and individual farmers are core actors in local networks of cooperation. Other participants in these networks are municipalities and other regional public bodies; actors in the value chains; environmental organisations; science, innovation and advisors which are support capacity building; and consumers and citizens (A). Cooperation takes place between CUMAs to enable knowledge transfer (I).

Although the level of cooperation between actors is relatively high, there are some conflicts between farmers and the municipality and its inhabitants (I). Economically those who process the grapes on-farm, organic farms and those with Protected Denomination of Origin labels are better off than those who have conventional farms and sell grapes to wholesalers (O). However, in general it is difficult to increase the added value.

The governance systems in the SES varies according to property rights regimes. Farmers who process and sell their products directly to consumers are operating under the structure of consumer market governance (G). Farmers who sell their grapes to processors (e.g. cooperatives) are acting under contracts with such processors (which could be part of SES if it is created by farmers). Under these two situations, the decision making would be by the individual (e.g. those processing on-farm) or by a collective (e.g. if the farmer is part of a cooperative), and so will follow the relevant rules and conditions of contract (G). External governance (G) represents regional or national policies on Protected Denomination of Origin (PDO), and rules of the Common Agricultural Policy, provision of support, and on pesticides use.

The main barriers to agro-ecological transitions are **increased costs, some negative economic effects of new practices**, and costs to farmers to organise themselves. **Institutional barriers** reflect the constraints on some practices of managing vine shrubs (e.g. reducing pesticides use). Options based on mechanisation are too costly, with the small margins of sales from vines not sufficient to support such investments. The current arrangement of vineyards does not permit the replacement of pesticides by machinery, expect by expensive types of specialist tractors). Reducing the use of pesticides is **perceived by farmers as a risk**, believing their produce may be of lower quality (e.g. appearance of grapes). Greater training and knowledge exchange could aid in overcoming such concerns and perceptions. Farmers do not trust resistant varieties of vine, arguing there is insufficient relevant research and reflecting some Protected Denomination of Origin rules which prevent the use of resistant varieties (G). Farmers are risk averse, and are unsure whether such resistant varieties will be effective for their circumstances, and as a result these varieties are not socially accepted. When too many labels are available they significantly reduce the benefit of labelling. Related to labelling, there is a **lack of awareness of existing initiatives and lack of coordination**. It is difficult to get added value and therefore those farmers who are not processing grapes are worse off economically. Cooperatives have a normative approach, with local uniqueness or specific characteristics not favoured in large markets. Urban expansion is a barrier to transition at a landscape level. There is **lack of collective organisation and of coordination of land use at a landscape level** leading to the expansion of urban and waste land.

Table 18 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773901.

Table 18. Key barriers and drivers to be addressed in the transition strategy in the French case study

Type of Barrier /Driver	Barrier / Driver
Social – normative / cognitive	• Attitude of farmers towards agro-ecological farming and perceived risks by farmers
Social - institutional	• Some rules (such as Protected Designation of Origin) prevent using some AEFS practices, lack of coordination of land use planning on regional basis • Lack of collective organisation
Knowledge	• Lack of knowledge of agro-ecological practices and their benefits due to lack of advice, research, and knowledge transfer • Lack of awareness (and coordination) of labelling initiatives
Technological	• *Expected technology change and new biocontrol methods (driver)*
Economic	• Increased costs and negative economic effects of new agro-ecological practices • Lack of added value from production systems with agro-ecological practices • *Agro-tourism generating markets (driver)*

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge, technological and economic barriers and drivers of initiating an agro-ecological transition in viticulture. Different strategic pathways are proposed including: i) fostering **local level cooperation on pesticide free farming** to address combinations of social and knowledge barriers; ii) **creating partnerships at a food system level to develop values based supply chains** that recognise the increased quality of vines and environmental criteria that address economic barriers, and iii) **strengthening collective actions for landscape management** to improve the coordination of land use planning on a regional basis.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 19 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773901.

Table 19. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the French case study

Suitable Agro-ecological Practices	Removal or reduction of glyphosate and non-herbicidal plant protection products, maintenance of soil fertility, and prevention of erosion		Landscape management and implementation of biological control solutions
Strategic Pathways	**Fostering local cooperation of pesticide free farming**	**Creating partnerships at a food system level for values based supply chains**	**Strengthening collective actions for landscape management**
Barriers / Drivers of Implementation to be addressed	Lack of advice, research, and knowledge transfer Lack of knowledge on resistant vine Protected Denomination of Origin rules prevent using some agro-ecological farming system practices *Expected technology change – robots weeding the rows (driver)* *Biocontrol methods: less active doses used (driver)*	Increased costs and negative economic effects of new agro-ecological practices Lack of awareness of value chain activities Attitude of farmers towards agro-ecological farming *Agro-tourism generating markets (driver)*	Lack of coordination of land use planning on a regional basis Lack of collective organisation Higher costs of diversification Lack of technical advice and lack of resources *Increasing importance and acceptance of biological control (driver)*
Actors Required in the SES to Address Barriers	Farmers, Chamber of agriculture, CUMA cooperatives, local communities, research / education / extension, water agency, National institute of origin designation, tree nurseryman.	Farmers and their networks, Chamber of agriculture, CUMA cooperatives, local communities, research /education/ extension, water agency, National institute of origin designation; consumers union; hybridisers and nursery men.	Farmers and their networks, Chamber of agriculture, CUMA cooperatives, local inhabitants, local communities and inter-communities.
Changes Envisaged in Cooperation and Governance of the SES	Exchange of innovation and debates between farmers of the social implications of glyphosate free farming Shared lobbying activities to get derogation to the prohibition of glyphosate Farmers and local level cooperation on knowledge exchange on other pesticides Increased farmer cooperation in research Green waste platform, exchange local composting	Partnership at food system level to develop values based supply chains that recognise increased quality of vines and environmental criteria Increased cooperation with research actors. Certification of High Environmental Value (HEV) by cooperatives and authorised organisations	Local partnerships and collective action including knowledge sharing on biocontrol measures and machinery sharing Training for farmers and advisors about biocontrol technics
Changes Envisaged in Market Institutions	Adaptation of PDO / PGI production rules (e.g. to capture new varieties)	Inclusion of environmental criteria in public and private specification for products Diversification of local market organisations Adaptation of PDO / PGI production rules (e.g. to	Diversification of local market organisations and partnership between agriculture, tourism, handicraft and energy sectors

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		capture new varieties) Individual processing-short chains and collective processing – long chains	
Policy Instruments to Support the Transition	National glyphosate ban, with specific constraints and under careful control Investment support to restructuring vineyards, support for green manure, LEADER-support of collective actions, economic and environmental interest groups (EEIG) supporting animation, remuneration for maintaining a carbon balance, national research on resistant varieties, agro-ecological climate measures relating to reducing pesticide use, and support for specialised advice and knowledge transfer	Financial incentives recognising the effort and/or biodiversity in product specification; labelling based on agro-ecological specifications; policy support for the design and implementation of sustainable food system; support for the exploitation and sharing of knowledge and experience in innovative food systems; investment support	Designation of agricultural and natural areas; local and intercommunal planning; water basin contracts Support for collective schemes to enable landscape level management Common Agricultural Policy: Agro-ecological Climate Measure payments for environmental services Research on natural biological control

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4.8. GR - Peach Fruits for Consumption and Processing in Imathia

KEY DILEMMA: HOW TO SUSTAIN THE LONG-TERM ECONOMIC VIABILITY OF FARMS WHILST PROTECTING THE NATURAL RESOURCES? HOW TO PROTECT BIODIVERSITY AND WATER QUALITY IN ORCHARDS WHILST ALSO IMPROVING COMPETITIVENESS AND MARKET ACCESS

The Greek case study located in Imathia, a NUTS 3 region in Northern Greece, aimed to understand the drivers and barriers in implementing agro-ecological approaches in a highly competitive agri-food sector. Imathia is one of the two main production areas of peaches in Greece, both for fresh fruit production and canning. The key **sustainability issues** to be addressed are the improvement of the economic efficiency of farms, the reduction of environmental impacts on biodiversity and water quality due to pesticide use, and the production of safe and quality fruit products. The transition strategies co-constructed with the members of the Multi-Actor Platform aimed to provide pathways for a transition from a farming system of high intensity input use to a more efficient system based on input substitution. It aimed to explore new forms of cooperation that address the lack of social capital amongst key actors in the agri-food sector, and the lack of knowledge and empirical data on innovations that impede the adoption of novel agricultural practices.

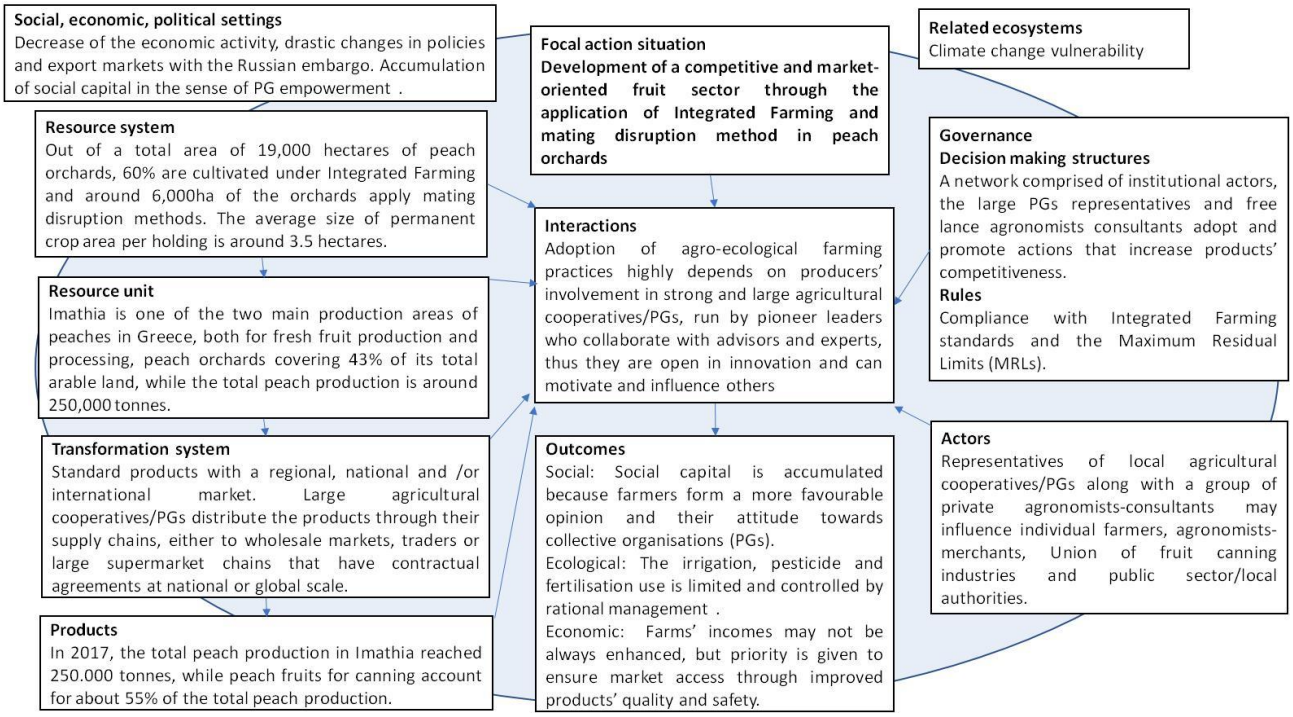

Figure 9. Overview of the social-ecological system - Greek case study (Source: own figure based on Ostrom and Cox 2010; McGinniss and Ostrom 2014)

Barriers *and* ***drivers*** *of transition*

Imathia is considered an area of intensive farm production, in which the dominant production type is of permanent fruit crops (R), mainly peach orchards for fresh consumption and canning (RU). There are approximately 19,000 hectares of peach orchards, from which peach production is divided into 40% for fresh fruit production and 60% for processing (P).

Farmers who are members of local agricultural cooperatives or producer groups (A) deliver their produce to their cooperative, which distributes the products after being processed, sorted and packaged according to

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size, to national or international markets. Individual farmers (A), typically conventional, usually sell their produce to middlemen, traders or wholesalers (A).

The fruit processing sector (T) plays a significant role in the economy of the region of Imathia, and to the country as a whole, as Greece is one of the five largest producers of canned peaches in the world. Fresh peaches destined for processing (mainly canned fruits, but also fruit juice and frozen fruit) are delivered to private or cooperative processing plants (A), many of which are represented by the Union of Fruit Canning Industries (A).

Two different farm types have been identified in the area. Conventional farms which focus on intensification of the production process, and those which aim to mitigate the environmental impact of agricultural activities and produce quality products at a competitive price through the implementation of Integrated Crop Management methods and/or Mating Disruption.

Imathia is one of the first regions in Greece that implemented Integrated Farming. This is an environmentally friendly farming method that controls the use of fertilisers, pesticides and irrigation as a response to the reform of the Common Market Organisation for fruit and vegetables, introduced in 1996, and the compliance with quality and safety standards in the agri-food sector, required by the EU and international markets (R). Powerful agricultural cooperatives and producer groups, in close collaboration with a network of private advisors (A), support environmentally friendly farming practices to improve the competitiveness of the sector in domestic and export markets (G). A significant outcome achieved by this collaboration is the inclusion of Mating Disruption within the agri-environmental schemes of the Greek Rural development Programme 2014-2020 (G). The role of public sector (A) is important but limited to financial aid. It does not address the lack of public extension services that could guide and inform farmers about farming methods and market conditions (I).

In addition to the advisors who provide advice on innovative ventures and promote farming practices related to sustainable agriculture, there is a group of agronomists-merchants (A) who work in an agricultural supply store and provide farmers with inputs, mainly fertilisers and plant protection products. These agronomists-merchants also have a role as advisors to many individual farmers who are not members of agricultural cooperatives or producer groups, so provide consulting services (mainly technical) for the correct application of inputs sold to their customers.

Two groups of key barriers of the agroecological transition have been identified. The first one is **lack of social capital**, since many actors have an inherently distrustful stance towards collaboration, mutual support and joint efforts, which results in a **lack of confidence and trust** in agricultural cooperatives. The second group consists of **insufficient knowledge** and **lack of empirical data** on innovations related to modern pomology and agro-ecological practices in local conditions, creating a feeling of uncertainty and hesitancy in adopting novel agricultural practices. To apply such practices, farmers need technical support and expert guidance in addition to gaining new skills. Economic barriers concern the **lack of targeted market incentives** and insufficient economic support measures as well as **inadequate information on market conditions**.

The increasing demand for food safety and quality, and especially the strict compliance with the Maximum Residue Levels (MRLs) for pesticides set by EU and national legislation and global market traders, is considered the key driver towards a more sustainable, competitive and market-oriented sector.

Often, it is easier for initiatives relevant to agro-ecological farming to be adopted by collective schemes and strong agricultural cooperatives and producer groups. In such groups there are often pioneer members who are open to innovation and can motivate and influence others. The role of advisors is critical, as they often provide technical assistance to farmers, spread innovation and transfer knowledge.

Table 20 summarises the key barriers and drivers identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

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Table 20. Key barriers and drivers to be addressed in the transition strategy in the Greek case study

Type of Barrier / Driver	Barrier / Driver
Social – normative / cognitive	• Lack of trust and confidence between the actors
Social - institutional	• Lack of social structure and organisation that hinder the collaboration, mutual support and joint efforts between local actors
Knowledge	• Knowledge gap in agro-ecological practices and sustainable farming in general and a lack of empirical data on innovation
Economic	• Inadequate information on market conditions • Lack of market incentives and economic support measures • *Increasing demand for food safety and quality by regulations and global market traders (driver)*
Policy-related	• Emphasis given to individual farm modernisation plans may hinder collective schemes

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge, economic and policy-related barriers of initiating an agro-ecological transition of peach orchard systems. **Different strategic pathways on increasing social capital of local actors, addressing knowledge gaps on agro-ecological practices and improving market access and value added are proposed. Key governance changes of those pathways are: i) formal agreements of contract farming, operating over longer time periods, to increase trust between actors, ii) inter-professional collaborations between farmers' unions, agri-food value chains and science brokers to address knowledge barriers, and iii) payments and market incentives for farmers who apply agro-ecological practices.**

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 21 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 21. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Greek case study

Suitable Agro-ecological Practices	Green manure crop application between rows of perennial crops, selection of varieties resistant to pest and diseases with good quality characteristics, transitioning to two-dimensional fruit orchards.		
Strategic Pathways	**Increasing social capital of local actors**	**Addressing knowledge gaps on agro-ecological practices**	**Improving market access and value added**
Barriers / Drivers of Implementation to be addressed	Lack of trust and confidence between actors Lack of social structure and organisation that hinder the collaboration, mutual support and joint efforts between local actors	Knowledge gap in agro-ecological practices and sustainable farming in Greece	Inadequate information on market conditions Lack of targeted market incentives Emphasis given to individual farm modernisation plans may hinder collective schemes *Increasing demand for food safety and quality by regulations and global market traders (driver)*
Actors Required in the SES to Address Barriers	Farmers, agricultural cooperatives and producer groups, advisors, agronomists and merchants, fruit processing industries	Farmers, agricultural cooperatives and producer groups, advisors, universities and research institutes	Farmers, agricultural cooperatives and producer groups, fruit processing industries, local and regional authorities, banking sector
Changes Envisaged in Cooperation and Governance of the SES	Empowerment of agricultural cooperatives Formal agreements through contract farming with a longer duration to establish trust and confidence between the different actors throughout the value chain, and a basis for developing equitable business relationships All conditions and terms (e.g. about price, quantity, quality, delivery time of farm products) need to be agreed by all actors at the outset	Cluster of inter-professional collaborations between farmers unions, agri-food value chains and science brokers to facilitate knowledge exchange Advice for farmers to manage the new canopy system and viable solutions to the cultivation challenges. Role of advisors is crucial, since they can link practice and research and help farmers improve fruit quality and gain access to the market.	Formal agreements through contract farming between individual farmers or agricultural cooperatives and producer groups, and fruit processing industries Cluster of inter-professional collaborations between agricultural cooperatives, and agri-food value chains to increase competitiveness of fruit production
Changes Envisaged in Market Institutions	Premium reward payments to farmers who apply agro-ecological practices	Not applicable	Premium reward payments to farmers who apply agro-ecological practices Implementation of quality standards (e.g. AGRO2 standards and GlobalGap protocol)
Policy Instruments to Support the Transition	Financial assistance in the form of aid to collective investments within the operational programmes of Producer Organisations under CMO for fruits and vegetables covering the costs associated with the establishment of the orchard and its operation during the first growing years. Co-operation Measure, Advisory and Training services	Agri-environmental schemes (such as the mating disruption method) Advisory & Training services	Farm modernization and investment combined with Agri-environmental schemes (such as the mating disruption method) Advisory and Training services

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4.9. HU - Soil conservation farming

KEY DILEMMA: HOW TO INTEGRATE AGRO-ECOLOGICAL PRACTICES ON ARABLE LAND IN HIGHLY MARKET-ORIENTED ARABLE FARMING SYSTEMS TO MAINTAIN AND IMPROVE SOIL QUALITY WITHOUT SIGNIFICANT NEGATIVE IMPACTS ON THE ECONOMIC VIABILITY OF FARMS.

The Hungarian case study aimed to explore transition strategies which address barriers and drivers of soil conservation farming. Of the more than 5 million ha agricultural land in Hungary, approximately 81% is used for arable crops. Agro-ecological conditions for crop production in Hungary are generally considered to be good, and market oriented arable farming systems are dominant. The key **sustainability issue** in the Hungarian case study is that of soil quality and health. Increasingly, arable farmers experience extreme weather events that either cause water erosion or a lack of water during the production period. Adapting soil conservation practices is considered to be the first step in market oriented arable farming systems towards an agro-ecological transition. With the Multi-Actor Platform, transition strategies were co-constructed that provide pathways for implementing soil conservation practices.

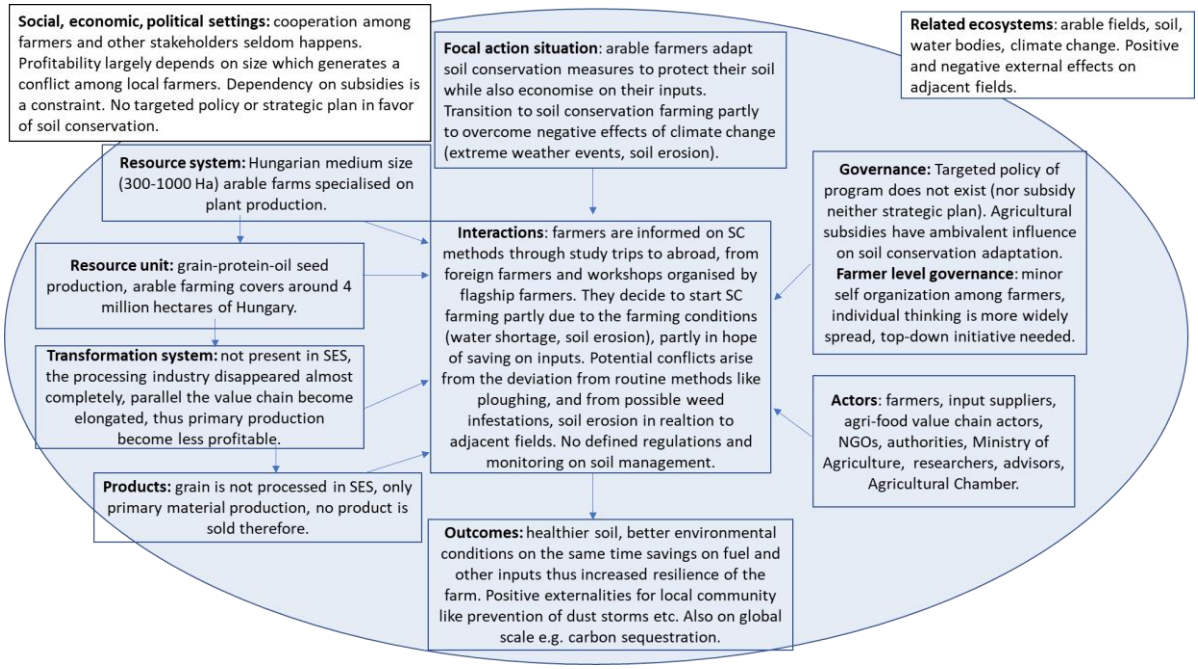

Figure 10. Overview of the social-ecological system - Hungarian case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

Barriers *and* ***drivers*** *of transition*

New approaches to water management and tillage practices are being sought by a number of individual farmers to meet the challenge of damage production in mid-sized arable farms due to climate change (R). The main commodities are grain-protein-oil crops (RU) produced for the world market. There is no local processing (T) which, currently, does not have an impact on the sustainability of the system. The key actors are the innovative farmers (A) who decided to apply alternative soil cultivation strategies to combat extreme weather events, and to reduce costs and so increase the economic efficiency of production. These farmers share their experiences, although this use of new approaches has the potential to create conflicts with conventional farmers (I). At a national level there is still a very low level of information exchange and low social capital, and public policies do not target the adoption of soil conservation measures (G).

Soil conservation farming practices appears to be viable, in a subsidy-free environment, but only under market conditions. The relevant technology exists, and the money for its implementation, but the latter is

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true mainly for capital-intensive entrepreneurs. Perhaps the most important experience gained from the case studies is that the adoption of an environmental intervention, soil-conservation farming, can produce market benefits. Evidence of those benefits have led other farmers to be enthusiastic about its application. They have an indirect awareness of environmental issues, driven by recognition of economic benefits arising from environmental interventions. They continue to be profit oriented, but recognize that targeted management of the environment could have a positive effect on their profits. This attitude of farmers can be considered the main driver in the dissemination and update of soil conservation farming.

There are two main reasons for the impediment to the widespread adoption of soil conservation farming practices:

i) Due to the **traditions and customs of arable farming**, most farmers regard ploughing as an essential and inherent part of soil cultivation. Farmers who learnt their farming practices some decades ago may not understand the benefits of not ploughing arable land.

ii) There is a lack of consensus as to the benefits and usability of soil conservation farming practices, and the associated technology, which can lead to farmers having different levels of understandings of such approaches.

The key barriers for the generic uptake of soil conservation practices amongst farmers, and this first step to agro-ecological transition, include a: **lack of knowledge and openness to alternative practices** and technologies; **farmer attitudes towards agro-ecological farming; low social capital**; a **lack of capital, credit and bank guarantees for investment in specific machinery**; a **lack of specific agro-ecological advisory services**; and a lack of recognition of soil as a natural resource with social and institutional value. Although 2015 was declared the International Year of Soils, and the topic of soils was promoted extensively, there remains a low level of social awareness of its importance.

Resolving these barriers requires national level initiatives, and cooperation between different actors from the practice-science-policy domains. Environmental issues which are perceived by the current government as key barriers to economic growth, have been systematically suppressed. However, the requirements to tackle environmental and climatic issues are expected to increase in the next cycle of the Common Agricultural Policy, which may force a change in the current political stance. The **lack of networking between stakeholders,** and the **lack of appropriate expertise** and insight of policy-makers, are additional key barriers to the diffusion of soil conservation farming in Hungary.

The flows of goods, services, knowledge and information related to soil conservation farming (e.g. from the public sector and science to farmers) are generally considered to be weak and highly fragmented in Hungary.

The long-term maintenance of soil fertility, soil organic matter, soil structure and soil health require knowledge intensive farming practices and decisions to be taken at farm level. Conventional grain farmers are risk adverse, locked-in by the value-chain (e.g. no capital and capacity to diversify activities). Despite low levels of cooperation, sharing experiences between farmers is very important, and the farming operations of neighbours and of flagship farmers are followed carefully. So, farmers are likely to adopt practices of a neighbour or flagship farmer in the region if their approaches are considered to be successful.

In general, there is a low level of social capital. and low levels of trust in the system. Collaboration and reciprocity amongst farmers are almost non-existent. Larger farmers provide machinery (e.g. harvesting) as a service to smaller farmers. Cooperation for the purposes of selling produce is difficult.

There is no market incentive specifically for soil conservation. From the perspective of wholesale buyers it is not an priority given a short-term focus on making profits. Finance could be provided through investment schemes for the purchase of machinery. Support schemes for machinery exchange or sharing are perceived as a political tool to provide generic support to farmers.

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At national level more cooperation would be needed within and between authorities and science to serve the practical needs of the sector in terms of climate mitigation, and in preparation for the transition to agro-ecology over the longer term. The lack of skilled agricultural employees with specific knowledge (e.g. precision agriculture) is a major problem. Innovations and digitalisation of the agricultural sector are not included in agricultural education at secondary and higher levels due to old structures of courses and topics, and a lack of capital for demonstration and training.

Table 22 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 22. Key barriers and drivers to be addressed in the transition strategy in the Hungarian case study

Type of Barrier /Driver	Barrier / Driver
Biophysical	• Changes in environmental and climatic conditions (e.g. soil erosion, extreme weather events and droughts) increase the awareness of farmers of the need to change management practices
Social – normative / cognitive	• Culture of individualism after the collapse of the socialist regime (with inefficient cooperation) leads to low social capital
Knowledge	• Lack of knowledge of farmers and advisors on soil conservation practices, their monitoring and technologies
Economic	• Technologies and machinery require significant investments which are not feasible for smaller farms • Lack of generation of added value for goods from soil conservation farming in value chains

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the members of the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the biophysical, social, knowledge and economic barriers of initiating an agro-ecological transition in arable farming systems. **Different strategic pathways on increasing cooperation at national level, fostering shift in mindsets and improving cooperation, enabling the application of new technologies and increasing consumer awareness are proposed. Key governance changes of those pathways are: i) setting up a national platform for soil conservation; ii) coordinated approaches to initiate cooperation and knowledge exchange between farmers to address social and knowledge barriers; iii) contracts with food processors for soil conservation labels to generate added value for goods from soil conservation farming.**

The strategic pathways identify key actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers, the changes envisaged in cooperation and the governance of the social-ecological system, and the changes in market institutions and policy instruments that have the potential to support the transition process.

Table 23 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 23. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Hungarian case study

Suitable Agro-ecological Practices	Reduced tillage, no-plough, regenerative no-till			
Strategic Pathways	**Increasing cooperation at national level**	**Fostering shift in mindsets and improving cooperation**	**Enabling the application of new technologies**	**Increasing consumer awareness**
Barriers / Drivers of Implementation to be addressed	Changes in environmental and climate conditions (e.g. soil erosion, extreme weather events and droughts) increase the awareness of farmers of the need to change management practices	Lack of knowledge of farmers and advisors on soil conservation practices, their monitoring and technologies Culture of individualism leading to low levels of cooperation and social capital	Technologies and machinery require significant investments which are not available to smaller farms	Lack of the creation of added value for goods from soil conservation farming in value chains
Actors Required in the SES to Address Barriers	Farmers Value chain actors, authorities and administration, researchers, NGOs, civil organisations, local communities, consumers, media	Farmers Advisory services, researchers, authorities and administrations, value chain actors, agricultural media	Farmers Value chain actors, authorities and administration, Researchers	Farmers Value chain actors, consumers, authorities and administration, local communities, media
Changes Envisaged in Cooperation and Governance of the SES	Cooperation between farmers (knowledge exchange e.g. at field days, participatory research), Coordinated cooperation between all stakeholders through a national plat-form for soil conservation farming to: • clarify the definitions in soil conservation farming, define technological recommendations, parameters, and indicators • narrow the science-policy-practice nexus by setting research an agenda based on needs from practice and policy • act as a board of representation of actors for policy consultations	To address issues of isolation of stakeholders, and low social capital, coordinated approaches to initiate cooperation, e.g. trusted intermediaries (e.g. researchers, advisory services or a farming peer) establishing a professional platform for knowledge exchange between farmers Similar coordinated mechanisms are needed to foster information flow, and sharing amongst the key actors identified	Setting up a network of demonstration farms to pilot feasible technologies and solutions together with researchers and machinery manufacturers	General national information campaign to raise public awareness about soil as an important natural resource, to be financed and initiated by the State: • environmental education in schools about the importance and multifunctionality of soils • consumer education by government and NGOs for shortening supply chain • demanding consumers are more conscious about the choice of healthy food and not biased by commercial ads and the lock-in of cheap food.
Changes Envisaged in Market Institutions	None identified	None identified	None identified	Contracts with food processors for soil conservation labels. There have been attempts but so far all have

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				failed (e.g. pasta industry) According to market actors it is very difficult to overcome the price sensitivity of Hungarian consumers. This is the main reason why market actors lose interest.
Policy Instruments to Support the Transition	Agro-environmental measures New law on establishing a scheme for handling agricultural risks, e.g. due to extreme weather events or droughts	Policy support through Rural Development Programme to set up professional platforms and demonstration farms for knowledge exchange and developing technological recommendations	Adapting policy and subsidy (investment support for machinery) to be effective in the future to help the adaptation of soil conservation farming practices. Improving the farm modernization and investment measure to enable the purchase of specific agricultural machinery and tools related to the implementation of the agro-ecological practices. Encourage bank and insurance companies to develop capital schemes for such investments.	Support for labels and / or certification Awareness raising campaign by the State

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4.10. IT - Chianti Biodistrict

KEY DILEMMA: HOW TO PROMOTE CROPPING SYSTEM DIVERSIFICATION IN A HIGHLY SPECIALISED AND MARKET-ORIENTED WINEGROWING AREA VIA THE ADOPTION OF AGRO-ECOLOGICAL PRACTICES, TO INCREASE BIODIVERSITY AND IMPROVE LANDSCAPE MANAGEMENT WHILE MAINTAINING THE PROFITABILITY OF FARMING THROUGH LOCAL VALUE CHAINS.

Chianti is an intensive wine-growing area of Tuscany (central Italy) which has undergone significant land use changes over recent decades, with increasing proportions of uncultivated agricultural areas, especially in marginal areas remote from the main sites of farm businesses. These land use changes have contributed to **sustainability issues** such as environmental impacts on ecosystems and human health. The principal reasons have been: i) emissions from the application of fertilisers and pesticides; ii) use of agricultural machinery; iii) soil degradation due to intensive vineyard management and terrace levelling; iv) expansion of unmanaged wooded land and woody encroachment into abandoned land; v) the vulnerability of most farms to environmental and economic shocks, due to their reliance on a single product, i.e. wine. Local actors have recognised the need for a **new model of territorial governance**, which focuses on agricultural diversification as a way to increase the provision of ecosystem services, and which could guide the diffusion of management practices and changes on institutional settings at the territorial level, with tangible benefits for the local agri-food sector and the community. In this respect, the co-construction of the agro-ecological transition strategy aims at providing solutions to increase environmental quality by acting on farm management practices and governance aspects relevance to the different interests, priorities and perspectives of local actors.

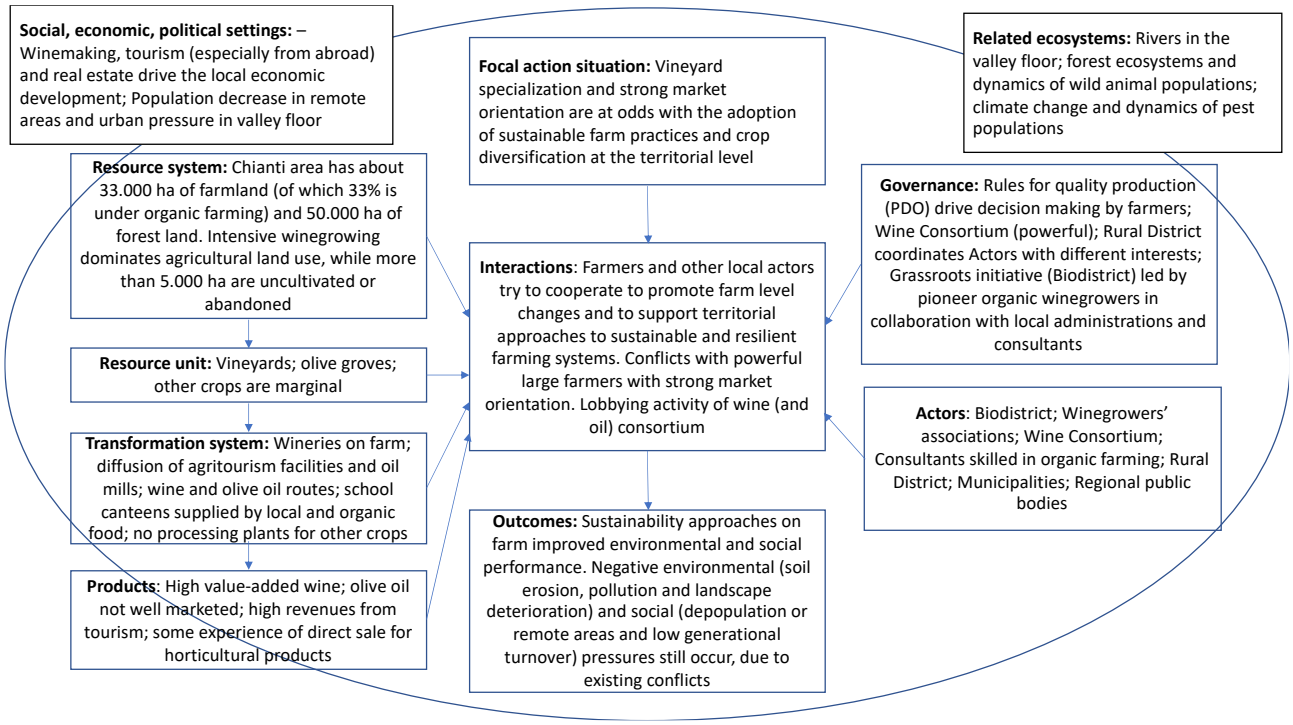

Figure 11. Overview of the social-ecological system - Italian case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

***Barriers** and **drivers** of transition*

The geographical boundaries of Chianti define the Resource System. Most agricultural land is used for agri-food production, especially wine. Apart from urban centres, most of the remaining area is woodland, a consequence of the abandonment of marginal land which has occurred over the last 40 years. Key Resource Units involve vineyards for winemaking and olive groves for oil extraction. Horticultural crops are minor in extent, cultivated on small land parcels which are not suitable for vineyards. Progressively, pastures have

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been abandoned or replaced by vineyards. Most farms host processing plants for the highest value-added product, i.e. wine; other widespread infrastructure over the case study are agri-tourism facilities and olive oil mills (Transformation). The reduced development of other food chains prevented the diffusion of processing plants for other crops (Transformation).

Protected Denomination of Origin (PDO) rules have influenced the decision-making of farmers. The Governance System includes two recently established organisations, i.e. the Rural District of Chianti and the Chianti Biodistrict. These both play an important role in the decision-making process related to the agro-ecological transition, by supporting strategic decision-making, coordinating actors and promoting interventions for the economic and social development of Chianti. Within those organisations, different Actors collaborate, such as farmers, farm consultants, Wine and Oil Consortia, and institutions. The most influential actors for the agro-ecological transition include the Scientific Committee of Chianti Biodistrict, and farm consultants skilled in organic farming. The collaboration amongst such actors has created the basis for the redesign of the food system, especially by creating reinforcing feedback loops among the resource system and resource units.

To foster the agro-ecological transition, the Biodistrict supports a series of interactions on agro-ecological practices, four of which have been included in the transition strategy having been valued positively by most actors, and sustained by the institutional settings (Governance System). Those settings are inter-row green cover, pest monitoring, small-scale composting of farm residues (field operations and processing), and crop diversification through the use of abandoned land and restoration of olive groves. The diffusion of those practices may boost the creation of reinforcing feedback loops between the resource system and resource units, thereby improving the outcomes and, in the end, the focal action situations.

In general, diffusion of the set of agro-ecological practices is prevented by the **lack of practice-specific knowledge** and/or know-how by a relevant proportion of farmers and farm advisors, and by the **limited willingness of farmers to cooperate**. Those barriers are preventing the adoption of agro-ecological practices by not addressing the issue of the aversion of farmers to risk. A series of additional practice-specific barriers accompany the two overarching barriers. **Limited coordination amongst AKIS actors** hinders the proper application of inter-row cropping, pest monitoring and composting. This is largely because, the Tuscany Region lacks a coordination centre for the diffusion of agricultural knowledge, and associated local branches which would be in direct contact with farmers.

The three types of Agro-ecological practices would require **specific machinery**, the purchase of which is not affordable by individual farms. Examples of machine sharing exist, with a small group of farmers collectively owing the machinery for on-farm compost management. This could be a driver for the diffusion and uptake of composting, which requires investment in labour to enable the processing of farm residues into soil amendments.

Apart from composting, **financial constraints and unknown returns on investment** are barriers to farm diversification. Restoring olive groves and introducing cereals of horticultural crops in marginal and abandoned land is a labour-intensive process, with uncertain yields and market opportunities for the products. Investments are required to fence land parcels and protect them from attack by wild animals, supply water, and provide routes for easy access. Trends in rural depopulation, and the high prices of land and housing, due to the popularity of the area and tourist interests, led to a **shortage of rural labour** and contributed to the **low generational succession** in agriculture, both of which are required for innovative approaches to farm diversification to be feasible.

The decision to diversify by recovering marginal and abandoned should be an entrepreneurial one, based on a study of the local market for the products. Without such knowledge, most farmers are not keen on taking on the risk of adopting this practice. However, some positive examples exist in Chianti of collaboration between pioneer farmers for crops other than wine grapes and local restaurants. This can support decision-making by innovative farmers, but more effort is needed by local stakeholders, including public institutions, to develop local food chains, to enable the self-sustained diffusion of the practice.

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Table 24 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 24. Key barriers and drivers to be addressed in the transition strategy in the Italian case study

Type of Barrier / Driver	Barrier / Driver
Social – normative / cognitive	• Limited willingness to cooperate
Social – institutional	• Low generational succession in agriculture • Limited AKIS coordination • *Driver: Similar grassroots initiatives in the past* • *Driver: Previous experience with machine sharing* • *Driver: Existing collaboration between pioneer farmers and local restaurants*
Knowledge	• Lack of practice-specific knowledge and/or know-how • Lack of knowledge about the market for agroecological products • Unknown returns to practice adoption
Technological	• Lack of practice-specific machinery
Economic	• Lack of financial resources for investments by small-medium farms • Limited development of local food chains • Low supply or rural labour

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the members of the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices, focussing on different forms of cooperation. The objective of the co-constructed transition strategy is to address the social, knowledge, technological and economic barriers of enhancing an agro-ecological transition in viticulture. **Different strategic pathways on empowering regional and local knowledge networks, promoting cooperation on the implementation of agro-ecological practices, and promoting the coordination among farmers and other local food chain actors are proposed. Key governance changes of those pathways are: i) a co-learning platform about agro-ecological practices such as inter-row green cover and pest monitoring; ii) the creation of machinery rings and small collective composting centres accompanied by policy support for advice and training to enhance the composting of farm residues; iii) setting up a cooperation platform for different value chain actors; iv) the creation of rural land associations to match supply and demand for uncultivated land to increase crop diversification on abandoned land.**

The strategic pathways identify key actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers, the changes envisaged in cooperation and the governance of the social-ecological system, and the changes in market institutions and policy instruments that have the potential to support the transition process.

Table 25 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 25. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Italian case study

Strategic Pathways for Addressing Barriers and Drivers of Implementation			
Suitable Agro-ecological Practices	Inter-row green cover, pest monitoring, Composting of farm residues (field operations and processing), Crop diversification through use of abandoned land		
Strategic Pathways	**Empowering regional & local knowledge networks**	**Promoting cooperation on the implementation of agro-ecological practices**	**Promoting the coordination among farmers and other local food chain actors**
Barriers / Drivers of Implementation to be addressed	Lack of practice-specific knowledge Limited AKIS coordination Lack of knowledge about the market for agroecological products Unknown returns to practice adoption Driver: Similar grassroots initiatives in the past	Low generational turn over in agriculture Lack of practice-specific machinery Lack of financial resources for investments by small-medium farms Limited willingness to cooperate Driver: Previous experience with machine sharing	Low supply or rural labour Lack of financial resources for investments by small-medium farms Limited development of local food chains Driver: Existing collaboration between pioneer farmers and local restaurants
Actors Required in the SES to Address Barriers (existing and new)	Farmers, farm advisors, associations of organic farming, university and research centres, Tuscany Region, the rural district, partners in EIP-AGRI Operational Groups, information technology companies	Farmers, farm advisors, Tuscany Region, Chianti Biodistrict, information technology companies, urban green management companies	Farmers, farm advisors, crop-specific producer associations, Chianti Classico Oil Consortium, Tuscany Region, Ministry of Agriculture, Chianti Biodistrict, local consumers, local caterers and groceries, tourism associations, rural land associations, municipalities
Changes Envisaged in Cooperation and Governance of the SES	Create a co-learning platform about agro-ecological practices and similar topics, to connect farmers with EIP-AGRI Operational Groups and pilot projects	Create machinery rings for specific agro-ecological practices Creation of small collective composting centres Create procurement platform for manure and other fresh organic matter, and for hay-manure exchange Partnerships with urban green management firms	Create cooperation platforms for different value chain actors and the creation of local value chains Create rural land associations to match supply and demand for uncultivated land for recovery Set-up projects for new processing plants for collective use
Changes Envisaged in Market Institutions	Organise improved agro-ecological practice specific training for advisors, farmers and skilled workers Improve farmer access to advisory services, especially small farmers Promote digitization and Agriculture 4.0 tools	Organise improved agro-ecological practice specific training for advisors, farmers and skilled workers, e.g. on how to compost correctly Promote digitization and Agriculture 4.0 tools	Set up pilot projects for the provision of meals from short supply chains
Policy Instruments to Support the Transition	Advice, information and training, support for cooperation actions, agri-environmental measures, farm modernization and investment (all within the Rural Development Programme (RDP)); Establishment of a coordination centre for experimental stations and advisory services	Advice, information and training, support for cooperation actions, agri-environmental measures, Organic farming, farm modernization and investment (all within the RDP); Forestry Regulation of Tuscany	Advice, information and training, support to young farmers, Farm modernization and investment, non-productive investments (all within the RDP); Law on locally grown food in public canteens, Rural and Organic Districts Development Plans

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4.11. LT - Small Scale Dairy Farmers and Cheesemakers

KEY DILEMMA: HOW TO MAINTAIN AND ENCOURAGE EXTENSIVE MANAGEMENT (GRAZING) OF GRASSLAND HABITATS. HOW TO BECOME (OR REMAIN) COMPETITIVE IN THE MARKET WITHOUT INTENSIFYING THE FARMING PRACTICE.

The case study is concerned with sustainable development of the dairy sector and the preservation and extensive management of valuable grassland and wetland habitats. It aimed to understand how dairy farmers can transition to agro-ecological farming, and how barriers and drivers for such a transition can be addressed. The dairy farming sector comprises smallscale extensive dairy farms that process their produce on-farm (cheesemakers), organic dairy farms, and larger more intensive dairy farms. The resources in focus are grasslands, wetlands, and biodiversity that is maintained through extensive management of those habitats. Currently dairy farming is shifting indoors, and grazing is becoming less common, thus the resource management is threatening the ecological quality of the grassland and wetland habitats. The key **sustainability issues** are socio-economic characteristics of small dairy farms. Small farmers are unable to survive from dairy farming, and potential of small-scale family farms is not appreciated at the state level. As a consequence, the number of small farms in Lithuania has been in sharp decline. The decline in farm and animal numbers results in the loss of valuable grassland habitats (or cessation of their management, due to a decrease in the number of grazing animals).

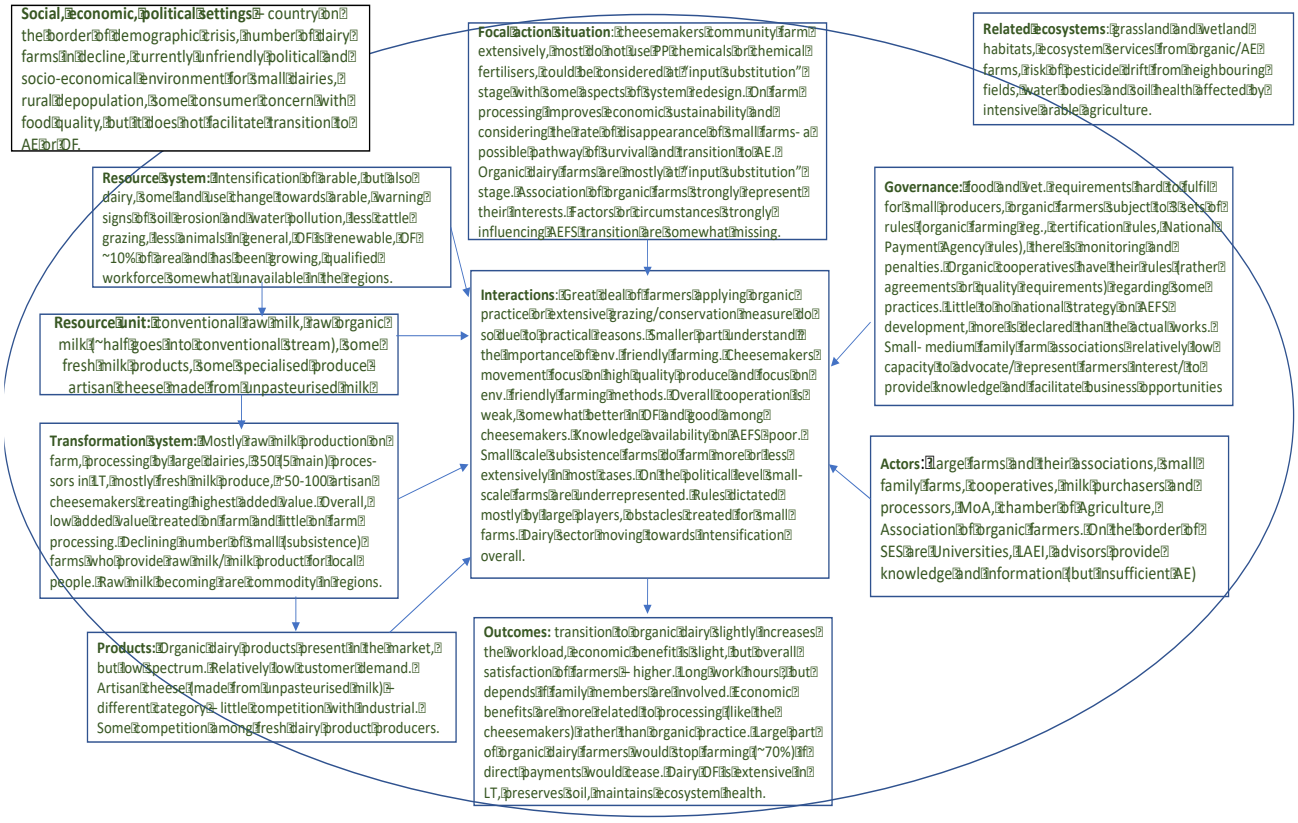

Figure 12. Overview of the social-ecological system - Lithuanian case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

Barriers *and* ***drivers*** *of transition*

In the Lithuanian dairy sector, large and intensive (conventional) farms are becoming more prevalent, whilst organic (overall, not only dairy) farming comprises approximately 10% of the agricultural area and approximately 10% of the number of farmers. The trend is similar when considering dairy farming alone. However, most dairy farms were, and still are, subsistence or small-scale non-intensive family farms that

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could be called extensive or have mixed practice. Part of the agricultural practices in these extensive farms are on the pathway towards agro-ecological transition as non-intensive farming methods are used. Although some of their farming aspects may be more accurately classified as conventional (e.g. farming practice during periods of in-door housing of livestock and manure management). However, most cheesemakers and organic farmers are in input substitution stages of a transition, with some elements of the system redesign stage (mostly extensive systems and some diversification).

Characteristic landscapes of Lithuanian are rich mosaics of semi-natural landscape with numerous habitats (many meadows for grazing, some wetlands, many small unmanaged areas, groups of trees, woodlands and many watercourses). The resource system enables the growth of crops and keeping animals without the need of irrigation (soil moisture storage capacity), and would allow extensive, organic or agro-ecological farming systems to thrive. However, the grassland area has been, and continues to be, converted to arable agricultural land uses. Its total area has declined by approximately 20% since 2003, and the number of grazing cattle has dropped significantly. Intensification can be observed with signs of increasing soil degradation and water pollution (R). Sustainable natural resource management is not sufficiently prioritised on the political level, and critical observations about soil and water health do not translate into policy well. The multi-stakeholder dialogue with respect to the development of agro-ecological farming systems is poor or non-existent. A national strategy or priorities on environmentally sustainable farming system development is lacking, as is the development of sustainable farming in protected areas (G).

The country is experiencing a demographic crisis. The number of small family farms is declining (S). Raw milk is produced (RU) and sold to big dairy companies, the greatest proportion of which is then exported but not those of the highest added value (selling internally is relatively more profitable) (P). There are few cooperatives (A), and very little on-farm processing, which means the added value created on farm is low. However, the number of processing dairy farms (e.g. cheesemakers) (T) is increasing slowly and, as observed, their environmental and economic sustainability is comparably better, and the realisation of niche products is easier (less competition) (I). Approximately, half of the organic dairy products end up in the conventional dairy stream (RU). The organic dairy sector is mostly renewable in Lithuania (R), with mid to low intensity, and a fragile economic sustainability reflecting on their dependency on direct payments (I). Rules governing organic farming (and related administrative rules), or those for receiving direct payments for the implementation of agri-environmental practices, are administratively burdensome for farmers (e.g. organic farming is subject to three different sets of rules) (G). Short supply chains and improving added value created on farm are currently important topics amongst stakeholders, which may help the economic sustainability (G) of farms.

Knowledge on sustainable and agro-ecological farming is presently low amongst farmers, as is its availability in the country and uptake. This is one of the key barriers to agro-ecological transitions. Low cooperation amongst farmers is also an important issue, and is likely to be a reason why small family farmer associations are weak in terms of advocacy and leadership (I). This results in under-representation of small farmers interests at a political level (G). **Insufficient farmer entrepreneurship** (I) and relatively **low added value** products created on an average farm (P) are also amongst key issues. Local sustainable food fairs, sustainable food markets, etc. would help to facilitate sustainable product realisation (I). In terms of **consumer interest**, the public is usually aware of the benefits of locally produced and environmentally sustainable goods. Product choice often remains based upon the price (local or sustainable goods are not the preferred reasons), although the situation is changing slightly towards more responsible choices (S).

There are good examples of how local and sustainable product uptake can be encouraged. 3 years ago, the Lithuanian Ministry of Agriculture initiated a programme called “Milk for Children” under which schools and pre-schools which wished to obtain organic dairy products were supported in covering the difference in price between organic and conventional dairy products. This initiative was only taken up in schools in a few municipalities. However, overall municipalities can be a good source of realisation of local and sustainable goods (e.g. trough **public procurement**) (I). Other barriers are a **lack of a political agenda on agro-ecology**;

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a low level of incentive to initiate transitions to agro-ecology (by the government, associations and farmers themselves); a low level of promotion of agro-ecology (agro-ecology is not legally defined). Current support for sustainable farming practices is management oriented and does not facilitate transition, as opposed to result-based support-schemes that are present in some EU countries (G). Amongst the barriers directly encountered by farmers are the **increasing prices of inputs** and **insufficient raw milk prices** for small farmers (lower for smaller amounts sold). In some areas, purchasers do not buy up organic milk (for logistical reasons), meaning that it is sold into conventional dairy streams (RU). From the position of small farmers, additional social issues are relevant, such as a **lack of a possibility to hire competitive replacement workers** (e.g. when a farmer is going on holiday or unable to work due to illness), farmer fatigue, inheritance regulations, an aging farmer population, and a lack of labour available in rural areas (linked to rural depopulation) (S).

Table 26 summarises the key barriers and drivers identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 26. Key barriers and drivers to be addressed in the transition strategy in the Lithuanian case study

Type of Barrier / Driver	Barrier / Driver
Social – normative / cognitive	• Farmer fatigue; farmers do not see long-term prospects or visions of farming • Lack of farmer entrepreneurship
Knowledge	• Lack of knowledge on implementation of AE practices
Economic	• High input prices • Low consumer interest in sustainable agricultural products • Lack of public procurement of products from small / agro-ecological / organic farms. • Low added value on farms. • *Driver: Quality dairy products have market share which helps small cheese makers to survive* • *Driver: Financial support for initiatives fostering development of short supply chains*
Policy-related	• Low promotion of AE practices in protected territories

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices, focussing on different forms of cooperation. The objective of the co-constructed transition strategy is to address the social, knowledge, economic and policy-related barriers to enhancing an agro-ecological transition in Lithuanian dairy farming.

Different strategic pathways on enhancing cooperation for improved value chains and consumer awareness and improving access to, and sharing of, knowledge are proposed. Key governance changes of those pathways are: i) cooperatives and joint marketing, supported by consultancy on marketing and pre-sales, and municipalities, to address the economic barriers; ii) knowledge networks and use of demonstration farms supported through CAP mechanisms to address social and knowledge barriers. Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 27 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 27. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Lithuanian case study

Suitable Agro-ecological Practices	Use of slow release fertilisers, sprouted grains as fodder, high diversity grass on temporary grasslands and more legumes, balance between extensive and temporary grasslands, extensive grazing on large areas, animal diversification, locally adapted livestock breeds, active hay drying, grass crop mixtures for peatland, soil analysis before re-seeding by grass, biological and biodynamic fertilisers use for grasslands, silica-based supplements to ruminants, areas for biodiversity.	
Strategic Pathways	**Enhancing cooperation for improved value chains and consumer awareness**	**Improving access to, and sharing of, knowledge**
Barriers / Drivers of Implementation to be addressed	High input prices Low consumer awareness and interest in sustainable agricultural products A lack of initiatives from municipalities in purchasing products from small / agro-ecological / organic farms through public procurement Low added value on farms *Quality dairy products have market share which helps small cheese makers to survive (driver)* *Financial support for initiatives fostering development of short supply chains (driver)*	Lack of farmer entrepreneurship Farmer fatigue, farmers do not see long-term prospects or visions of farming Lack of knowledge on implementation of agro-ecological practices Low promotion of agro-ecological practices in protected territories
Actors Required in the SES to Address Barriers	Farmers, their associations and cooperatives MoA, MoE, other Gvmt institutions, Chamber of Agriculture, Advisory service, State Food and Veterinary Service, Municipalities, Local consumers, Private consultants, LAGs, Public Procurement Service under Min. of Economy, Agri-food value chain	Farmers Ministry of Agriculture, Chamber of Agriculture, Advisory service, Municipalities, Associations, cooperatives, Educators
Changes Envisaged in Cooperation and Governance of the SES	Farmer cooperation in sharing machinery and marketing, creation of cooperatives to reduce the risk of losses when starting marketing and to create joint open farm days Support of farmer cooperatives by consultancy on marketing and pre-sales Design of innovative digital platforms for consumers to link to farmers selling cheese Cooperation with municipalities to implement green public procurement Establishing regional food associations and farmers networks to secure sales	Creation of knowledge networks (formal and informal) for sharing descriptions on the implementation of AEPs Establishment and use of demonstration farms, e.g. through cooperatives and / or advisory services Hiring consultants or attending training (supported) Agro-ecology legalisation
Changes Envisaged in Market Institutions	Rules governing and easing marketing, transportation, storage by farmers New agreements on common marketing Agreements to cooperate to supply to green public procurement system. Establishment of trust-based labelling schemes	Not identified
Policy Instruments to Support the Transition	Easier procedure for small farmers to access support of cooperation (RDP Cooperation, mobile markets and other types of open markets support) Support of Short supply chains (RDP measure) Support for starting marketing and no VAT to small farms selling their products Support of online platform supporting marketing	Agro-ecology should be defined in national law Agro-ecology to be supported under CAP including education in the field Revision of farming regulations in protected areas Gvmt. support mechanism for small farmers to gain knowledge and skills All needs to be a part of national agriculture strategy

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4.12. LV - Organic dairy farming

KEY DILEMMA: HOW TO INCREASE THE ECONOMIC VIABILITY OF CONVENTIONAL AND ORGANIC, LARGELY GRASS-BASED, DAIRY FARMS WHILE PRESERVING BIODIVERSITY IN GRASSLANDS AND WATER RESOURCE QUALITY? HOW TO ENSURE THAT ALL ORGANIC MILK IS PROCESSED INTO ORGANIC DAIRY PRODUCTS.

The rural landscape of Latvia is still largely characterized by a mosaic of farmland and woodland. As such, Latvia is well-positioned to preserve and enhance existing high biodiversity and good water quality. However, both conventional and organic dairy farms are under pressure to increase productivity to remain economically viable resulting in the intensification of farming practices, including the conversion of permanent pastures and increased use of mineral fertilizers on grassland and for crop production.

The Latvian case study aimed to explore transition strategies which address barriers and drivers of the economic viability of conventional and organic, largely grass-based, dairy farms by identifying actions that strengthen organic and agro-ecological farming practices, increasing the amount of certified organic milk processed into organic dairy products and stimulating consumer demand for organic dairy products.

The key **sustainability issue** in the Latvian case study is the economic fragility of organic dairy farms. The dairy sector in Latvia has been impacted upon by unstable and low milk prices, Russia's embargo on the import of EU farm products, and the saturation of dairy products in the regional market. Dairy farmers have a weak position in the value chain, which is dominated by dairies and large retail chains. Although the production of organic milk has increased to more than 10% of total milk production, only 44% of organic milk is processed into organic dairy products. Addressing the key dilemma is, to a large degree, contingent on ensuring that more of the organic milk produced on farms is processed as organic dairy products.

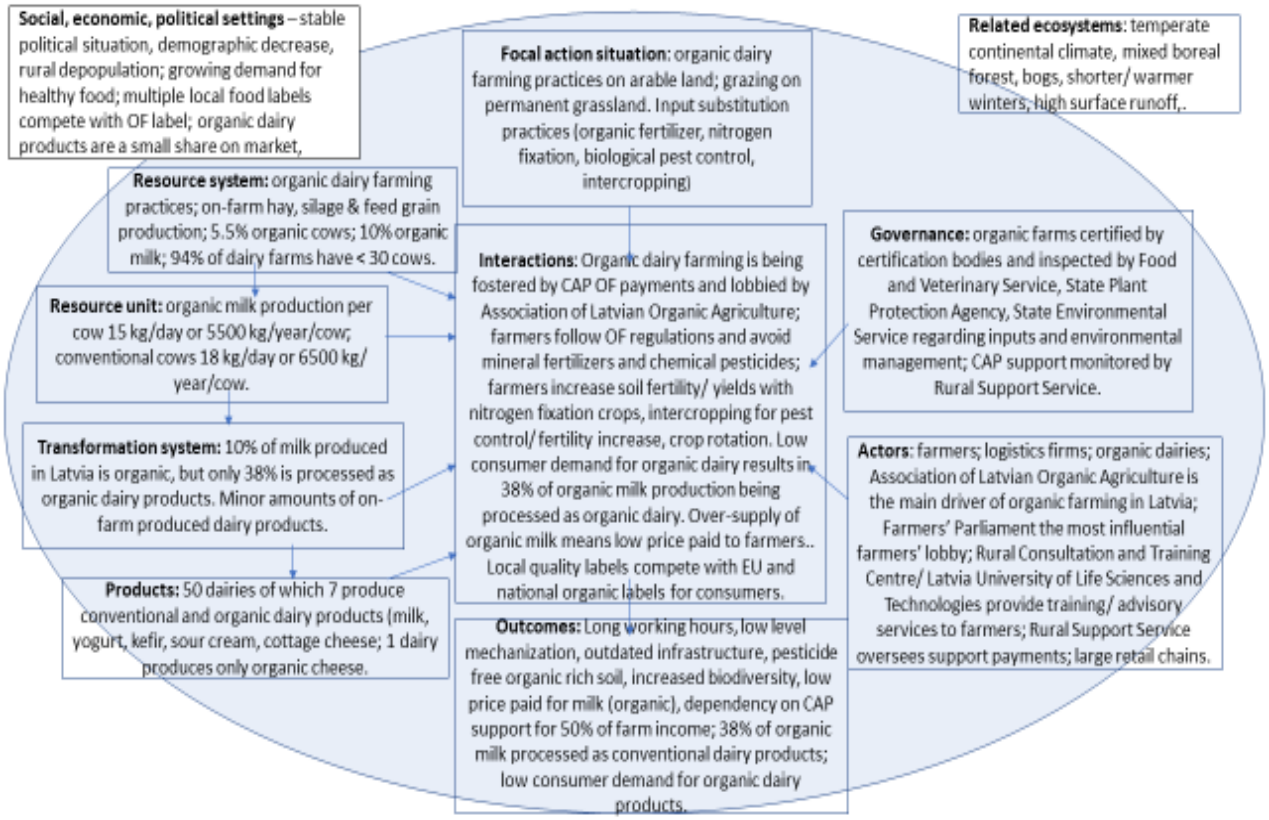

Figure 13. Overview of the social-ecological system - Latvian case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

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Barriers *and* ***drivers*** *of transition*

Latvia is well suited to organic dairy farming as large areas of grassland are too wet for crop production, but are rich in plant biodiversity for the production of grass-based feedstuff for dairy cattle. There is a tradition of "natural" dairy farming based on complex crop rotations without the use of chemical fertilizers and pest control. Economic viability of small organic dairy farms is dependent on on-going EU agricultural support. Dairy farmers have demonstrated a willingness to transition to organic dairy farming practices incentivized by EU agricultural support payments which can amount to 50% of total farm income for organic farms (I).

Presently, in Latvia, certified organic agricultural land makes up about 14% of all agricultural land. Organic dairy farms (number = 2,104) account for 50% of all organic farms (number = 4,105) in Latvia, whereas organic dairy farms make up about 10% of all dairy farms. Conventional and organic dairy farms operate on grassland and arable land (R). The typical dairy operation is the "family farm" with less than 30 dairy cattle producing about 6,000 kg/year of milk per dairy cattle (RU). Both farm types typically graze dairy cattle on perennial grassland and produce their own roughage (hay, silage) and grain feed (oats, wheat, barley, rye, buckwheat). Clover is sown in temporary grassland to improve soil fertility and to produce a richer roughage. Legumes, such as peas, are intercropped with grain crops. Organic dairy farms use only organic fertilizers, whereas conventional dairy farms additionally use mineral fertilizers and chemical plant protection products. Grain yields are 50% less in organic operations (2 tonnes/ha) (RU).

There are 50 dairies that produce conventional dairy products, but only seven dairies process organic dairy products (milk, yogurt, kefir, sour cream, butter, cottage cheese, cheese) (P). As the organic dairies and dairy farms are unevenly distributed across Latvia, logistical challenges exist in relation to the collection and delivery of organic milk to organic dairies for processing. Milk is collected from farmers by dairies, specialized logistics companies and farmer cooperatives, the latter seeking to increase the volume of organic milk collected and price paid for organic milk to farmers (T). Over-supply of organic milk in relation to consumer demand results in a low price being paid to farmers, in many cases equivalent to that paid for conventional milk. Dairy farmers have a weak position in the value chain dominated by numerous dairies and large retail chains (T).

Local product labels (e.g. Green Spoon) with lower quality standards compete with EU and national organic labels, thus negatively impacting on consumer demand for organic dairy products (I). Although, presently, the supply of organic milk exceeds demand, there is nevertheless a strong lobby by the Association of Latvian Organic Agriculture to expand organic dairy farming for the sake of the livelihoods of farmers and environmental protection. At the same time, there is a growing recognition on the part of consumers of the value of healthy food produced in an environmentally friendly manner (I).

Some of the barriers to organic dairy farming are related to the production of organic milk, whereas others are linked to ensuring delivery of organic milk to organic dairies for processing as organic dairy products. The existing surplus of organic milk highlights the need to stimulate consumption of organic milk.

One of the main barriers to transition to organic dairy farming practices is the **decrease in productivity of farms** due to reduced crop and milk yields during transition to organic dairy farming practices (RU). This threatens the economic viability of farms, particularly during the transition period. Continued receipt of support payments for adhering to the EC Organic Regulation farming practices does not incentivize farmers to increase their agro-ecological and environmental performance and economic viability.

The transition to organic farming also requires specialized knowledge and skills on organic and agro-ecological farming practices in order to maintain crop yields and milk production without the use of chemical fertlizers and plant protection products. Presently, agricultural advisory services are mainly focused on supporting conventional farmers. There is a lack of capacity building that meets the specific needs of organic dairy farmers. Both advisory service personnel and farmers **lack practice-specific training** on organic and agro-ecological farming practices, particularly in relation to maintaining soil fertility, crop yields and plant protection without the use of mineral fertilizers and plant protection products. If agro-

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ecological advice is available, it is unaffordable for many small farmers (A). A **shortage of skilled auxillary workers** on conventional and organic dairy farms results in farm managers being overworked which impacts on overall farm viability. Insufficiently coordinated and targeted farm worker training and funding programmes within state administrations are hindering the resolution of this widespread issue in the farming sector (A).

Many small organic dairy farms lack mechanized mucking-out systems, feedstuff preparation and distribution systems, and milk lines or milking rooms. Animal housing conditions do not always meet "good practice" standards of livestock rearing. This impacts on the overall productivity of farms. **Low mechanization** of existing dairy farming makes the sector unappealing to young farmers. Many small and medium family farms were established following land reform in the 1990s. Now, farm owners are approaching retirement age and are considering either downsizing their dairy operation, transitioning to less labour-intensive farming, or transferring the farm holdings to their offspring. In this regard, labour reducing mechanization and infrastructure modernization of dairy farms is needed to incentivize young farmers to pursue organic dairy farming. Presently, investment support for farm modernization for small organic and conventional dairy farms is highly competitive and inequitable (I).

Limited cooperation among organic dairy farmers, and between organic farmers and organic dairies, results in logistical challenges to organic milk collection, limited processing of organic milk into organic dairy products, and a low premium paid to farmers for organic milk. For some organic farmers it is economically advantageous to sell organic milk to conventional instead of organic dairies (A). Existing State Support Payment is provided to organic dairy farmers for the production of organic milk regardless of whether the organic milk is processed into organic dairy products (G).

Presently there is a **low level of public sector procurement** of organic dairy products, as public procurement of organic dairy products is voluntary. It is thought that the introduction of mandatory criteria for the procurement on organic milk and kefir would stimulate processing and consumption of organic dairy products. Similarly, consumption of organic dairy products by **consumers is hindered by higher prices**, which could be remedied in part by reducing the Value Added Tax on organic dairy products (G). Overall **policy goals are lacking** with respect to the development of organic farming and the organic food sector in Latvia. The formulation of a national organic policy would provide a framework for identifying priorities actions and funding (G).

Table 28 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

Table 28. Key barriers and drivers to be addressed in the transition strategy in the Latvian case study

Type of Barrier /Driver	Barrier / Driver
Social – institutional	• Limited cooperation among organic dairy farmers, and between organic farmers and organic dairies which results in logistical challenges to organic milk collection and processing
Knowledge	• Lack of skilled dairy workers
Technological	• Low level of mechanisation and outdated infrastructure on small organic farms
Economic	• Small volume of production and irregular supply of small farms • High price of organic dairy products leading to low demand for organic farming products • Low level of public procurement of organic products
Policy-related	• Lack of differentiation of CAP Pillar II organic farming and agri-environmental support • Insufficient support for transition to organic farming.

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*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers, and different actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge and economic barriers of enhancing an agro-ecological transition of organic dairy farms to strengthen their economic sustainability. **Different strategic pathways on creating dairy cooperatives to increase market access, increasing public awareness and demand, and improving policy support for agro-ecological transitions are proposed. Key governance changes of those pathways are: i) the creation of organic dairy cooperatives, common marketing approaches and green public procurement to address the technological and economic barriers, and ii) improved policy coordination and targeting of CAP mechanisms to address knowledge and policy-related barriers.**

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 29 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 29. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Latvian case study

Suitable Agro-ecological Practices	Conversion to Organic farming and introduction of buffer strips		
Strategic Pathways	**Creating dairy cooperatives to increase market access**	**Increasing public awareness and demand**	**Improving policy support for agro-ecological transitions**
Barriers / Drivers of Implementation to be addressed	Small volume of production and irregular supply of small farms Low level of mechanisation and outdated infrastructure on small organic farms Lack of logistic infrastructure to collect certified milk	High price of organic farming products leading to low demand for organic farming products Low public procurement of organic products	Lack of differentiation of CAP Pillar II organic farming and agri-environmental support Insufficient support for transition to organic farming Lack of skilled auxiliary dairy workers
Actors Required in the SES to Address Barriers	Farmers, farmers cooperatives, Ministry of Agriculture including the CAP Strategic Plan Development Team	Ministry of Environment, Ministry of Justice, Ministry of Finance, Ministry of Defence, Ministry of Interior, Ministry of Economy, Ministry of Interior, Ministry of Science and Education, Ministry of Culture, Ministry of Welfare, Ministry of Transportation, Union of Municipalities, Employers Federation	Ministry of Agriculture, team designing CAP Strategic Plan, Rural Development service Association of Latvian Organic Agriculture, Farmers' Parliament, Latvian Agricultural Organization Cooperation Council
Changes Envisaged in Cooperation and Governance of the SES	Creation of organic dairy cooperatives to increase milk volumes and price paid for milk, strengthening collective action including a common approach to marketing. Propose/ discuss change during preparation of national CAP Strategic Plan (2021-2027)	Increase public consultation on Green public procurement and amend existing Regulations	Propose/ discuss change during preparation of national CAP Strategic Plan (2021-2027) Increase coordination between Ministry of Agriculture, Ministry of Welfare and Rural Consultation and Education Centre in the development and funding of agricultural farm worker training programmes
Changes Envisaged in Market Institutions	Shared marketing Green public procurement	Green public procurement to increase demand for organic products	None
Policy Instruments to Support the Transition	A national organic farming and food policy designed	A national organic farming and food policy designed Lower VAT for organic dairy products	Design a national organic farming and food policy Under CAP: funding for re-training of rural unemployed for farm help positions; allocate funding for training programme for organic farmers on agro-ecological farming practices

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4.13. RO - Hotspot of Biodiversity and Healthy Food in Transylvania Area

KEY DILEMMA: HOW TO INCREASE THE ECONOMIC VIABILITY OF SMALL- SCALE FARMING WHILE PRESERVING THE CULTURAL LANDSCAPE AND BIODIVERSITY.

The case study in Romania is focused on the Transylvanian Highlands (TH) and Maramures. These areas are characterized by a fragmented agricultural landscape with a mosaic of patches of semi-natural grasslands created and maintained by traditional livestock grazing systems, and small plots of cultivated land with extensive management and circular farming patterns practiced over generations. In addition to these practices supporting a diverse mosaic landscape, they also have essential benefits for biodiversity. The input of pesticides and synthetic fertilizers is relatively low; the amount of manual labour to work the land is high. **Key sustainability issues** are the low level of profitability of the extensive farming system and unfavourable conditions in the wider policy and socio-economic settings (e.g. subsidy system and market conditions). The case study aims to address the main challenge of increasing the economic competitiveness of this farming system while preserving the cultural landscape and the typical biodiversity it nurtures.

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Figure 14. Overview of the social-ecological system - Romanian case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

Barriers *and* ***drivers*** *of transition*

Currently, the agricultural sector in the case study area is characterised by family farms and land fragmentation produced by mixed, integrated farming which results in a biodiversity-rich mosaic landscape. There are some commercial, conventional farms which practice intensive animal husbandry, without any access to grasslands (e.g. Farm 3 – Dolagra), or an evenly split regime of indoor rearing and free range of livestock (e.g. Farm 4 – Hans). The economic trait of this farm system is that it is semi-subsistence, producing for family consumption and for the market, and its disconnection from business. The small areas of farms make it difficult for farmers to access certain payments which favour large surfaces and production volumes, irrespective of quality.

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Economic viability is a key problem for smallholder farmers, limited by obstacles such as **poor infrastructure for processing and storage**. Farmers do not have the capacity (including the fiscal status which is difficult to obtain) and the infrastructure to store and process their raw material in order to sell finished food products. Therefore, they tend to sell products directly, through short supply chains, or to industrial, regional processors, usually at lower than standard prices. Those processors then develop their own branded product ranges which are distributed to regional and national shops and retails chains. They also sell produce through intermediaries who buy milk, for example, in bulk from the local producers and then travel to more distant urban centres to sell it at a premium or send it to export.

Another barrier is the **insufficient policy support for agro-ecological practices** (including a lack of adequate subsidies) and a **lack of information and advisory services** regarding the use of agro-ecological practices. EU Agricultural Policy, with its national policy counterpart, does not adequately fit local needs and reward sustainable farming systems. The complex regulations often disadvantage smallholder farmers, who also often lack the time and capacity to apply for and access funds. In terms of information and knowledge transfer, there is **poor information transfer** between public authorities and farmers, and a **lack of transparency and public participation** in decision-making. The administrative capacity of local government bodies is often limited technically, and insufficient personnel. This results in a systemic inadequacy, in quantitative and qualitative terms, for tackling the specific and real needs of farmers, including the needs associated with the maintenance or transition to sustainable farming, as per societal expectations.

Trust and collaboration to carry out and develop agricultural activities in a collective manner (through cooperatives or producer groups) are weak in the region due to the social trauma left by the nationalised collective agricultural system imposed by the communist regime. Farmers associations exist, but in small numbers, while cooperatives and producer groups are even scarcer. However, there are examples of functional, cohesive associations that represent and defend local farmers interests and act as advocacy actors. An example of such an association is the Agro-Eco-Viscri Association (one of the farms in the UNISECO case study) which has begun to reclaim pastures as common property.

The national Rural Development Programme is addressing some of the needs (e.g. High Nature Value farming support measures), but only to a certain extent. Funds are more restricted than in Pillar I in which eligibility criteria are keep a certain category of smallholders away from income support. Several initiatives by civil society and NGOs are providing invaluable assistance to farmers applying for EU subsidies or funding. These are creating new contexts for promoting smallholders and local products, and **bringing consumers closer to producers.** This helps to alleviate the economic constraints of traditional farming. These actors are also helping to bridge the gap in information and participation in public decision-making. Several initiatives are trying to foster community empowerment and social networking, and involving actors from civil society, which have begun to **collaborate on sharing information, skills and resources** to directly act or lobby for change. The rich array of these initiatives can be seen as valuable “seeds” of a bolder vision for sustainable agriculture and food consumption, including through agro-ecology.

Table 30 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

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Table 30. Key barriers and drivers to be addressed in the transition strategy in the Romanian case study

Type of Barrier /Driver	Barrier / Driver
Social – cognitive / normative	• Preference of farmers to use chemicals than agro-ecological practices
Knowledge	• Lack of information and consultancy services on the use and benefits of agro-ecological practices • Poor quality of agricultural education • *Driver: Knowledge / experience / information sharing between farmers*
Technological	• Complexity of agro-ecological practices (e.g. compost management) leads to increase in cost and labour requirements
Economic	• Insufficient/ lack of storage and processing infrastructure • Insufficient/ lack of market access for quality products • *Driver: Growing demand for local/quality food products and civil initiatives and NGOs supporting market development*
Policy-related	• Bureaucracy and poor information exchange between public authorities and farmers regarding access to policy support, and a lack of transparency and public participation in decision-making • Unsuitable prescriptions such as the obligation to clean (vegetation on) agricultural land.

*Characteristics of identified **transition strategies***

The transition strategy for the Romanian case study is focussed on improving the economic viability of small-scale farming using a range of pre-selected agro-ecological practices that are already present in the case study area. Producing and/or using compost on the farm, orchard meadows and extensive grazing, are representative of the key sustainability issues of the case study farming system, of which *the nexus biodiversity-economic sustainability* is the top priority.

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform, involving farmers and other actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge, technological, economic and policy-related barriers of enhancing an agro-ecological transition in small-scale farming in Transylvania.

Strategic pathways on enhancing knowledge sharing on agro-ecological practices, increasing market access through cooperation and improving targeting of, and access to, policy support are proposed. Key governance changes of those pathways are: i) cooperation of advanced farmers and farmers associations with schools to address the knowledge barriers; ii) shared processing and storage, and joint initiatives of producers and consumers, facilitated by the Ministry of Agriculture to address economic barriers; iii) practice-policy partnerships to improve access to policy support for agro-ecological farms.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

The proposed main elements and pathways of the transition strategies are summarised in Table 31. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 31. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Romanian case study

Suitable Agro-ecological Practices	Compost production and/or use in farming	Traditional orchard pastures and extensive grazing	
Strategic Pathways	**Enhancing knowledge sharing on agro-ecological practices**	**Increasing market access through cooperation**	**Improving targeting of, and access to, policy support**
Barriers / Drivers of Implementation to be addressed	Lack of information and consultancy services on the use and benefits of agro-ecological practices Poor quality of agricultural education Increased complexity of compost management leads to increase in cost and labour requirements Farmers prefer using chemicals (fertilizers, pesticides) *Driver: Knowledge / experience / information sharing between farmers, power of examples*	Insufficient or lack of storage and processing infrastructure Insufficient or lack of market access for quality products *Driver: Growing demand for local/quality food products*	Conditions for accessing policy support Obligation to clean (vegetation on) agricultural land Bureaucracy and too strict conditions of hygiene and food safety (for small producers)
Actors Required in the SES to Address Barriers	Farmers Farmer associations, Consultancy services, Agricultural chamber, Paying Agency (APIA), Local Action Groups, Ministry of Agriculture, Ministry of Education	Farmers Ministry of Agriculture, Consumers, Mayors, Paying Agency (APIA)	Farmers Farmer association, Landowners, Ministry of Agriculture, Paying agency, NGOs, Local Action Groups
Changes Envisaged in Cooperation and Governance of the SES	Cooperation of Ministry of Agriculture, consultancy services and farmers in design and implementation of policies supporting knowledge transfer. Ministries of Agriculture and Education creating suitable curriculum Creation of central digital hub (e.g. through AKIS) in cooperation with several actors Cooperation of advanced farmers and farmers associations with schools, enabling students to get on-farm practical skills	Introduce common processing units on communal level which individual farmer cannot afford. Creation of associations of cooperative for facilities sharing (processing and storage). Smaller slaughter units on commune level or mobile.	Cooperation of Ministry of Agriculture and farmers or their associations, to build partnerships based on transparency and participation in decision-making and implementation Cooperation between Mayors and local community (farmers) should be improved (to overcome a current lack of trust) building partnerships based on transparency and participation in decision-making and implementation
Changes Envisaged in Market Institutions	Not directly applicable	Mayors could invest from EU funds in collective storage, processing, slaughterhouses, infrastructure	Creation of brand recognition and promoting the origin of such production, habitats and quality (e.g. grown without treatment) Increasing consumer appreciation of local and Romanian products

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Policy Instruments to Support the Transition	Policies supporting knowledge transfer Enforcement of the EU Nitrate Directive rules coupled with funding support to realise the investments in mandatory manure storage platforms Creation of partnerships facilitated by local authorities and the Payment Agency Support of demonstration farms promoting agro-ecological practices Implementation of simplified fertilization plans on small farms, and fertilization plan with soil testing	Common manure storage supported by Mayors (local community) Adaptation of legislation on slaughter houses to small local facilities. Public procurement should include fruits from traditional local orchards and dairy from local producers Support of promotion of good examples of good practice (e.g. *production from the vicinity*) and marketing and awareness and educating consumers Certification schemes for quality products and growing demand for such products	Removal of the administrative policy barriers (e.g. the complicated provisions for the locker room, the approval process on hygiene/food safety concerns) Less restrictive policies on vegetation clearance Better convergence on subsidies, to eliminate unfair price competition from the market

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4.14. SE - Diversification of ruminant production

KEY DILEMMA: WHAT ARE THE CHALLENGES AND POSSIBILITIES TO DIVERSIFY SPECIALISED RUMINANT FARMS (CONVENTIONAL AND ORGANIC) TO INCLUDE MORE CROPS FOR DIRECT HUMAN CONSUMPTION WHILE SIMULTANEOUSLY INTEGRATING MORE AGRO-ECOLOGICAL PRINCIPLES TO ENHANCE SUSTAINABILITY PERFORMANCE IN AN ECONOMICALLY STRAINED PRODUCTION SECTOR.

A key aspect of the transformation is the greater integration of livestock and crop production, and the production of more crops for direct human consumption. Integrating crops and livestock production is a key characteristic of agro-ecology in which the role of the animals is to convert non-human-edible biomass to food and to convert grass and other biomass to manure to fertilise crops. The Swedish case study addresses key **sustainability issues** of reducing climate impacts and greater integration of livestock and crop production, and considers diversification as a strategy to move closer to systems where animals can play a truly positive role in food production systems.

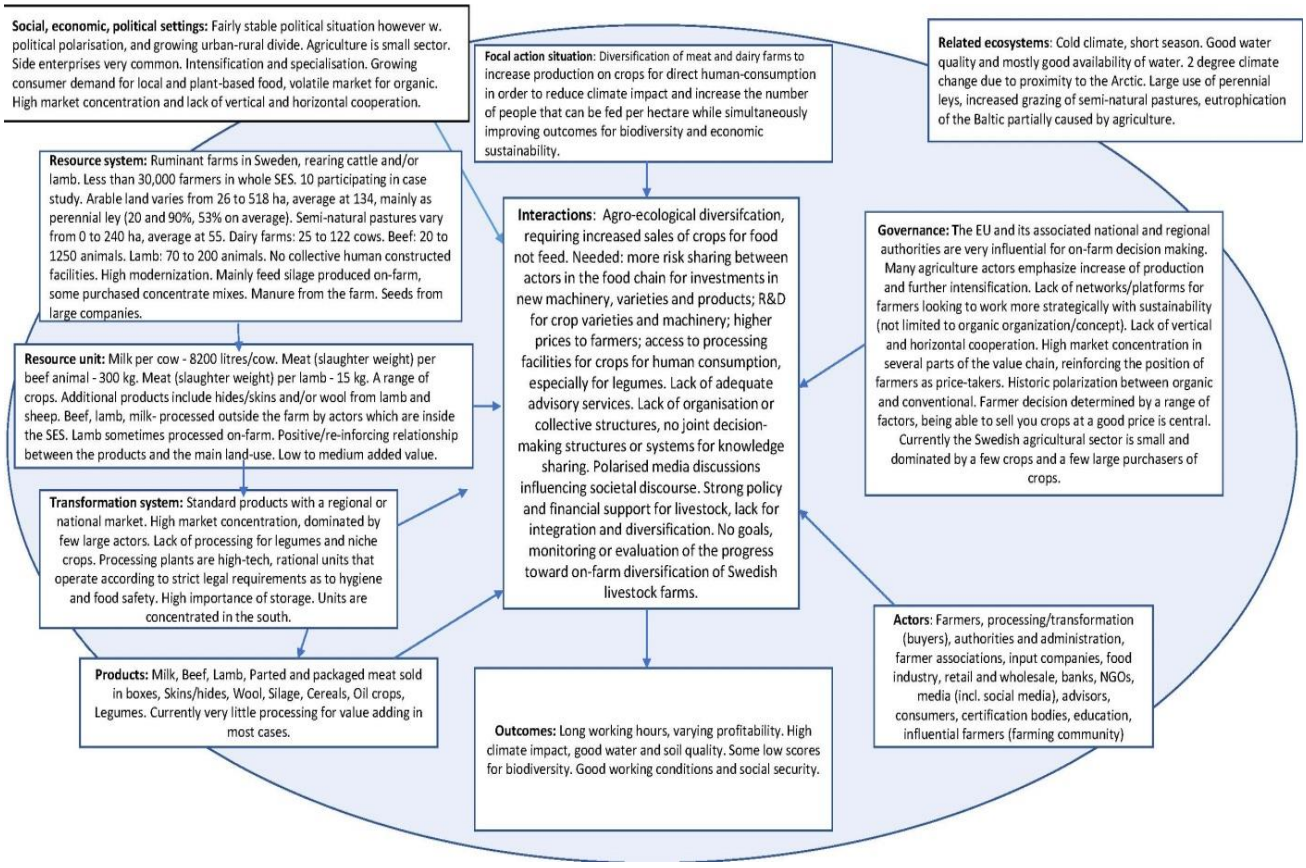

Figure 15. Overview of the social-ecological system - Swedish case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

Barriers *and* ***drivers*** *of transition*

The farms in the case study are ruminant farms at different levels of transition towards agro-ecological practices, with various degrees of diversification and both organic and conventional production (R). The main type of agricultural land is arable, of which approximately half is devoted to perennial leys (R). The main commodities produced are milk, beef and lamb for animal-derived products, while crops include ley, wheat, barley, oats, rye, rape seed, potatoes, and whole crop cereal silage. Some lamb farmers also

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produce skins and hides (RU). Most farmers sell their products on the regional or national market. Beef and dairy are processed by a few powerful actors in the dairy and meat processing industry (A). Some farmers also sell meat directly to consumers through box-schemes or on-farm stores. Cereals are sold either directly to mills, dried on farms for subsequent sale, or sold to neighbouring farms as feed. Potatoes are washed (and in one case processed and packaged) on farm (RU).

The main actors in the SES are the farmers working actively with sustainability and agro-ecological diversification (A). One of the barriers they face is the **lack of networking and knowledge sharing** to produce plant-based foods as there is a lack of cooperation both amongst farmers, and between farmers and industry actors (I). Farmers are also influenced by **strong traditions** associated with meat and dairy, which are often deemed the production of the "real" farmer, as well as the lack of knowledge about producing crops for direct human consumption (I). The few organizations that exist to promote plant-based products do not have direct contacts with farmers. There is some polarization (I) between actors that support meat/dairy production and those against it (A). Currently, farmers wishing to diversify their production are mainly left to do so based on personal interests and contacts (I). Finally and most importantly, lower profitability, on a per hectare basis, in crops compared to livestock production makes it difficult for farmers on smaller farms to move their production away from livestock (S).

The most important factor for farmers in their decision to diversify is the possibility to sell crops at a good price. Selling common crops like wheat, oats, rape seed etc. might not be profitable for farmers located in less favourable areas. Here, alternative crops or varieties could be an option. However, currently, finding stable sales channels for such crops is difficult (G). Retailers (A) were identified as crucial actors to enable sales of plant-based products, legumes and niche crops, as they control what is purchased and what is made available to consumers (G). Consumers (A) are also considered very important actors, ultimately driving the demand for more Swedish and sustainably produced foods. From 2018, the **willingness of consumers** to pay for organic products has decreased, but they are starting to value attributes such as locally produced and plant-based foods. Consumer demand is, to a large extent, driven by what is made available and what is marketed (T). Retailers, food industry, NGOs, public agencies and the media, are important actors (A) for shaping consumer demand, and they could help turning the upward trend in plant-based food into a driver for diversification (T).

There are several barriers to what actors can do. At the economic level, there is a **market concentration** in all sections of the value chain "above" the farmer, in which a few large actors have considerable power over prices and conditions for farmer. There is a **lack of processing faciliti**es for legumes and niche crops, which limits sales opportunities for farmers and hinders increased cultivation of these crops (T). The value chain also lacks support for farmers, who are left with all of the risk that derives from testing new crops and/or more diversified management techniques. This **lack of risk sharing** hinders innovation and the adoption of new practices (I).

The governance system also plays a significant great role in the scope of farmers to diversify and implement more sustainable practices (G). Support from the EU CAP is often an important part of the viability of a livestock farm, influencing decisions and long-term strategies (G). The National Food Strategy for Sweden encourages production both of conventional and organic production but mainly by supporting continuation of current trends including continued specialisation. This leads to **investment lock-ins** being an important barrier to diversification, whereby farmers have already invested in long-term infrastructure that limit their ability to change on-farm management for the future 10 to 20 years. However, if farmers are facing the need to invest, there could be a window of opportunity to change during which time the barriers to diversification are lower (S).

Table 32 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

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Table 32. Key barriers and drivers to be addressed in the transition strategy in the Swedish case study

Type of Barrier / Driver	Barrier / Driver
Social – cognitive / normative	• Personal beliefs of farmers of agroecology • Strong traditions of meat and dairy systems • Lack of role models and networks for knowledge sharing
Social - institutional	• Lack of institutions for both vertical and horizontal cooperation
Knowledge	• Lack of knowledge about producing niche crops for direct human consumption
Economic	• Low profitability in general • High market concentration • High risk and lack of risk sharing • Lack of processing facilities • Reduced willingness to pay for organic products • Investment lock-ins • *Driver: Increasing consumer demand.*
Policy-related	• Policy support favours livestock production

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers and different actors who can influence the farmers' decisions to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge, economic and policy-related barriers of initiating transitions to diversified farming systems producing more crops for human consumption.

Different strategic pathways on fostering knowledge exchange and cooperation and enhancing cooperation in the value chain and market access are proposed. Key governance changes of those pathways are: i) cooperation of cooperatives with advisory services and research organisation to demonstrate good practices of diversification and its benefits to address social and knowledge barriers, and ii) cooperatively investing in processing facilities and private sector payment schemes to pay for sustainability improvements to address technological and economic barriers.

Each strategic pathway identifies key actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers. Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 33 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 33. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the Swedish case study

Suitable Agro-ecological Practices	Increased cultivation and sales of more crops for direct human consumption (based on: crops previously sold as feed sold as food, abandoned land taken into cultivation, a balance between livestock and crops to cover fertilisation needs, balanced crop rotation with leguminous leys, grazing on permanent pastures, feed ruminants mainly from roughages, reduced stock densities and reduced need for concentrate feed)	
Strategic Pathways	**Fostering knowledge exchange and cooperation**	**Enhancing cooperation in the value chain and market access**
Barriers / Drivers of Implementation to be addessed	Lack of knowledge about producing crops for direct human consumption Personal beliefs of farmers of agroecology Strong traditions of meat and dairy	Low profitability in general High market concentration High risk and lack of risk sharing Lack of processing facilities for legumes and niche crops Reduced willingness to pay for organic product Driver: Increasing consumer demand
Actors Required in the SES to Address Barriers (existing and new)	Farmers, Farmer associations Advisory services, Research, New actors/Innovation hubs	Farmers Buyers, Consumers, Retailers/Wholesale, Bank/creditors, Policy, New actors/Innovation hubs/"Owners" of cooperative initiatives
Changes Envisaged in Cooperation and Governance of the SES	Farmer to farmer cooperation	Farmer to farmer cooperation Vertical cooperation across the value-chain
Changes Envisaged in Market Institutions	Start testing centres and incubators for product development of sustainable products Cooperation of cooperatives with advisory services and research to demonstrate good practices of diversification and its benefits Research to improve dissemination	Stronger farmer cooperatives and reduced role of farmers as price takers Start testing centres and incubators for product development of sustainable products Hubs as a "match-maker" between farmers and buyers Secure and stable growing contracts for crops Cooperatively investing in processing facilities that support the creation of added value Retail/wholesale to understand and adapt their timeframes to the reality of farming Private actor payment schemes to pay for sustainability improvements at the farm Retailers/wholesale and bank/creditors fund as warrant for investments
Policy Instruments to Support the Transition	Political support for diversification. Regulation to ensure that companies selling input goods do not act as advisors Increased investment in dissemination and knowledge transfer and creation	Agricultural policy with a food systems perspective Political support for creation of more small and medium size actors Support (financial and other) for innovation of products and operations Increased information to consumers regarding added values Increased support for agro-ecological transitions

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4.15. UK - Mixed Farming and General Cropping in North-east Scotland

KEY DILEMMA: PRODUCING PUBLIC GOODS WHILST MAINTAINING VIABLE PRODUCTION OF PRIVATE GOODS, AND SECURING ECONOMIC AND SOCIAL SUSTAINABILITY AT A FARM LEVEL.

The dilemma being addressed in the United Kingdom (UK) case study is the production of public goods whilst maintaining viable production of private goods and securing economic and social sustainability at a farm level. The geographic area of the UK case study includes Grampian and Tayside in north-east Scotland. The size of the case study area is 291,826 hectares, comprising 12,360 farm holdings, equivalent to 24.2% of holdings in Scotland 4,366 farm businesses. Of these holdings 1,574 are mixed holdings (36.2% of those in Scotland) and 1,022 are general cropping (59.3% of those in Scotland). In 2017, 67,000 people were employed in farming (including owners), of which 19,500 (29.1%) were in Grampian and Tayside.

This area has a focus on the primary production of agriculture, forestry and fishing, which are characteristics of its landscapes and cultural identity. The farming production systems represented by this case study are relevant across the European Union (i.e. Mixed farming with livestock, and General cropping). Examples of the agro-ecological farming practices used to address issues of sustainability are biodiversity support practices, nutrient budgeting, organic farming, permaculture and agroforestry. The main **sustainability issues** of the case study are of environmental (e.g. soil erosion and reductions in soil health and quality; and threats to pollinators and biodiversity) and socio-economic nature (e.g. long-term viability of farms and value chains, weak involvement of communities). Tackling the socio-economic and environmental sustainability issues at a farm level is challenging in several ways and at several levels. At a farm level actions can be taken to reduce dependency on external inputs, invest in improving natural and social capital, and operate more efficiently. However, solutions to sustainable farming systems can only be achieved with actions beyond the farm level. The functioning of the farming systems in the case study area rely upon the effectiveness of the supply chains, the operation and feedback of the markets, all within the biophysical and regulatory frameworks of the area, and with the support of society and peers (e.g. through forms of collaboration). So, at a system level, its components need to transition together, albeit on different but compatible pathways, which maintain key links, overcome barriers, and respond to feedback within and from outwith the system.

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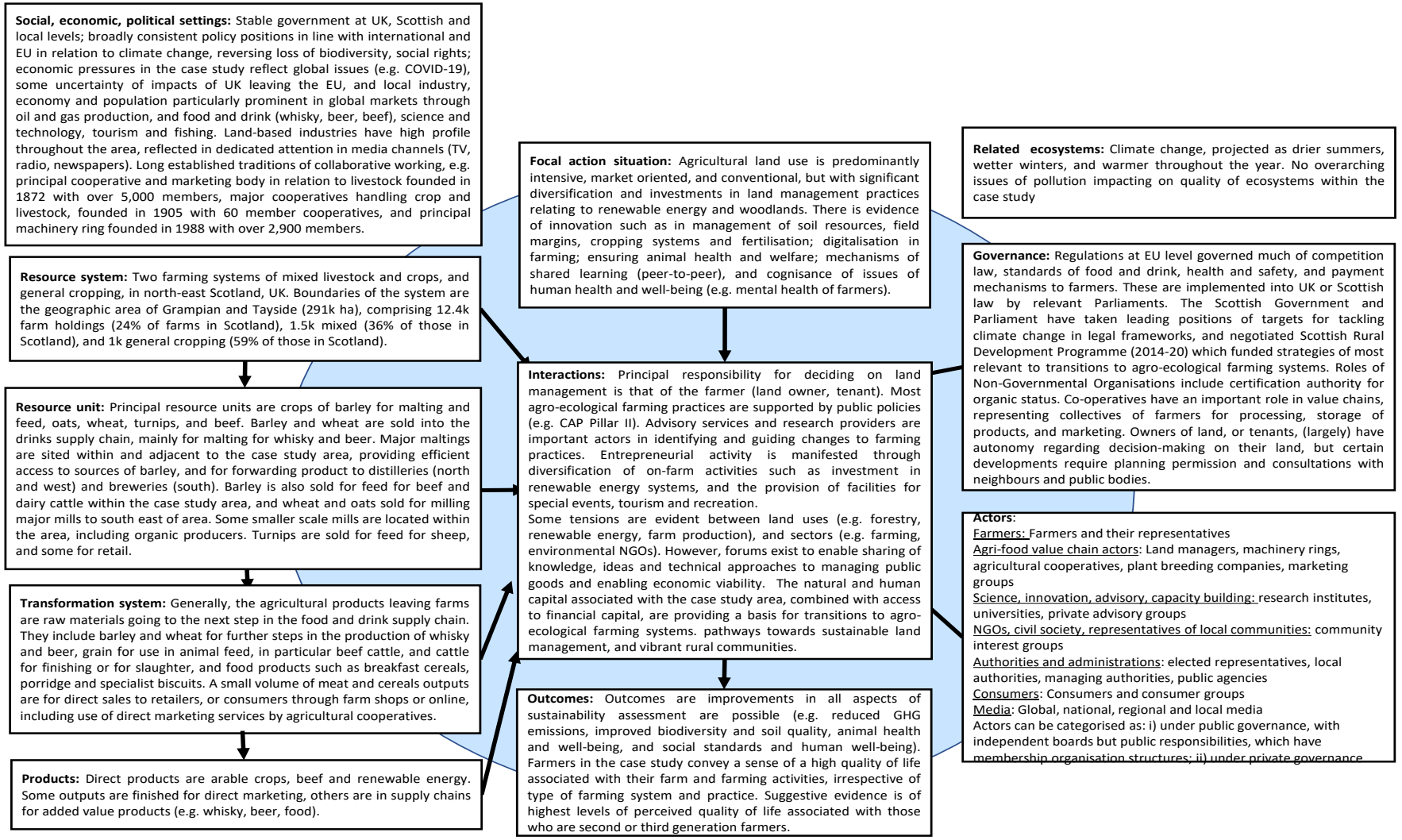

Figure 16. Overview of the social-ecological system - UK case study (Source: own figure based on Ostrom and Cox, 2010; McGinniss and Ostrom, 2014)

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Barriers *and* ***drivers*** *of transition*

Culture and mindset can be a barrier to transition to agro-ecological farming systems due to a reliance of farmers and actors in the value chain on familiarity with existing approaches, and (experience based) known outputs and implications for the business and its assets. Such resistance to change, or unproven approaches, can inhibit the uptake of new ideas and practices. Aspects of the barrier can be addressed by more effective communication and explanation of agro-ecological farming systems which is being provided in a wide range of types of engagement activities including Monitor Farms, organised by research organisations (e.g. James Hutton Institute; Scotland's Rural Colleage, SRUC), and organisations representing steps or actors in the supply chains (e.g. Scottish Agriculture Organisations Society, SAOS; Aberdeen and Northern Marts, ANM; National Farmers Union Scotland, NFUS).

Another important barrier is the **shortage of skilled labour**. The creation of training infrastructure for land-based industries contributes to addressing the shortage of skilled labour. Scotland's Rural College (SRUC; www.sruc.ac.uk), largely funded by the Scottish Government, is the principal provider of education in land based industries. It has three main education centres, one of which is in the case study area (Craibstone, Aberdeen). SRUC, in collaboration with specialist training providers such as LANTRA Scotland and Digital Skills Scotland, and financial and technical support by organisations such as the Royal Highland and Agriculrural Scociety of scotland, RHASS), is enabling the barrier to be addressed over the medium to long term.

Limited access to land constrains opportunities for new entrants to try a career in farming. The Scottish Land Commission (2019) notes that "A steady flow of new entrants is crucial to the ongoing vitality, resilience and competitiveness of the agricultural sector and rural regions in Scotland. New entrants and fresh business models bring innovations which are of importance for the entire agricultural community and are likely to increase the productivity and sustainability of the sector." Mechanisms for enabling access to land are Share Farming, Contract Farming, Tenancies, Partnerships, Short term leasing or licencing. An important means of overcoming a barrier of access to land is providing and enabling access to information about approaches for new entrants to farming and sharing experiences.

Producers work to the standards set by retailers for outputs to be accepted. Current **retailer standards for produce hinder differentiation** and variety in produce associated with agro-ecological practices. Initiatives by retailers (e.g. on sustainability, product pathways to market) provide scope for more variety in produce, something which is often associated with agro-ecological practices. Improvements in collaborative working between suppliers and retailers have the potential to overcome retailer standards for produce being a barrier. Sharing of knowledge and information between retailers, actors in the supply chain, and producers about environmental, social and economic factors may influence the evolution of retailer standards. There is also some evidence to suggest that such closer working is leading to the development of new pathways to marketing produce, which is also being well received by consumers.

The Scottish Government Food Processing, Marketing and Co-operation Fund (FPMC) policy helps investment in improvements of local processing facilities. Support for facilities in the case study area has been across a range of sizes of businesses from, for example, a butcher in Fraserburgh, Aberdeenshire, £59,000 (2017) to £4 million of a £17 million investment in a new abattoir and meat-processing facility (2018). Such investments contribute to keeping added value within the case study area. Significant **collective investment in local processing or infrastructure** has been made by cooperatives renovating or building new facilities for markets (e.g. Thainstone, Aberdeenshire) and grain storage (e.g. Coupar Angus), and by large malting businesses (e.g. grain storage, Boormalt at Buckie).

Table 34 summarises the key barriers and drivers that were identified to be addressed in the transition strategies co-constructed with farmers and other key actors in the Multi-Actor Platform.

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Table 34. Key barriers and drivers to be addressed in the transition strategy in the UK case study.

Type of Barrier /Driver	Barrier / Driver
Social – cognitive / normative	• Culture and mindsets of actors
Social - institutional	• Lack of access to land
Knowledge	• Lack of knowledge and shortage of skilled labour
Economic	• Retailer standards for produce hinder differentiation and variety in produce associated with agro-ecological practices • Lack of processing facilities • *Driver: Collective investment in local processing or infrastructure by cooperatives renovating or building new facilities for markets.*

*Characteristics of identified **transition strategies***

Strategies to address the barriers of agro-ecological transitions have been co-constructed with the Multi-Actor Platform involving farmers and different actors who can influence the decisions of farmers to implement agro-ecological practices. The objective of the co-constructed transition strategy is to address the social, knowledge, and economic barriers of initiating agro-ecological transition in mixed farming systems in North-East Scotland.

Strategic pathways on enhancing knowledge exchange and changing culture and mindsets and increasing cooperation and diversity in the value chain are proposed. Key governance changes of those pathways are: i) cooperation through farmer membership groups and their mechanisms for sharing specialist machinery, and providing facilities at different parts of the supply and value chains; ii) engagement with civil society and authorities to share understanding of the function of landscape features and soil management practices; iii) collaboration between farmers, authorities and advisors to explain regulations, guidelines and opportunities for funding for slurry management and communication mechanisms explaining the benefits of the grazing and fertiliser management to actors in agri-food value chain; iv) new agricultural support mechanisms linked to the Scottish Biodiversity Strategy for land management practices that encourage spatial diversity of crops; v) strategies that set pathways to contribute to climate neutrality in response to climate change, such as the Scottish Government Climate Ready Scotland and Farming for a Better Climate.

Each strategic pathway identifies the key types of actors, in addition to farmers, who need to be involved in the social ecological system to overcome the barriers through changes in cooperation and the governance of the social-ecological system, and changes in market institutions and policy instruments which have the potential to support the transition process.

Table 35 summarises the proposed main elements and pathways of the transition strategies. While specific pathways of the strategies have been identified to address different barriers, it is important to note that the different transition barriers are not independent from each other and need to be addressed jointly to enable a successful agro-ecological transition.

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Table 35. Co-constructed transition strategy to address barriers and drivers of implementing agro-ecological practices in the UK case study

Strategic Pathways for Addressing Barriers and Drivers of Implementation		
Suitable Agro-ecological Practices	Soil management (e.g. returning chopped straw back onto land, Direct drilling), Tillage (e.g. reduced tillage), Management of landscape elements and biodiversity management (e.g. field margins and hedges), Livestock feed and grazing practices (transitioning to rotational grazing), Fertilizer management (e.g. green manure, farmyard manure), Spatial diversity of crops (e.g. agroforestry and intercropping)	
Strategic Pathways	**Enhancing knowledge exchange and changing culture and mindsets**	**Increasing cooperation and diversity in the value chain**
Barriers / Drivers of Implementation to be addressed	Culture and mindsets Lack of knowledge and shortage of skilled labour	Limited access to land Lack of processing facilities Retailer standards for produce hinder differentiation and variety in produce associated with agro-ecological practices *Existing collective investment in local processing or infrastructure by cooperatives renovating or building new facilities for markets (Driver)*
Actors Required in the SES to Address Barriers	Farmers Authorities / Administration, science, innovation, advisors, general public	Farmers Agri-food value chain, Authorities / administration, science, advisors, civil society
Changes Envisaged in Cooperation and Governance of the SES	Cooperation through farmer membership groups (e.g. SOAS, ANM) and to share experience of farmers with similar interests (e.g. QMS Better Grazing Groups); Collaboration between farmers, authorities, advisors and science to introduce and co-learn about the benefits and requirements of practices, to set baseline indicators, and peer to peer demonstration events Collaboration in events for awareness raising for public audiences and to share understanding of functions of landscape features	Cooperation to share specialist machinery Cooperation on collective investment in local processing or infrastructure Advice and co-learning on benefits of practices, such as through knowledge exchange events and demonstration events with value chain actors and public audiences, public engagement events and co-created knowledge exchange media Sharing of knowledge and information between farmers and value chain actors about environmental, social and economic factors to influence retailer standards Knowledge exchange on strategies for climate change adaptation and mitigation
Changes Envisaged in Market Institutions	None identified	Roles for membership organisations and authorities in guiding community benefits (e.g. investment in public services in the locality)
Policy Instruments to	Funding to support grazing groups with the aim of sharing knowledge and experience of grazing practices and support for temporary fencing sub-dividing	Support for spatial diversity of crops in new agricultural support mechanisms, linked to Scottish Biodiversity Strategy

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Support the Transition	fields into management units Scottish Farm Advisory Service, Rural Innovation Support Service For Scotland, Knowledge Transfer and Innovation Fund, Strategic Research programme (2016-2021), North-East Scotland Agriculture Advisory Group Events co-designed for all types of relevant actors to share understanding of issues, for use in revising regulations, or developing new regulations Public policies for mainstreaming biodiversity, and no net loss of biodiversity Expanding the agri-environment schemes of the SRDP	Scottish Government Climate Ready Scotland, Farming for a Better Climate Support for public engagement and outreach activities Grant schemes (e.g. Agri-Environment Climate Scheme; slurry stores; Food Processing, Marketing and Co-operation Fund)

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5. ANALYSIS OF BARRIERS AND DRIVERS OF TRANSITION

5.1. Synthesis of Key Barriers and Drivers

The objective of this sub-section is to synthesise the key barriers and drivers that impact on the different stages of transitions across the 15 case studies. It draws on the evidence gathered in the summaries of the individual case studies in Section 4, to inform the identification and explanation of the main clusters of themes of barriers and drivers of agro-ecological transitions that are emerging. It also describes how these main themes of barriers and drivers differ between case studies in incremental and transformational transition stages. An inventory of the barriers and drivers identified in the 15 case studies is provided in Annex 1.

Figure 17 shows a word cloud of the aspects of barriers and drivers to which reference is made most frequently. Foremost amongst the most frequently used words are those relating to knowledge, practices, products, support, value, and farmers, farms and farming (reflecting the principal responsibility for production, and users of knowledge and support).

Figure 17. Word cloud of the barriers and drivers identified in the 15 case studies

From the analysis of the inventory of barriers and drivers three broader main themes of clusters of barriers and drivers have been derived: i) Lack of knowledge and social capital; ii) lack of added value, processing and market access; iii) ineffective policy design. For each theme, the most commonly identified barriers and drivers are explained, and the main categories of actors to whom these barriers relate (for a definition of the actor categories, see Vanni *et al.*, 2019).

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Knowledge and social capital

The most commonly identified barrier is the lack of knowledge of specific agro-ecological practices and their sustainability benefits, and the economic opportunities and associated uncertainties for creating added value from agro-ecologically produced goods. Such barriers were reported for most of the case studies, and reflects the knowledge-intensive character of agro-ecological farming. These barriers relate mainly to a lack of knowledge amongst farmers, but also highlight the need for specialised knowledge for advisors and teachers working in vocational schools. Two main constraints for farm advisory services need to be considered. They can be underfinanced or they have difficulties in recruiting qualified advisors. A related weakness is one of limited coordination amongst AKIS actors, and the lack of networks for knowledge sharing involving farmers, advisors and researchers. Such weaknesses in knowledge sharing infrastructure can hinder the effective implementation of more complex agro-ecological practices. Without peer-to-peer networks to share experiences and knowledge farmers feel unable to implement agro-ecological practices and the lack of institutional support can create a sense of loneliness and farmers fatigue (e.g. Lithuanian and Romanian case studies). Case studies that are more advanced in transitions have overcome this barrier through the creation of producer organisations and networking between farmers and trusted advisors, which has enabled different actors to meet and share their experiences. Such peer-to-peer networks and institutional support can reduce risks of a sense of loneliness.

In many case studies there was evidence of barriers to agro-ecological transitions due to a low capacity and willingness to cooperate due to weak social capital and individualism of, and rivalry between, farmers. For case studies in Eastern Europe, the reluctance to cooperate can be explained by the negative experience of nationalised collective agricultural systems imposed by the communist regime. In these contexts, the term 'cooperation' has a negative connotation. The lack of confidence and trust in agricultural cooperatives, and resulting low willingness to cooperate, is closely linked with economic barriers. For example, a lack of willingness to cooperate may inhibit options for shared purchasing of storage and processing infrastructure, or direct marketing. Members of some Multi-Actor Platforms also emphasised that a lack of trust and confidence negatively impacts on the willingness of different types of actors (e.g. farmers, consumers and policy actors) to collaborate with each other. Explanations for such a lack of willingness to collaborate are high levels of bureaucracy and rigidity of policy support, increased cost-price squeeze for farmers, and cases of animal cruelty and environmental pollution reported in the media. These findings highlight the need for actions in the transition strategies to build trust and social capital, which is a long-term process.

In addition to the barriers commonly identified in several case study contexts, several specific barriers were identified in particular case study contexts. An agro-ecological transition requires specialised knowledge and skills of agro-ecological farming practices in order to maintain yields without the use of chemical fertlizers and plant protection products. A shortage of skilled labour on agro-ecological farms results in farm managers being overworked which impacts on overall farm viability. Such a lack of skilled labour to implement knowledge-intensive agro-ecological practices was highlighted as a barrier to the organic farming sector in Latvia and the mixed farming systems in Scotland, UK. Specific technological barriers were highlighted in the Austrian case study which targeted the improvement soil humus content and soil fertility of arable and perennial soils. For example, several farmers in the case study compost urban organic waste by order of the State Government. Due to the contamination of the bio-waste with other types of waste (e.g. plastic or batteries), soil specialists consider this a problem, although all those interviewed were convinced of the need to close these nutrient and carbon cycles. The southern European case studies in Italy and Spain also reported problems of generational replacement and farm succession. The lack of successors is linked to a number of economic barriers, e.g. in relation to the lack of added value, financial resources needed for the investment required, and access to land.

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Table 36. Knowledge and social capital: Commonly identified barriers and involved key actors

Description of Commonly Identified Barriers	Main Category of Actors	Relevant Case Studies
Lack of knowledge on specific agro-ecological practices and their sustainability benefits	Farmers	AT, CZ, CH, DE, ES, FR, GR, HU, IT, LT, RO, SE
Lack of knowledge and awareness of economic and market opportunities of agro-ecological farming	Farmers	AT, CZ, CH, DE, ES, FI, FR, GR, HU, IT, LT, RO, SE
Lack of access to advisory services for agro-ecological practices and need for specialised knowledge in advisory services and agricultural education	Farmers, and science, innovation, advisory, capacity building	AT, CH, FR, HU, RO
Limited AKIS coordination and lack of knowledge networks and practice-relevant research	Science, innovation, advisory, capacity building	AT, DE, ES, FR, HU, IT, RO
Attitudes and beliefs towards environmental concerns and agro-ecological farming	Farmers, and science, innovation, advisory, capacity building	DE, HU, SE, UK
Strong tradition of conventional farming practices and of specific production systems (e.g. meat and dairy)	Farmers	CH, DE, HU, RO, SE, UK
Low capacity and willingness to cooperate due to weak social structure and individualism and rivalry	Farmers	AT, CZ, ES, GR, HU, IT, SE
Lack of trust and confidence between actors	Farmers	CZ, DE, GR, HU, RO
Fatigue, fear, isolation or loneliness and lack of long term prospects or visions of farming	Farmers	ES, LT, RO

While the main emphasis was on understanding barriers that need to be addressed in the co-constructed strategies, a set of existing drivers were also highlighted that initiate or on which the enhancement of agro-ecological transitions can build. Those drivers relate to existing collaboration and cooperation between farmers (e.g. producer organisations such as EHKO in the Basque country in the Spanish case study, and machinery rings in the German, Italian and UK case studies), and between farmers and advisors and other key actors (e.g. pioneer farmers and local restaurants in the Swedish case study, and the Agro-Eco-Viscri Association in the Romanian case study). The establishment of trusted long-term relationships between farmers and between farmers, advisors and other actors facilitates knowledge sharing and joint knowledge creation relating to the benefits of agro-ecological practices.

Value added, processing and market access

Commonly identified barriers across several case studies relate to the economic sustainability of agro-ecological farming within the framework of the current conventional food systems. Cost-price squeezes were highlighted as a challenge, reflecting a combination of increasing prices of inputs and insufficient product prices. Farmers are price-takers, lacking the market power to negotiate higher prices. The low productivity and profitability, in particular of smaller farms, aggravates a lack of financial resources for the larger investments required to purchase the technology required to implement more complex agro-ecological practices (e.g. machinery for compost management on farms in the Italian case study). In addition, investment lock-ins create path dependencies and hinder the transitions to different production systems, e.g. moving from livestock production to more diversified farming systems with crop production

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(Swiss and Swedish case studies). In the case of incremental and subsided agro-ecological practices (e.g. through agri-environmental measures), the financial risk taken by the farmers in establishing agro-ecological practises is limited.

Important barriers were also identified in a number of case studies in relation to the additional labour requirements of agro-ecological farming and a lack, or perceived lack, of access to land. The barrier of a lack of access to land differs in different case study contexts. In the context of conventional arable farming in the German case study the implementation of agro-ecological practices was perceived by farmers as increasing the risk of losing access to land. This is confirmed through specific conditions in rental agreements in which landowners exclude the option of implementing agro-ecological practices that would impact on the value of the parcels. In other case study contexts, lack of access to land for young farmers and new entrants was highlighted (e.g. in the Spanish and UK case studies).

Further important key barriers relate to activities and infrastructure of the value chain. Findings in several case studies showed that: i) farms did not have the capacity and the infrastructure to store and process their raw material in order to sell processed food products directly to the consumer (e.g. in the Romanian case study); ii) a lack of differentiation of agro-ecologically produced raw materials is driven by the standardisation of processing in the value chain. Producers work to standards set by retailers for their outputs to be accepted. The lack of local food chains and saturation of the market for on-farm shops can hinder market access for quality products. Co-constructed strategies need to develop pathways for sharing knowledge and information between retailers, actors in the supply chain, and producers, about the environmental, social and economic factors that could influence the evolution of retailer standards. Those new standards may find high levels of acceptance by consumers.

Table 37. Value added, processing and market access: commonly identified barriers and main category of key actors involved

Description of Commonly Identified Barriers	Main Category of Actors	Relevant Case Studies
Cost-price squeeze and low productivity and profitability	Farmers and agri-food value chain	CH, CZ, LT, LV, SE
Lack of financial resources, investment lock-ins and big investments needed to afford required technology to implement practices	Farmers and financial institutions	ES, FI, FR, HU, IT, RO, SE
Access to land: risk of losing access and lack of access to land for new entrants	Farmers and landowners	CZ, DE, ES, UK
Low supply or rural labour	Farmers	IT, LT, LV, RO
Lack of added value from agro-ecologically produced goods and lack of market incentives	Farmers, agri-food value chain and consumers	CZ, DE, GR, HU, LT
Lack of differentiation and availability of storage and processing infrastructure	Farmers and agri-food value chain	DE, LV, RO, SE, UK
High market concentration, lack of local food chains and lack of market access for quality products	Agri-food value chain	IT, RO, SE
Market conditions including small volume produced, irregular supply, sales uncertainty and market saturation for direkt marketing	Farmers and agri-food value chain	CH, CZ, LV, GR
High prices for consumers and low demand and consumer awareness and interest in sustainable agricultural products	Agri-food value chain and consumers	CH, CZ, LT, LV, SE
Low public procurement of organic and agro-ecologically produced goods	Authorities and administration	LT, LV, RO

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Low levels of demand and low consumer awareness and interest in sustainable agricultural products, are key barriers of transition in a number of the case studies. This is reflected in the current governance networks of most case studies irrespective of the transition stage, in which key actors who are missing are the consumers, and in the evolution of the roles and relationships of actors recommended for addressing the key dilemmas of the case studies (Vanni *et al*., 2019).

Although low consumer willingness to pay and of awareness of the benefits of agro-ecologically produced goods were identified as significant barriers, there is some evidence that consumers are starting to value attributes such as locally produced and plant-based foods, and that demand for locally produced and quality food is increasing (e.g. see recent data from the organic food sector in Germany; BMEL, 2021).

Other drivers of agro-ecological transitions are: i) changes in diets, such as reductions in meat consumption, as reported from the Swiss and Swedish case studies; ii) increased consumer awareness of benefits of agro-ecological farming systems through building on the experiences with, and infrastructure for, marketing of organic farming products; iii) the collective ownership of machinery by small groups of farmers for use in agro-ecological practices, drawing on the experience from existing grassroots initiatives (e.g. in the Italian, French and Romanian case studies).

Policy design

Unsuitable prescriptions in current policy measures which hinder the effective implementation of policy measures and contribute to a lower uptake of agri-environmental measures have been reported in several case study contexts. Such prescriptions are those which negatively impact on potential environmental benefits (e.g. to clean the vegetation on agricultural land in the Romanian case study) and barriers to the design of policy measures that reduce the potential for successful cooperation (e.g. prohibiting marketing cooperatives to sell milk to traders in the Czech organic sector; emphasis on individuals instead of collective actions in the Greek Rural Develepment Programme). Negative experiences with a high level of bureaucracy of the Common Agricultural Policy payment system, detailed monitoring at a level of a square metre, and perceived high risks of financial penalties have all negatively impacted on their willingness to sign up to agri-environmental measures that support the adoption of agro-ecological practices.

Similarly, administrative burdens and the additional knowledge required for new food safety regulations were perceived as barriers. In particular, complex regulations have a negative impact on smallholder farmers who often lack the time and capacity to comply with these regulations and prescriptions, and to access funds necessary for their implementation. In several case study countries and regions, programmes exist that aim to promote the consumption of healthy and sustainable food in schools. Such programmes can create demand for agro-ecologically produce goods, but only a few local municipalities have taken this up through public procurement (e.g. in the case of the "Milk for Children" programme in Lithuania).

Table 38. Policy design: Commonly identified barriers and main category of key actors involved

Description of Commonly Identified Barriers	Main Category of Actors	Relevant Case Studies
Unsuitable prescriptions and lack of flexibility in implementation and monitoring	Farmers and authorities and administration	CZ, ES, GR, LV, RO, SE
Bureaucracy of policy support, regulations and control mechanisms to implement agro-ecological practices	Farmers and authorities and administration	DE, CH, RO
Lack of targeting of agro-ecological practices	Authorities and administration	AT, LT, RO
Lack of public procurement of agro-ecologically produced goods	Authorities and administration	CZ, LT

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Operational Groups and other networking activities of practice and policy innovations through EIP-Agri (e.g. its prospective partnership on agro-ecology and living labs and research infrastructures), are drivers for close cooperation between practice and policy, informing effective design of policy support for agro-ecological transitions.

Table 39 synthesises the importance of each theme of barriers and drivers across the 15 case studies. This synthesis is based on the number of barriers and drivers in each theme, and the main barriers and drivers identified in each case study summary report. The evidence gathered from the case studies suggests that a lack of knowledge and immature social capital are key barriers to initiate transitions in conventional systems, and higher barriers than where transitions are being enhanced. The role of cooperation and social capital will be further examined in Section 6.2.

Barriers and drivers in relation to issues of policy design have a less important role in most of the case studies. One possible explanation is the intended focus of the co-construction process on barriers and drivers that local actors can address, and that local actors perceive their influence on improving the policy design as being very limited.

Table 39. Overview of transition stages and main themes of barriers and drivers

Case Study	Transition Stage	Main Themes of Barriers and Drivers		
		Knowledge and Social Capital	Value Added, Processing and Market Access	Policy Design
AT	Initiating	✓		(✓)
CH	Initiating	✓	✓	(✓)
DE	Initiating	✓	✓	(✓)
FI	Initiating		✓	
FR	Initiating	✓	✓	✓
GR	Initiating	✓	(✓)	(✓)
HU	Initiating	✓	✓	
SE	Initiating	✓	✓	
UK	Initiating	✓	✓	
CZ	Enhancing	(✓)	✓	
ES	Enhancing	(✓)	✓	(✓)
IT	Enhancing	(✓)	✓	
LT	Enhancing	(✓)	✓	(✓)
LV	Enhancing	✓	✓	(✓)
RO	Enhancing	✓	(✓)	(✓)

✓ = Several key barriers have been identified; (✓) = Single barriers have been identified.

Table 39 indicates the complexity of barriers and drivers of agro-ecological transitions, in the case studies initiating and enhancing transitions. Although the barriers and drivers under each of the three main themes require specific actions and changes in governance, the different barriers and drivers do not occur in

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isolation. Specific interdependencies between barriers might strengthen or weaken other barriers and drivers over time, and may lead to loops and cycles of barriers and drivers that reinforce their hindering of the initiation or progress towards agro-ecological transitions.

5.2. Interdependencies Between Barriers

This sub-section identifies and discusses examples of interdependencies between different barriers and drivers. It explains the complexity of the relationships between different factors impacting on the success or failure of initiating or enhancing transitions, and to inform the types of key actions and changes in governance required in future transition strategies. The interconnectedness and interdependencies between different barriers result in examples of virtuous cycles, in which the existence of some barriers reinforces the pace at which other barriers develop over time. An improved understanding of these dynamics can inform actions and changes in governance in future strategies for agro-ecological transitions that effectively break these causal loops.

Low social capital in the farming systems in a number of case studies results in a low capacity and willingness to cooperate (Figure 18). Farmers have a distrustful stance towards collaboration, mutual support and joint efforts, which leads to a lack of confidence and trust in agricultural cooperatives and collective processing and marketing activities. The low willingness to cooperate in processing and marketing activities reinforces the barrier of there being a lack of value chains for agro-ecological farming. In turn, the lack of value chains and collective marketing initiatives prevents closer producer-consumer linkages and reduces the raising of awareness of consumers of the benefits of agro-ecologically produced goods. This has a consequence of exacerbating the barrier of low demand and consumer interest for agro-ecologically produced goods, which in turn contributes to the negative beliefs and attitudes of farmers towards agro-ecological farming and its benefits. Changes in the beliefs and attitudes towards agro-ecological farming and its benefits are needed to increase the willingness to cooperate.

A second cycle of barriers relates to policy support, networks, education and awareness (Figure 19). Insufficient targeting of policy towards supporting knowledge creation (including curricula of vocational schools), or of the establishment of formal knowledge networks of farmers with trusted and skilled advisors in agro-ecology who act as local and permanent network managers, reinforces the barrier of the lack of access of farmers to advisory services for agro-ecological practices and need for specialised knowledge networks. In turn, this results in a lack of education and training of farmers (both through vocational schools and advisory services) and advisors of the requirements and benefits of agro-ecological practices. As a consequence, there is no improvement in the level of awareness of farmers of the benefits that different agro-ecological practices can provide in the specific contexts of their farms. Such low levels of awareness contribute to low levels of demand by farmers and farming organisations for policy actors to strengthen support for knowledge creation on agro-ecological farming.

The third identified cycle links social barriers with aspects of farm economics that hinder agro-ecological transitions (Figure 20). Trends in rural depopulation have led to a shortage of supply of labour in rural areas. That shortage restricts the feasibility of innovative and labour-intensive approaches to farm diversification and agro-ecological farming. The shortage of farm labour contributes to farm managers being overworked and results in fatigue of farmers and a lack of visions for the future of their farms. In turn, this impacts on the viability of the farm and reinforces the barrier of low productivity and profitability of the farms. This often leads to small and irregular volumes of produce from farms, which impacts negatively on the prospects of access to market incentives for agro-ecologically produced goods and hinders the creation of added value. The lack of added value generating from agro-ecological practices limits the economic capability of farms to recruit external farm labour.

The fourth example of a cycle of barriers relates to policy support, trust and knowledge (Figure 21). Unsuitable policy prescriptions and rigid requirements for implementation and monitoring increases the bureaucracy of policy support and control mechanisms. Negative experiences of farmers of a high level of

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bureaucracy of the CAP payment system contributes to mistrust and a lack of confidence between farmers and policy actors, such as paying and monitoring agencies. They also lead to conflicts between farmers and advisors in cases where farmers have to pay penalties for offences of not fully complying with detailed requirements and payment prescriptions. Lack of trust reduces information exchange and cooperation between actors, contributing to the lack of knowledge of farmers and policy actors on agro-ecological practices. The lack of knowledge on how to implement such practices most effectively in different farm contexts results in less informed policy and hinders the adaptation of a more effective design of policy measures.

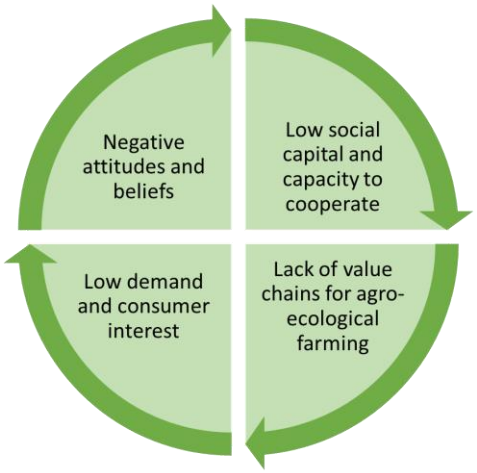

Figure 18. Cycles of barriers of transition: Social capital – value chain – consumer – attitudes – social capital

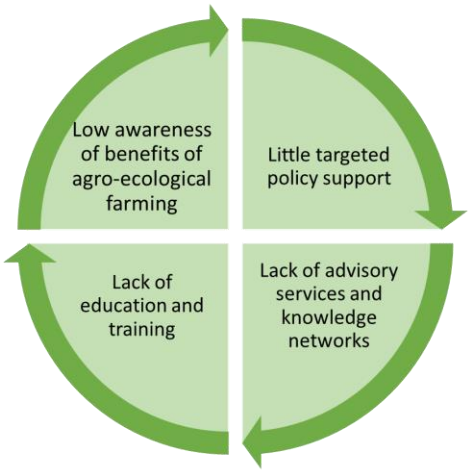

Figure 19. Cycles of barriers of transition: Policy support – networks - education – awareness – policy support

Figure 20. Cycles of barriers of transition: Social aspects – economic performance – added value – social aspects

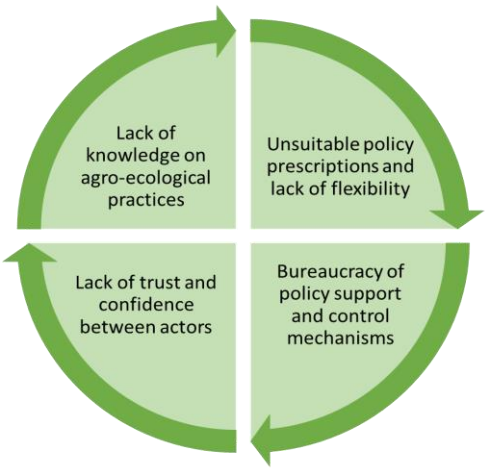

Figure 21. Cycles of barriers of transition: Policy support – trust – knowledge – policy support

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6. STRATEGIES FOR AGRO-ECOLOGICAL TRANSITIONS

6.1. Synthesis of Transition Strategies for AEFS

This section aims to synthesise the strategies for agro-ecological farming systems co-constructed with actors in the case studies. Due to the direct involvement of local actors and stakeholders, and the importance of the different contexts of each case study, the results are case study specific. While this makes a comparison of strategies across the case studies more challenging, which is also emphasised as a problem of transdisciplinary research (Binder *et al*., 2010), the main strategic pathways and their proposed key actions (governance changes) of the case study specific strategies are summarised, and differentiated according to: a) the identified three main themes of enhancing knowledge and social capital, creating added value and market access and designing effective policy support; and b) internal and external actions and resources (governance changes) that drive the strategies.

Table 40 provides an overview of the strategic pathways co-constructed to address key dilemmas in the 15 case studies and indicates the main themes of barriers and drivers to which these mainly respond. Most of the case studies identified strategic pathways that respond to at least two of the three key themes reflecting the interdependencies of barriers and drivers across the main themes discussed in section 5.2. Most commonly, Multi-Actor Platforms have proposed strategic pathways that relate to improving knowledge and social capital and value added, processing and market access. This also mirrors the importance of value chains that recognise agro-ecological principles.

Reflecting the attention on economic barriers and drivers of the biogas plant development, the Finnish case study solely focuses on economic pathways in the co-constructed transition strategy. Similarly, the strong economic focus of the case study dilemma in Latvia is echoed in several strategic pathways which identify key actions and governance changes to improve market access, accompanied by an improved design of policy instruments supporting agro-ecological transitions. Overall, changes in the design of policy instruments are the subject of strategic pathways in fewer case studies, which have a greater focus on external governance changes in the policy environment of the farming systems studied.

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Table 40. Overview of the case study dilemmas and the co-constructed strategic pathways (Main themes of barriers and drivers: KNO – Knowledge and social capital; VAL - Value added, processing and market access; POL – Policy design).

Case Study	Case study Dilemma	Co-constructed strategic pathways	Main Themes
AT	How to tackle impacts from climate change (e.g. water stress), increase carbon sequestration in soils, prevent soil degradation and reduce soil fertility loss while maintaining or improving the farm's social and economic sustainability and contributing to climate change mitigation.	• Strengthening knowledge networks and cooperation • Supporting humus formation at systems level urban waste management • Improved action research	KNO
CH	How to reduce the high animal densities and at the same time remaining profitable against the backdrop of important path dependencies (barn constructions, depths, up- and downstream market, knowledge system).	• Conversion to organic farming • Diversification with new farm enterprises • Increase in direct marketing	KNO VAL
CZ	How to maintain the good performance of arable land management in organic dairy farms in Vysočina region to reduce arable soil degradation and water pollution by pesticides while ensuring economic viability.	• Improving market access and added value • Enhancing knowledge and cooperation • Improving access to land	KNO VAL
DE	How to integrate agro-ecological practices on arable land in market-oriented farming systems to reduce biodiversity loss and water pollution without significant negative impacts on the economic viability of farms.	• Setting up and strengthening knowledge networks • Engaging landowners in agro-ecological transitions • Creating markets and generating added value • Increasing the effectiveness of policy support	KNO VAL POL
ES	How to reduce the fragility of agro-ecological farms while maintaining the social, economic and environmental sustainability.	• Strengthening farmers' cooperation and networks • Supporting collectivization of services and infrastructures • Improving conditions of access to land	KNO VAL
FI	How to reduce harmful climate, soil and water impacts of dairy farming in Nivala region without sacrificing economic viability of the dairy sector, by means of envisioning and implementing a multipurpose bio-product plant along the lines of circular bioeconomy, with the aim of producing bioenergy and organic fertilizers from manure.	• Improving economic valuation of manure input • Supporting valorization of biogas digestates • Creating a supportive and consistent policy framework for investments in biogas plants	VAL
FR	How to reduce dependency on external fertilisers and to reduce pesticides use (especially glyphosate) through agro-ecological practices increasing soil ecological services (soil biology) while maintaining the economic profitability of farms.	• Fostering local cooperation of pesticide free farming • Creating partnerships at a food system level for values based supply chains • Strengthening collective actions for landscape management	KNO VAL

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GR	How to sustain the long-term economic viability of farms whilst protecting the natural resources? How to protect biodiversity and water quality in orchards whilst improving competitiveness and market access.	• Increasing social capital of local actors • Addressing knowledge gaps on agro-ecological practices • Improving market access and value added	KNO VAL
HU	How to integrate agro-ecological practices on arable land in highly market-oriented arable farming systems to maintain and improve soil quality without significant negative impacts on the economic viability of farms.	• Increasing cooperation at national level • Fostering shift in mindsets and improving cooperation • Enabling the application of new technologies • Increasing consumer awareness	KNO VAL
IT	How to promote cropping system diversification in a highly specialised and market-oriented winegrowing area via the adoption of agro-ecological practices, to increase biodiversity and improve landscape management while maintaining the profitability of farming through local value chains.	• Empowering regional and local knowledge networks • Promoting cooperation on the implementation of agro-ecological practices • Promoting the coordination among farmers and other local food chain actors	KNO VAL
LT	How to maintain and encourage extensive management (grazing) of grassland habitats? How to become (or remain) competitive in the market without intensifying the farming practice.	• Enhancing cooperation for improved value chains and consumer awareness • Improving access to, and sharing of, knowledge	KNO VAL
LV	How to increase the economic viability of conventional and organic, largely grass-based, dairy farms while preserving biodiversity in grasslands and water resource quality; How to ensure that all organic milk is processed into organic dairy products.	• Creating dairy cooperatives to increase market access • Increasing public awareness and demand • Improving policy support for agro-ecological transitions	VAL POL
RO	How to increase the economic viability of small- scale farming while preserving the cultural landscape and biodiversity.	• Enhancing knowledge sharing on agro-ecological practices • Increasing market access through cooperation • Improving targeting of, and access to, policy support	KNO VAL POL
SE	What are the challenges and possibilities to diversify specialised ruminant farms to include more crops for direct human consumption, while simultaneously integrating more agro-ecological principles to enhance sustainability performance in an economically strained production sector?	• Fostering knowledge exchange and cooperation • Enhancing cooperation in the value chain and market access	KNO VAL
UK	Producing public goods whilst maintaining viable production of private goods, and securing economic and social sustainability at a farm level.	• Enhancing knowledge exchange and changing culture and mindsets • Increasing cooperation and diversity in the value chain	KNO VAL

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The actions identified in the co-constructed transition strategies comprise changes in the governance of the social-ecological system (SES) that will be done by actors inside the SES (e.g. common storing or processing activities of farmers) as well as changes carried out by external actors including changes to market institutions and, if relevant within the specific local context of the case study, new forms of market incentives and policy support that have the potential to foster the transition processes. Tables 41 and 42 summarise the key internal and external governance changes under the three main themes of socioeconomic and policy barriers and drivers.

Governance changes internal to SES *(Table 41)*

To enhance **knowledge and social capital** in agro-ecological transitions new institutions designed by farmers have been identified in a number of case studies. This includes agreements on sharing funds to hire targeted advisory services, to create knowledge exchange hubs (e.g. Czech, Lithuanian, Romanian and Swiss case studies) and the creation of networks of farmers, which facilitate the gathering and sharing of information, knowledge and experiences and peer-to-peer learning, e.g. on pilot testing and good practices in implementing agro-ecological practices (e.g. Spanish, French, and Italian case studies). Such knowledge networks are likely to be effective in overcoming the barriers in knowledge transfer which individual farmers face, and help to address barriers in relation to reliability, credibility, and trust (Feldman and Ingram, 2009).

Trusted intermediaries (e.g. advisors) play an important role in initiating and facilitating knowledge networks and coordinating cooperation between farmers and farmer cooperatives, advisory services and research. Their aim is to demonstrate good practices of diversification (e.g. German, Italian and Swedish case studies), to pilot new practices and technologies on demonstration farms (e.g. insect sexual confusion methods for pest control in the Greek case study; soil conservation practices in the Hungarian case study) and to establish closer and trusted relationships between practice and applied research (e.g. Austrian case study). The organisation of a central digital platform, coordinated by AKIS actors in cooperation with farmers, could facilitate the collection and management of digital knowledge and innovation transfer infrastructures.

Strategic pathways paid particular attention to actions that increase the knowledge and awareness of the young generation (future farmers and consumers). A particular role was proposed for farmers with advanced know-how in agro-ecological practices, supported by advisors, to work with schools and vocational schools to increase the knowledge of agricultural students on agro-ecology. The learning topics would include information on new technologies to increase the attractiveness of agro-ecological farming amongst young farmers (e.g. Romanian case study), and to raise public awareness of the benefits of agro-ecologically produced goods (e.g. Czech and German case studies).

Complementing changes in the curriculum with internships on agro-ecological farms could increase the understanding of the benefits of agro-ecological farming. The cooperation of farmers with schools can build on existing school programmes (e.g. in Lower Saxony, Lithuania and Romania), and can benefit from policy-related drivers such as the review of the EU school scheme legal framework with a view to refocus the scheme on healthy and sustainable food foreseen in the action plan of the Farm-to-Fork Strategy (action 25, year 2023) (Massot Marti, 2020).

Knowledge networks to raise awareness on the benefits of agro-ecological farming also contribute to addressing economic barriers in relation to **value added, processing and market access**. Knowledge networks provide information on market opportunities and returns on investments for diversification and other agro-ecological practices. Most of the actions which target the generation of added value were to:

- create markets, e.g. through development of regional fairs as a platform and market for niche products (e.g. Swiss case study);
- initiate collective actions to sharing factors of production, in particular sharing of machinery and creating machinery rings for agro-ecological practices (e.g. French and UK case studies) but also through composting centres and procurement platform (e.g. for manure and other fresh organic matter in the Italian case study);

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- develop collective processing, storing, and marketing e.g. common shops, processing and storage to get added value and market access) with agreement on common rules, as well as cooperation with existing marketing initiatives (e.g. Latvian, Romanian and Swedish case studies).

Table 41. Overviews of actions leading to changes in internal governance of the SES

Key Actions Identified in Co-constructed Strategic Pathways	Case Studies
Knowledge and Social Capital	
Farmers create formal and informal knowledge networks and peer-to-peer learning	AT, CZ, DE, ES, FR, HU, IT, LT, UK
Farmers hiring advisors for open days on farms and roundtable discussion	CH, CZ, HU, LT
Trusted intermediaries (e.g. advisors) coordinate networks for knowledge transfer and social capital generation	AT, DE, HU, IT, UK
AKIS actors coordinate creation of a central digital hub for knowledge exchange	RO
Agro-ecological farmers cooperate, supported by advisors, with schools to increase the knowledge and to raise awareness of benefits	DE, CZ, ES, RO
Farmer cooperatives, advisory services and research cooperate to demonstrate good practices of diversification	IT, LT, SE
Farmers participate in pilots of new technologies on demonstration farms in cooperation with research and machinery manufacturers	HU, IT
Value Added, Processing and Market Access	**Case Studies**
Farmers creating cooperative and collective processing and marketing (e.g. common shops, processing and storage) with agreement on common rules	CZ, ES, LT, LV, RO, SE, UK
Farmers cooperating in shared marketing attracting other actors to become involved, and cooperation with existing marketing initiatives	CZ, CH, LT, LV
Farmers creating machinery rings, small collective composting centres and procurement platform for manure and other fresh organic matter	FR, IT, UK
Farmers cooperating with food policy councils set up by consumers and citizens, and / or initiate producer-consumer associations in cooperation with local communities	DE, LT
Farmers becoming members in regional food associations, with memberships of other key actors, for marketing and market access, and markets of uncultivated land	CZ, DE, IT
Development of regional fairs as a platform and market for niche products and farm tours organised by farmers targeted to consumers	CH
Policy Design	**Case Studies**
Farmers utilise opportunities for active participation in the consultations and discussions on the design of the CAP Strategic Plan or its equivalent	LV, RO, UK
Involvement of trusted peers (farmers) in monitoring and controlling of policy measures, e.g. in result-based agri-environmental measures	DE
Bottom-up initiatives to better understand and adjust to the needs of government staff	ES

Agro-ecological farming has the potential to be economically viable through higher gross margins for its products (van der Ploeg et al., 2019). However, processing capacities can be a key determinant for market access of agro-ecological farms. Local processors can help to increase the sales opportunities of the farms in the region, as it is the case in the Swedish case study. With the same expectation, agro-ecological cereal farmers in Spain seek to establish a local processing infrastructure. Also the Romanian case study revealed that the lack of access to local processing infrastructure is one of the issues faced by the smallholders in the

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region which in turn means that raw materials are sold into conventional channels with a high pressure on prices. Processing, when controlled by producers, creates value added as in the case the small-scale cheese makers in the Lithuanian case study.

Consumers are key to agro-ecological transition in terms of demand for products. The extent to which they are directly involved depends upon the product, brand, and supply chain. Some products may be in a position to retain consumers more easily than others. Cooperation of farmers with food policy councils set up by consumers and citizens, and the initiation of producer-consumer associations are key actions in the strategic pathways. These actions are in contexts of where there is some experience with short supply chains already exists and where the proximity of consumers and producers facilitates strengthened links between them (e.g. German and Lithuanian case studies). The scope and number of consumers engaged in such producer-consumer associations can be further expanded through innovative digital platforms that link consumers with farmers selling produce from agro-ecological farms. In addition, the membership of farmers in regional food associations is expected to connect farmers with other key actors in marketing and improved market access, and through regional (local) branding of products (e.g. Czech and Italian case studies).

There are examples of new ideas from farmers which align with emerging consumer preferences (e.g. organic dairy enabling consumers to self-collect milk), and the role of care farming for the benefit of the community. These deliver public goods, while the farm business remains viable, within their selected form of governance. The type, quality and effectiveness of farm practices contribute to the attractiveness of rural landscapes, evidence of which is recorded in surveys of visitors and their annual expenditure in the region. Specific opportunities exist in utilising the potential for tourism in the development of local value chains and on-farm value processing and marketing strengthening the cultural importance of local produce (Schwarz and Stauß, 2021). Existing farm tours organized by farmer associations and advisory services could be extended and specifically targeted at tourists (and thus consumers) (e.g. Swiss case study).

In terms of improving the **design of policy support** only a few actions were identified that directly relate to key actors internal to the SES. Farmers agreed they need to be a well-prepared partner for the State administrations, and to be more involved in the development of innovative policies. Opportunities need to be taken for active participation in the consultations and discussions on the design of the national Common Agricultural Policy Strategic Plans or their equivalents in associated countries (e.g. Romanian and UK case studies).

Governance changes external to SES *(Table 42)*

The external governance changes reflect the identified needs of farmers and other local actors involved in agro-ecological transitions of farming systems for support through changes in market institutions and policy instruments. Changes in external governance identified in strategic pathways targeted at **enhancing knowledge and social capital** focussed on government support for engaging different actors in agro-ecological transitions, and strengthening the capacity of farmers and other local actors for cooperation and knowledge exchange. The main actions for changes in external governance are to support:

- strengthening the capacity and skills of local actors for collective activities (e.g. training advisors and farmers in the facilitation of network and cooperation);
- piloting and setting up local agro-ecological networks bringing together innovative farms, landowners, advisors, and other relevant actors;
- training advisors in agro-ecological farming systems and practices, and the use of demonstration farms, peer-to-peer learning and professional platforms, e.g. on themes such as resource conservation, diversification and direct marketing;
- the creation of a coordination centre for advisory services, and to increase access of farmers to advisory service and other sources of knowledge on agro-ecological farming and relevant Rural Development Programme measures and regulations;

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- training of farm employees and unemployed people in the rural population on agro-ecological farming practices;
- coordinating education and awareness raising of landowners of the benefits of sustainability of providing land for agro-ecological farming.

Different combinations of market and policy instruments are needed to face the different knowledge-related challenges of agro-ecological transitions. Networking and cooperation instruments are crucial to create synergies within and amongst value chains and to support consumer responsibilities and involvement, which are needed to address the challenges of capacity building (Galioto *et al.*, 2021).

Creating clusters of inter-professional cooperation and networks of farmers, agri-food value chains, advisors and science brokers can facilitate new contractual agreements between farmers or agricultural cooperatives and processing industries that result in increased **added value, processing and market access**. When it comes to perennial crops, such contractual agreements need to be of a longer duration, building conditions of trust and confidence between the parties. Farmers are more willing to venture into innovative and advance farming and make long-term investments when they believe that business relationships are equitable, and all conditions and terms (e.g. about the price, quantity, quality, delivery time of farm products) are well defined and agreed by both parties at the outset (e.g. Greek case study).

Several of the changes were targeted at supporting farmers in cooperation, setting up direct marketing or testing centres as incubators of product development, or the initiation of associations of value chain actors to facilitate matching supply and demand of different products and resources. Rural Land Associations, voluntary associations between owners of public and private land, can pool abandoned or uncultivated land and entrust it to the management of agro-ecological farmers. In the Italian case study the agreements between land owners and tenants are sponsored by local authorities. For similar reasons of addressing barriers relating to lack of access to land, the Czech and Spanish case studies proposed the creation of land banks and new regulations for rental agreements to facilitate access to public or private land for farmers. This reflects the importance of regulatory policy changes to stop agricultural land concentration and speculation, and grant equal and democratic access to land (Palomo-Campesino *et al.*, 2021).

Mechanisms to incentivise the engagement of land owners in agro-ecological transitions were identified in strategic pathways to initiate agro-ecological transitions in the context of high quality arable land in Lower Saxony in Germany. Tax reductions to compensate opportunity costs of land owners were envisaged as a suitable mechanism, if tied to the implementation of agro-ecological practices and the provision of specific ecosystem services (Tittonell *et al.*, 2020).

Reductions in the Value Added Tax (from 21% to 5%) on certain fruits and vegetables grown in Latvia successfully stimulated consumer demand for local produce and led to increased retail sales, reduced the shadow economy in this sector and contributed to an increase in wages in the fruit and vegetable sector. In light of these preliminary positive outcomes in the fruit and vegetable sector, it was proposed that a similar strategy could be used for organic milk and dairy products to stimulate consumer demand.

Further actions in the strategic pathways to stimulate demand for agro-ecologically produced goods are support for promotional campaigns and advertisements, and regional labels and certification schemes (e.g. Hungarian and Romanian case studies). Promotion and awareness campaigns need to educate consumers about the quality of products, what certain logos represent and what these logos protect (e.g. soil conservation farming in Hungary and biodiversity on traditional fruit orchards in Romania). A challenge for agro-ecological labelling and certification is the variety of interpretations of agro-ecology, which results in a lack of clarity for consumers and other actors, as experienced in some of the UNISECO case studies, which may pose difficulties in creating a market for agro-ecological products. Indeed, as the term 'agroecology' is not protected by law (IFOAM, 2019), the closest existing version of a market label is organic farming (Oberč and Schnell, 2020).

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Strategic pathways for initiating and enhancing agro-ecological transitions in arable, dairy and viticulture systems highlight the important role public authorities, especially local authorities, can play in advancing the development of sustainable farming systems by implementing actions where other public actors, such as schools, and farmers are involved and cooperate (e.g. Czech, German, Italian, Lithuanian and Romanian case studies). Green public procurement of public canteens and schools improves market access for agro-ecological farms, such as creating new rules on the minimum share of agro-ecological or organic food in those canteens. Such an approach can also be used in education and raising awareness of the benefits of agro-ecological farming (Perez-Neira *et al.*, 2021).

Green public procurement (alongside producer-consumer associations, community support agriculture, and farmers' markets) has the potential to become a relevant driver for transformation, re-connecting producers and consumers (Gliessmann, 2020) in which public institutions, and specifically local government, commit to playing exemplary roles.

However, green public procurement needs to be accompanied and supplemented by public policies to enhance conditions and infrastructures for agro-ecological farming for it to be successful in promoting agro-ecological transitions, and to address possible difficulties in guaranteeing volume and continuity in local supply, in particular of small-scale farming systems such as in the Romanian case study (Simón-Rojo *et al.*, 2020). Such policies include rules governing or enabling marketing, transportation, and storage by farmers, including changes in spatial planning to enable direct marketing and on-farm processing as well as investment support for collective storage, processing, slaughter and other infrastructure (e.g. UK case study).

Investment support to address financial barriers of implementing agro-ecological practices was highlighted as an important policy instrument in a number of case studies (e.g. the Czech, Hungarian and Spanish case studies), including the support for investments in bioenergy and biogas plants (e.g. Finnish case study). Initiating transitions in intensive livestock systems could also be supported by financial incentives and / or regulation to extensify livestock production and to reduce livestock numbers (e.g. Swiss case study).

Decisions made in response to the COVID-19 pandemic have illustrated impacts that external actors can have on operational issues in supply chains. It is an example of an external threat to supply chains which can be reflected in responses of public policy (e.g. restrictions on movement of labour, retail opening hours, closing of markets and consumer movement), business responses (e.g. investment in home deliveries), and consumer behaviour (e.g. increased demands for farm shops) (Phillipson *et al.*, 2020).

The principal areas of proposals for changes in the **policy design** co-constructed were on:

- the design of innovative policies (e.g. involving farmers in the payments for results) and support schemes tailored to agro-ecological farming practices (e.g. on nutrient cycles, mating disruptions, diversification);
- to increase the efficiency of policies leading to a decrease in the administrative burden for farmers.

The co-constructed strategies consist of a combination of policy instruments (e.g. area-based support measures, market rules, creation of framework for knowledge transfer), which require to be integrated and tailored to overcome specific barriers to the transition to agro-ecological farming systems. Most of the actions proposed for happening inside the social-ecological systems were based on an increase in the level of cooperation between actors, leading to improvements in knowledge transfer and education, adding value to the products throughout the supply chain.

A theme of many of the strategies developed in the case studies was of the need for an external governance structure that would facilitate the process of transition. This would provide a supportive environment for improving cooperation, and developing marketing rules which would be favourable to the transition to agro-ecological farming systems.

Several case studies identified gaps in policy (e.g. green procurement). Most of the areas of specific policies are present in some form in the current EU Common Agricultural Policy, but are experiencing insufficient

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uptake, or they are not well tailored to tackling specific barriers (e.g. investment support not targeted to specific investment needs, advisory services not sufficient to cover gaps in information of knowledge in the social-ecological systems). Beyond the scope of the Common Agricultural Policy is the proposed shift to a wider food policy approach that pays particular attention to local demand for agroecological products, promotion of healthy diets and reducing food waste. A particular challenge is to design policy instruments that encourage the coordination of actors to promote agro-ecological transitions at territorial level (Caquet *et al.*, 2020)). The different proposals for changes in the design of policy instruments and new instruments are analysed further as part of a participatory multi-criteria assessment in Galioto *et al.* (2021).

Table 42. Overviews of actions leading to changes in external governance of the SES

Key Actions Identified in Co-constructed Strategic Pathways	Case Studies
Knowledge and Social Capital	
Local authority coodinating education and awareness raising of landowners of the benefits for sustainability of providing land to agro-ecological farming	DE, CZ
Empowerment of agricultural cooperatives, e.g. support for initiatives creating collective structures and group skills	CZ, ES, GR, IT
Support for setting up and educating local networks and inter-professional collaborations and their network manager to facilitate knowledge exchange	CH, CZ, DE, GR
Support for pilot testing of instruments to foster cooperation between farmers and other actors including the use of demonstration farms and professional platforms for implementing agro-ecological practices	GR, CZ, DE, FR, HU, IT, RO, UK
Establish a coordination centre for advisory services and improve access of farmers to advisory service and other sources of knowledge on Rural Development Programme measures and regulations	ES, IT, RO
Support for training of advisors and controllers on key aspects, such as technical know-how, peer-to-peer learning and direct marketing	CH, CZ, DE, ES, IT, UK
Mentoring of transitional farmers - psychological support	ES
Re-training of rural unemployed for farm help positions - focus in organic/agri-ecological farming	LV
Value Added, Processing and Market Access	**Case Studies**
Creation of cooperation platforms for different value chain actors, for the creation of short value chains with secure and stable growing contracts and joint initiatives of agri-food value chain actors and research	FI, GR, IT, SE, UK
Setting up testing centres and incubators for development of sustainable products	SE
Creation of rural land associations for matching the supply with the demand for uncultivated land for recovery	IT
Creation of land banks and new regulations for rental agreements facilitating access to public or private land for farmers	CZ, ES
Private actor payment schemes to pay for sustainability improvements at the farm/ retailer/wholesale/ bank/creditors fund as guarantee for investments	SE
Support for cooperatives to hire consultancy on marketing, and support for collective marketing infrastructure and collective investments	CH, GR, LT
Rules governing or enabling marketing, transport, and storage by farmers, including changes in spatial planning to enable direct marketing and on-farm processing	CH, CZ, RO

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Green public procurement of public canteens and schools to buy products from agro-ecological farming systems	CZ, DE, IT, LT, LV, RO
Support for promotional campaigns and advertisements, and regional labels and certification schemes to increase demand for agro-ecologically produced goods	CH, DE, HU, RO
Financial incentives and / or regulation to extensify livestock production	CH
Farm investment support to address financial barriers of implementation	CZ, ES, FI, HU
Tax reduction for landowners to enhance their willingness to enable implementation of agro-ecological practices and for small farms and organic products	DE, LT, LV
Policy Design	**Case Studies**
Result-based approaches in Agri-environment Climate Measures to increase targeting, reduce administrative burdens, and increase flexibility of implementation and delivery	AT, DE, RO
New Agri-environment Climate Measures (e.g. mating disruption method, dealing with droughts risks)	GR, HU
Setting up a national platform for soil conservation as a board for the representation of actors for consultations on policy	HU
Removal of administrative barriers to the implementation and controlling of instruments and involve trusted peers in monitoring and controlling	DE, ES, RO
New regulations or regulatory changes, e.g. for enhancement biodiversity related trading standards in value chain and renting rules to secure maintaining soil quality	CZ, DE
Inviting all actors to Common Agricultural Policy design debates	FI, HU, RO
Organic Districts Development Plans	IT
Promoting closed nutrients cycles and fodder crops and enforcement of existing regulations such as the Nitrate Directive	CH

While the co-constructed strategies need to be interpreted in their specific case study contexts a set of overall key lessons can be derived:

- Improving farmer knowledge of the benefits of agro-ecological practices and economic opportunities is a key aspect for successful agro-ecological transitions.
- The importance of education, training and life-long learning, including: i) on-farm peer-to-peer learning; ii) actor-led knowledge and innovation and active sharing of place-based knowledge; iii) principles and practices of agro-ecology in school curricula covering principles of food production and consumption, agricultural practices, and social responsibility.
- Horizontal and vertical collaboration in the value chain are of crucial importance to address key barriers. This includes increased collaboration of farmers in shared storage, processing and marketing activities, and engagement of value chain actors including traders, retailers, restaurants, schools and consumers in the creation of value chains that recognise the requirements and benefits of agro-ecological farming and food systems.
- Agro-ecological transitions require an enabling policy environment that provides tailored support to increase the capacity of local actors to create agro-ecological networks and territories.
- In the long-term, transformational change requires several interlinked strategic pathways that address the whole food system (from farm to fork) including changes in consumer preferences and diets.

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6.2. Roles of Different Forms of Cooperation in Transition Strategies

The case studies identified an increase in cooperation as being important for enabling the transition processes. Such cooperation is horizontal amongst farmers and vertical between different value chain actors. This section discusses the different forms of cooperation identified in the co-constructed strategies, and explores if the stages of transition to agro-ecological farming systems, and the level of needs of cooperation, have a direct causal link. The relationship can be assessed only in a qualitative way as, in most case studies, the stage of transition and levels of cooperation cannot be measured exactly, and the level of cooperation is influenced by a range of other factors.

One determinant of the level of cooperation required during transition periods relates to the significance of the changes in institutional arrangements or governance of the farming system. If the farming system is governed by a "free" market, and farmers act independently in the market then, usually, cooperation does not develop because it is not required.

However, if the increase in sustainability of a farming system requires agreement on new institutions (e.g. informal agreement on sharing knowledge) then an increased level of cooperation will be required (e.g. French and Greek cases). Similarly, an increased level of cooperation will be required if actors agree on collective actions for pursuing common interests (e.g. common marketing, storing, processing, labelling), assuming the action is successful (e.g. Romanian, Spanish and Italian cases) and in setting up new associations and contractual arrangements in the value chain (e.g. Swedish and UK case studies).

An important factor influencing the type of cooperation, and the level of coordination required, is the level of social capital. This is because although some farmers realise that cooperation could help them to increase sustainability and help in the transition, if the social capital is not mature, farmers could be discouraged by the potential transaction costs of reaching agreements (e.g. the level of trust is low). Low social capital requires higher levels of coordination, which in some case studies has led to emphasising important facilitating roles of trusted intermediaries (e.g. Austrian and German case studies) and coordinating roles of governmental organisations (e.g. Hungarian case study).

Table 43 provides an overview of existing levels of cooperation as identified in the SES assessment of the status quo of the case study farming systems in relation to the two stages of the transition, and of the main themes of barriers of knowledge and social capital and value added, processing and market access.

Table 43. Overview of existing levels of cooperation in relation to the stage of the transition to Agro-Ecological Farming Systems and main themes of barriers.

	Stage of Transition	Knowledge and Social Capital	Value Added, Processing and Market Access		Other Common Activities	Level of Cooperation
			Common Processing/ Marketing	Engaging other Value Chain Actors		
AT	Initiating				Collective action between actors participating in the humus-farmer concept (e.g. municipalities, farmers, inhabitants paying contribution to CO_2 storage through humus accumulation)	Many actors in agriculture are sceptical of benefits of cooperation, more defined by rivalry than cooperation
CH	Initiating					Low

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CZ	Enhancing		Marketing cooperative created for organic milk			Medium, Coordinated actions
DE	Initiating	Multi-actor platform on biodiversity-friendly farming			Coordinated cooperation between farmers, water protection advisors, water management associations and authorities on improving water quality; machinery rings	Low, Coordinated actions for environ-mental purposes
ES	Enhancing	EHKO association: coordinated and mutual knowledge exchange	EHKO: common processing and marketing, promoting short value chain	EHKO: collaborates with local consumers	COLECTIBOA/EHKO: agreement on the nature of the organic production, additional rules agreed; municipalities also involved.	High, Collaborative actions
FI	Initiating			Dairy cooperatives and energy company plan investment to create a bio-product plant	Dairy farmers contracted by bio-gas plant to provide manure and organic matter and get fertiliser in return; cooperation for purchase of expensive machinery	Low (not fully established), Coordinated actions
FR	Initiating	The CUMA network facilitates knowledge sharing			The CUMA network provides leadership to farmers to substitute inputs, i.e. changing farming practices.	High
GR	Initiating	Producer groups facilitate knowledge transfer (e.g. by hiring consultants)			Agronomists and the leaders of large producer groups promoted the concept of collective implementation of inte-grated farming practices in peach production	Medium, Coordinated actions
HU	Initiating					Low
It	Enhancing	Biodistrict association provides knowledge exchange and transfer to its members by hiring experts and advisors			Stakeholders in the Chianti biodistrict agreed on rules concerning farm practices and its relationship to whole landscapes, tourism etc.	High
LT	Enhancing		Cheesemakers collaborate in processing and marketing			Low
LV	Enhancing		Farmer coop-			Low (in

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			eratives seeking to in-crease volume and price of organic milk			particular for processing and marketing)
RO	Enhancing				New development of associations emerging helping small farmers, and NGOs setting up food hubs	Low
SE	Initiating				Some buyers initiate collaboration with farmers, but rarely	Low, rare coordinated actions
UK	Initiating	Knowledge sharing facilitated by several agricultural associations	Cooperatives in farm product storage and distribution, wholesale and retail marketing	Collaboration of farmers with value chain actors	Machinery rings	Medium

Notes: i) The theme "Creation of added value and market access" was divided in two categories, "Common processing/marketing", and "Engaging other value chain actors" to reflect the differences in the nature of the cooperation. The first category related to actors inside the SES, and the second related to cooperation between the SES with external actors. ii) Blank cells represent where no cooperation was reported.

The **main factor hindering cooperation** is immature social capital. Addressing this issue requires a high level of effort by leaders of a group activity for the initiative to be successful. If the change in relationship between actors is considerable, then the process towards a successful cooperation can be very challenging (Ostrom, 1990; Ostrom, 2005; Ostrom, 2010). Examples of circumstances which could lead to changes of such a nature are: i) property rights (e.g. sharing financial resources when building a common facility for storing or processing associated with high risk); ii) when the number of farmers necessary for cooperation is high; iii) when the interests of the farmers (and other stakeholders) are very different, or incompatible.

In most case studies, high or medium levels of cooperation were associated with enhancing stages of transition. The exceptions were case studies in which negative experiences from nationalised collective agricultural systems in the past played a noticeable role in reducing the willingness for cooperation (e.g. in Lithuanian, Latvian and Romanian case studies). In these cases the farming practices are favourable from an environmental perspective, but the economic sustainability is low and not supported by cooperation (i.e. immature social capital) (see Table 43). In some contexts, the initiating stage can also require a high level of cooperation. This would be aided by a mature level of social capital, and experiences and trusted gained in collaborative actions which are not necessarily directly linked to any required changes in farming practices (e.g. in the Austrian and UK case studies).

As explained in Section 2.5, in UNISECO a generalised adaptation of transition stages was used that reflects the purpose of the co-construction process to initiate or enhance transitions, and considers the differences between incremental and transformational change. With this binary classification it was apparent that an increase in the level of cooperation, and thus an actions that was more collaborative than coordinating, is more likely to happen in case studies of enhancing transitions.

Enhanced and new forms of cooperation in comparison to the existing status quo in the case studies (as summarised in Table 43) were identified in the co-constructed strategies to overcome the barriers of agro-ecological transitions. Table 44 provides an overview of these enhanced or new forms of cooperation, again in relation to the two stages of the transition and main themes of barriers.

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Table 44. Overview of enhanced and new forms of cooperation in relation to the stage of the transition to Agro-Ecological Farming Systems and main themes of barriers.

	Stage of Transition	Knowledge and Social Capital	Value Added, Processing and Market Access		Policy Design
			Common Processing/ Marketing	Engaging other Value Chain Actors	
AT	Initiating	Further knowledge networks coordinated by intermediary Closer collaboration of research and practice and integration of research questions for sustainable soil management and agro-eoclogy			
CH	Initiating	Roundtable events with farmers and advisors	Collective marketing initiatives, farm tours organised by farmers	Regional fairs as a platform and market for niche products	
CZ	Enhancing	Increase in collaboration of farmers in cooperative to design a strategy for knowledge sharing		Common campaign with land owners showing advantages of renting land to organic farmers	
DE	Initiating	Knowledge networks coordinated by intermediary		Producer-consumer associations Food policy councils Membership in regional food associations	Participation of trusted peers (farmers) in on-farm monitoring of CAP measures
ES	Enhancing	Further collaboration in networks for knowledge transfer, attitude change, access to land	Common centres for the collection and sale of produce	Collaborative projects across value chain actors to share machinery and infrastructure	
FI	Initiating	Coordinated actions with researchers		Coordinated actions between value chain actors, authorities, researchers	
FR	Initiating	Local partnerships and collective action for knowledge sharing	Green waste platform, exchange local composting	Partnership at food system level for values based supply chains Increased collaboration with research actors	
GR	Initiating	Farmer to farmer collaboration Cluster of interprof-essional collaboration of farmers unions, agri-food value chains and science brokers		Contract farming between individual farmers or agricultural cooperatives, and fruit processing industries	

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HU	Initiating	Collaboration between all actors to set up platform, involving trusted intermediaries			
LT	Enhancing	Co-learning platforms and knowledge networks	Machinery rings Small collective composting centres Procurement platform for manure and other fresh organic matter, and for hay-manure	Partnership with urban firms and rural land associations Collaboration platforms for value chain actors and short supply chains	
LT	Enhancing	Knowledge networks Common hiring of consultants	Cooperatives for sharing machinery and common marketing		
LV	Enhancing		Cooperatives for common processing and marketing		Participation in the consultations and discussions on the design of the national CAP Strategic Plan
RO	Enhancing	Central digital hub through AKIS Collaboration of advanced farmers and farmers associations with schools	Common storage, processing and marketing	Coordination and facilitation of close producer-consumer linkages through NGOs and Ministries	Participation in the consultations and discussions on the design of the national CAP Strategic Plan
SE	Initiating	Farmer to farmer collaboration, and with advisory services and researchers	Farmer to farmer cooperation for common processing and marketing	Collaboration with value chain actors Hubs as a "match-maker" between farmers and buyers	
UK	Initiating	Increased collaboration of farmers in membership groups Joint awareness raising events	Machinery rings Cooperatives for storage and distribution, wholesale and retail marketing Collective investment in local processing or infrastructure	Farmers collaboration with value chain actors	

Notes: i) The theme "Creation of added value and market access" was divided in two categories, "Common processing/marketing", and "Engaging other value chain actors" to reflect the differences in the nature of the cooperation. The first category related to actors inside the SES, and the second related to cooperation between the SES with external actors. ii) Blank cells represent where no cooperation was reported.

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Designing effective policy support did not require an enhancement in the level of cooperation in most of the strategies co-constructed by the relevant stakeholders in case studies. In some cases, there was evidence of a role for participation in the development and monitoring of novel policies (such as payment for results), or benefits of broadening understand of the expectations of administrations (e.g. in the consultations on the national CAP strategic plans). However, in most cases, enhanced or new forms of cooperation were required for themes dealing with knowledge and social capital, and the creation of added value, processing and access to markets. These are discussed for each theme below.

Knowledge and social capital

Knowledge sharing can be carried out as a coordinated action (e.g. supported by public funds or farmers associations). However, the nature of the cooperation can be more demanding in collaborative actions when farmers share funds and hire advisors to facilitate the sharing or transfer of knowledge, tailored to that group (e.g. to agree on how to share costs). Peer-to-peer knowledge sharing and learning of farmers was found to be very effective in promoting the uptake of agro-ecological practices in the UK case study. The potential of peer-to-peer learning as well as farm visits was also recognised in other case studies initiating agro-ecological transitions (e.g. the Greek and Swedish case studies).

Agro-ecological transitions lead to cognitive shifts and new understandings of what is a 'good farm', and acceptance of temporary difficulties as necessary steps towards agro-ecological transition. The understanding of a 'good farmer identity' with respect to improved yields, land acquisition, and improved operational efficiencies (Burton and Wilson, 2006) will be challenged in agro-ecological transitions. It may require a new type of farmer identity, whose learning process obtains support from agro-ecological peer-to-peer learning (Padel *et al.*, 2020).

Enabling such peer-to-peer learning is also one goal of the French Coopératives d'Utilisation du Matériel Agricole (CUMAs), which is involved in trying to facilitate the sharing of equipment since investments in machinery needed for agro-ecological practices is a common economic barrier to the uptake of practices. Machinery rings are a form of collaborative actions that were reported in other case studies, such as the Italian case study. However, the establishment of collaboration in machinery rings requires a certain level social capital.

Immature social capital is not easy to change and requires time. The initiative cannot be too ambitious in the short to medium term, and should build its social capital gradually (e.g. starting from a coordinated action or, in a collective action, with limited changes in property rights). Positive feedback loops can develop through experiences of successful collaborative actions and the associated trust gained (e.g. clear sharing of costs and benefits). Networking and capacity building activities are important for increasing levels of trust between actors. The key for successful trust-building activities is acceptance by all of the actors involved, which is largely influenced by who has initiated the activities. A proposed approach is the identification of intermediaries such as trusted advisors and trusted farmers who are experienced in cooperation and widely appreciated in the community. As the level of trust grows so also could the ambitions of the collaborators.

Value added, processing and marketing

Examples from the case studies are of value added by means of agreements on shared storage, processing or marketing. However, if these agreements can only be established by coordinated actions then challenges can be expected. Such agreements may require a change in property rights or other forms of collaborative or collective actions, and agreement on an associated new sets of rules (i.e. substantial institutional or governance change). The cooperation required could be facilitated if suitable changes in external institutions and governance are implemented by the relevant level of national or regional government. An example of what this may entail is that of the rules governing organic farming (e.g. in farm practices, labelling, and marketing).

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In the assessment of the trade-offs (Albanito *et al.,* 2021; D3.5), in several cases the introduction of agro-ecological farming practices could reduce the economic sustainability of the farming system. Currently, some farming systems are successful in maintaining or enhancing public goods, but do not always perform well in supporting economic sustainability (e.g. extensive cattle grazing on biodiversity rich meadows). In such cases, improvements in the sustainability of the farming systems are sought by adding value to their produce (e.g. through processing, direct sale, or recognition of the associated provision of public goods). However, such actions face competitive conditions in the market, made more challenging if farmers act independently. For example, smallscale or fluctuating production volume does not create conditions conducive to investing in storage or processing facilities, do not provide bargaining power in markets, and are attractive propositions to other actors in the value chain for close cooperation. Evidence from the case study reports highlighted the importance of farmer cooperatives or producer associations as an effective means of providing volume of produce and a stronger negotiating position regarding purchasing costs.

Cooperation needs to go beyond that between farmers. Cooperation over the long-term, between producers and different kinds of value chain actors (including processors, retailers and restaurants) and consumers, has been identified as a key strategic pathway for market access to enable agro-ecological transition. Strengthening vertical collaboration between farmers and value chain actors and consumers (e.g. producer-consumer associations, food policy councils) is also critical for ensuring that the provision of public goods and ecosystem services of agro-ecological farming is being adequately rewarded by the market.

Policy design

The scope for coordination and collaboration in policy design is more limited than in the previous two themes of barriers. Farmers could share knowledge about how to deal with the administration of policies, or set-up working groups to enable a more coordinated approach to the discussion of policy design with governments or authorities. Such coordinated approaches are usually undertaken by their representative bodies. Several case studies (e.g. German and Spanish case studies) emphasise the need for closer cooperation of farmers and authorities in designing, implementing and monitoring policy measures. Such a cooperation needs to overcome critical barriers of mistrust, with longer term benefits in facilitating joint understanding and enhanced appreciation of the practical and political challenges as a basis for more effective policy support.

The provision of information and knowledge was shown to be effective in some case studies when done through public administrations and authorities, at regional or national scales (e.g. funded through Rural Development Programmes; UK case study). Cooperation between farmers was shown to be another effective means of sharing information, investment in research, education and training, and purchasing of knowledge from advisors. Both approaches can be effective when the geographic scale of the interests is broad (e.g. across a region or country), with benefits accruing from the scale of cooperation and reduced transaction costs.

7. CONCLUSIONS

The overall objective of this deliverable was to analyse barriers and drivers of agro-ecological transitions and how these can be overcome through co-constructed strategies that take into account the complexity of interactions and processes between actors within the social-ecological systems (SES) of the 15 UNISECO Case Studies examined. The SES framework developed by Guisepelli *et al.* (2018) was used to systematically identify barriers and drivers and the co-construction of strategies to initiate or enhance agro-ecological transitions built on social network analysis (SNA) done in previous steps of the case study analysis (Vanni *et al*., 2019). The process provided insights to the changes in the governance of the farming system and the roles of different actors in the strategic pathways to address different barriers and drivers of agro-ecological transitions.

The aim of the deliverable was also to analyse how cooperation between actors can help address key drivers and barriers to transitions to agro-ecological farming systems. This was to explore how the actors

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could cooperate to support the implementation of agro-ecological practices, and which changes in formal and informal rules are required to facilitate the desired cooperation (both internally between the key actors in the farming system, and externally with actors influencing the settings of the farming system).

The assessments of the social-ecological systems in the case studies Identified a wide range of barriers that hinder the implementation of agro-ecological practices. The focus of the UNISECO project was on socio-economic and policy factors, from which three broader main themes of barriers and drivers could be identified: i) a lack of knowledge and social capital, ii) a lack of added value, processing and market access; iii) ineffective policy design. Specific attention was paid to the complexity of the relationships between different factors that impact on the success or failure to initiate or enhance transitions, and to inform the types of key actions and changes in governance required in future transition strategies. The interconnectedness and interdependencies between barriers and drivers across the main themes are reflected in the combination of different strategic pathways in the case studies. Those pathways combine actions and governance changes addressing at least two of the three main themes, in particular the lack of knowledge and social capital and the lack of value added, processing and market access.

Addressing barriers and drivers in relation to social capital is of particular importance for increasing the potential for successful cooperation between actors. In addition to farmers as the central actors of the social-ecological systems (SES) which were analysed, a range of different key actors have an active role in addressing the barriers of agro-ecological transitions in the various case study contexts. Some of the actors were part of SES and some of them were external to SES studied, depending on the development of the governance in the farming system in question. Depending upon the maturity of the social capital, cooperation can be achieved through collaborative actions initiated by farmers (e.g. knowledge sharing, common marketing) or through coordinated actions initiated by, for example, regional authorities.

The UNISECO systems approach enabled recognition that, whilst governance changes inside an SES could significantly change the capacity of the farming system to undergo a transition, changes in the external governance contribute to creating a supportive environment, which in turn can enable such changes inside the SES. For example, economic barriers to the implementation of agro-ecological practices can be addressed by farmers jointly storing or processing their commodities, which represents a substantial change in governance requiring a commonly agreed set of rules. Such a change in property rights requires the knowledge and experience of how to achieve agreement amongst farmers, which is a capacity that may be lacking within participating farmers and for which support may be needed.

Similarly, if there is not sufficient, close cooperation already established between farmers within the social-ecological system, it is unlikely they will agree on a strategy that can convince other value chain actors to join the SES, and to engage in the agro-ecological transition of the farming system to increase added value and market access. Low levels of trust prevents actors to agree with whom and how to initiate new cooperation.

Mature social capital is thus critical for the institutional changes proposed such as new knowledge networks and value chain associations, and is a key factor of success for agro-ecological transitions. Case studies identified an important role of intermediaries to facilitate the generation of social capital and the institutional changes, e.g. trusted advisors reaching out to farmers and bringing actors together. In particular, in cases where agro-ecological transitions are initiated in conventional farming systems, the institutional changes proposed need to recognise traditional values and attitudes of farmers to avoid incompatibility with views about a ‘good farmer’ (Runhaar, 2021). An example of a novel institution was that of an integrated farming standard in the Greek case study, proposed by a newly established public actor which aimed at the protection of natural resources and biodiversity (Vlahos *et al.*, 2017), and which reduced the cost of institutional change.

Improving social capital is a long-term process that requires an enabling policy environment through support for capacity building and for investments in institutionalising new forms of cooperation. In the Spanish case study, such investments were financed by the local government’s Rural Development

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Programme. Learning from that experience, Rural Development Programmes should be designed to make it possible for agro-ecological organisations, such as the Biodistricts in the Italian case study, to apply for funding. The conclusion drawn is that external policies should be based on an in-depth knowledge of the dynamics of the transition in each farming system, the relevant barriers in the transition, and a detailed design of policies addressing those barriers.

A key lesson of the co-construction of the strategies across the case studies is the need for strengthened collaborative action and collective institutions to increase negotiating power within the value-chain. This would enable higher prices to be obtained for agro-ecological products and realise the potential of agro-ecological farming to be economically viable. Such processes need to be supported by policy and the public sector, to address issues of economic exploitation and power relations, as well as problems of overconsumption and food waste in food chains with their implications for public health, social justice and food security (Lampkin *et al*., 2020). This highlights the need for a wider food system perspective of agro-ecological transitions, which is also supported by the results of the territorial level analysis in UNISECO (Mayer *et al.*, 2021).

The analysis at territorial level mirrors the analysis of the socio-ecological systems of the case studies, that changes in food consumption, and especially the consumption of animal products, is a major factor impacting on the feasibility of agro-ecological transitions. More sustainable human diets which contain less animal products enable large-scale implementation of agro-ecological practices without overstretching domestic agricultural land and avoiding deforestation (Mayer *et al.*, 2021).

Trends of increased demand of consumers for food labelled as healthy, sustainable and local have been further accelerated by the COVID-19 pandemic (Vittuari *et al.*, 2021). Higher demand for local products and short value chains has been observed in several countries (Hobbs, 2020). If sustained after the end of the pandemic, these trends in consumer behaviour could be reinforced by consumer awareness campaigns and public procurement programmes in schools and canteens which were proposed in the co-constructed transition strategies. This would help overcome barriers such as market saturation of organic products. However, reorientation to direct consumer sales is not always possible or can often only be done with significant financial implications, particularly for small-scale farmers (Hingley, 2005).

This discussion explains the necessity for a wider food systems perspective in agro-ecological transitions as well as at the policy level. An enabling policy environment needs to be targeted at all actors involved in agro-ecological transitions. The co-constructed strategies identified a range of different market and policy instruments, including: i) support for knowledge exchange and networks; ii) training farmers and advisors; iii) eligibility of actor associations for policy support; iv) result-based and cooperative agri-environmental measures and payments for ecosystem services; v) incentives for landowners; vi) public procurement programmes; vii) trade standards and environmental and food regulations; viii) new or revised labelling, awareness campaigns for landowners, value chain actors and consumers; and, ix) nudges for promoting further changes towards healthy diets and reduced food waste. The different market and policy instruments identified in the co-constructed strategies are further investigated in a multi-criteria analysis (MCA) to identify changes in the design of the instruments that increase their effectiveness in promoting agro-ecological transitions (Galioto *et al.*, 2021).

The research process and findings of the co-construction of the strategies for agro-ecological transitions demonstrate how an open science transdisciplinary approach using Multi-Actor Platforms can contribute to just transitions for agro-ecological farming systems. The Multi-Actor Platforms provide a continuous and transparent exchange of information, data and outputs between society, policy and science and motivate and empower all actors to develop shared visions for local areas, monitored and informed through citizen science.

However, some methodological limitations need to be considered and addressed in future work. Research findings are based on collaboration with a pool of actors, who have specific views and interests. Despite efforts to reflect the diversity of actors involved in agro-ecological transitions, and to systematically select

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participants of the Multi-Actor Platforms according to a set of consistent criteria (Budniok *et al.*, 2018), some views and insights might have been omitted. Further strengthening of the participation of value chain actors and consumers is needed.

This study was based on the adapted SES framework of UNISECO, enabling the identification, analysis and understanding of barriers and drivers of agro-ecological transitions. Further analysis of the co-constructed strategies within a multi-level perspective would deliver insights to understanding lock-ins and levers to upscale agro-ecological transitions to food system transformation.

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ANNEX 1 INVENTORY OF BARRIERS AND DRIVERS

Provided in separate Excel file.

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