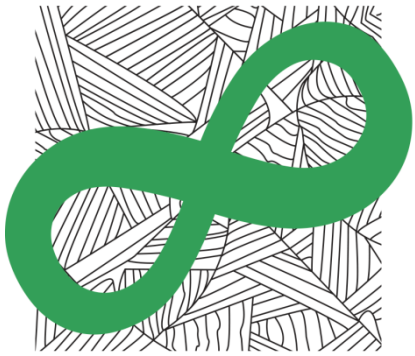

SURE Farm
SUSTAINABLE RESILIENT EU FARMING SYSTEMS

Start date of project: June 2017

Duration: 4 years

D2.3. Report on farmers' learning capacity and networks of influence in 11 European case studies

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Executive Summary

Introduction and aim

Learning is considered an important component for resilience building in socio-ecological systems, not least because resilience is about dealing with, adapting to and responding to change. Thus, knowledge constantly needs revision and approaches to management require adapting to changing circumstances. Reflecting the SURE-Farm resilience framework that recognizes the three capacities of resilience as robustness, adaptability and transformability, this deliverable examines the role that learning plays across these resilience capacities. Through 11 farming system case studies across Europe, the objectives were to (i) identify farmer attributes that enable or constrain learning; (ii) understand the networks of influencers on farmer decision-making; (iii) identify the external factors that enable or constrain learning; and (iv) assess European farmers' learning capacity in the context of the resilience capacities of robustness, adaptability and transformability.

Methods

A conceptual framework for guiding the research was developed, drawing on the work of Oreszczyn et al. (2010) and Baird et al. (2014), amongst others. The framework recognised that farmers' decision-making is likely to be influenced by a diverse range of cognitive and affective factors that contribute to farmers' subjective construction of risk and how to deal with it. In addition, farmers' knowledge networks, or networks of influence, are likely to contribute to their learning and influence their decision-making in a variety of ways. A further dimension - external influences - was added to the framework to consider the context within which farmers make decisions, asserting that learning and adaptive capacity may be enabled or hindered by various external factors such as institutional and policy structures, market systems and access to new technologies. Semi-structured interviews were combined with an interactive mapping activity to identify the 'networks of influence' associated with farmers' decision-making and farmers' learning strategies, as well as exploring the role of cognitive, affective and external factors that may enable or constrain learning. A total of 130 farmer interviews were conducted across the 11 case studies.

Learning strategies

A range of learning strategies were identified across cognitive, experiential and relational dimensions of learning. **Cognitive learning** included formal agricultural education or skills acquisition and attending training courses, as well as farmers seeking out new information across a wide range of issues. Farmers use a wide range of sources when they seek out information, including online information, the farming press, social media, engaging with advisors and other

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farmers, or attending events, fairs and exhibitions. Younger farmers are more likely to engage in sharing experiences or seeking out information through online resources and social media, whereas older farmers tend to prefer more traditional forms of communication such as the farming press and books.

Experiential learning involved farmers learning through their own experience. This is gained over time and through trial and error, adapting to changing circumstances and learning from what has worked in the past. It may also involve bringing skills, knowledge and expertise from working in other industries beyond farming. Experimentation is an important strategy, occurring across a range of activities, such as trying out new extreme weather-resistant crops, changing cattle breeds, testing out new plant protection products, testing small plots of organic or no-till cultivation, as well as trying out new labour recruitment or product marketing techniques. Findings show that farmers who experiment are also better able to adapt themselves to shocks and stresses

Relational learning involves learning from others. This learning can take many forms, from talking to neighbouring farmers or farmer friends, engaging in farmer discussion groups, observing what other farmers are doing through field visits or interacting with farmers around the world through social media. Farmers also learn from non-farmers, including advisors, technological consultants, financial advisors and scientists.

Farmer attributes

Farmer attributes, such as interests, motivation, entrepreneurial spirit and personality, are important in influencing the degree and type of learning that is undertaken. From our analysis across the case studies, we identified two broad categories of learner: the 'proactive learner' and the 'reactive learner'.

Proactive learners are likely to be willing to take risks and apply proactive risk management strategies. They are open to new ideas and seek out new information. They do not wait for problems to occur, but rather seek to constantly improve their business and their activities, anticipating and adapting to future changes. They welcome innovation and will experiment with new technologies and new approaches on their farm and are often early adopters. Such farmers have a positive attitude and high self-efficacy. They are reflexive, critically assessing what they do and the information and learning they receive from others. A key attribute is their ability to convert knowledge into action, and the translation of their learning from non-farmers into farmer practice that can be applied. They also have an enquiring personality and will engage with other farmers and non-farmers across their social network to share experiences and expand their knowledge; valuing other people's opinions and input. These farmers tend to have a clear vision

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of the wider farming system which helps them to better reflect on their own behaviour and specific farm situation.

Reactive learners tend to be risk averse and deal with the consequences as and when they occur. Thus, they may be fairly passive, perceiving a lack of self-efficacy and a sense that things happen to them that are beyond their control. They prefer to operate a 'business as usual' model, keeping to tried-and-tested methods that they know have worked in the past. This lack of flexibility can lock them into a way of operating that constrains their ability to learn about (potentially more resilient) ways of working. When they do innovate, they prefer to wait until others have experimented first and then adopt when they are confident that it will work. They are less likely to engage in social networks than proactive learners, preferring to observe other farmers' behaviour and reflect on whether it would apply in their own circumstances. Alongside this, attachments to a particular farming way of life or an occupational identity may make them reluctant to undertake radical adaptations or transformations on their farm. Their focus tends to be narrowly centred on their specific farm situation rather than considering the broader farming system.

Knowledge networks

The role of a farmer involves a wide range of skills; and as both practitioners and managers they need to seek out information on a broad range of topics from a diverse range of people. In many cases, farmers do not make decisions in isolation; decision-making and learning occur through the complex social systems in which farmers live and work and are important environments in which to consider their capacity for learning. Importantly, the degree to which the farmer trusts influencers and the level of confidence they have in the source of advice or information is crucial. We distinguish between three levels of influencers:

The 'ring of confidence': trusted professional and personal advisors, including family members, who in effect constitute the farmer's business management team. These tend to be individuals who are personally known to the farmer, have a good knowledge of the farmer's farm and the farmer is confident in their advice.

Information sources: individuals and organisations that farmers may consult for advice (that are external to the inner ring of confidence, but provide advice or information to the farmer) at various moments in time. In some instances, farmers may be less confident in the advice they receive from influencers in this category, particularly if they feel that the advice is not coming from an independent source.

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External influencers: Contacts, organisations or information sources that provide the context within which farmers operate, such as policies and the legislative framework, markets, access to finance, consumer demand, NGO narratives, social norms, local planning contexts and the media portrayal of farming.

Learning for resilience

This study clarifies some important concepts relating to farmers' learning capacity and its role in resilience-building. In terms of resilience, reactive farmers may be robust, enabling their farm to recover from moderate shocks and stresses. However, they are less likely to be able to adapt, where possible persisting in their tried and tested ways of working. In response to major shocks, they may be forced to undertake a significant transformation of the farm business, or exit farming. However, proactive learners, while enabling robustness and transformability, are also able to adapt. These farmers are more entrepreneurial and are able to anticipate and prepare for future challenges. They can identify and respond to business opportunities, translating what they observe and learn from others into practice on their own farm.

The implications of these findings suggest:

- A role for a financial or business advisor to fill the 'learning gap' for reactive farmers through coaching and assisting with future-proofing business plans.
- Attachments to particular ways of farming can hinder adaptation, so careful consideration needs to be given to enabling farms to adapt while maintaining their core identity.
- Expanding farmers' knowledge network out to those beyond the farmer's immediate circle could help to bring new innovative ideas from other farmers and those beyond the sector.
- Social networks in the former communist states (Bulgaria, Poland, Romania, East Germany) are not well developed. There is scope for improving farmer knowledge networks and opportunities to exchange ideas, with lessons to be learnt from other countries with more developed farmer networks (e.g. benchmarking, farmer discussion groups etc.).
- A need for better communication between scientists and farmers. Such alignment could help to improve the adoption (and design) of new technologies.
- A need for an enabling policy environment that provides long-term security and a clear strategy for the sector. An important component of this is supporting the establishment of farmer-farmer, farmer-scientist and farmer-other business networks, implying a need to support and strengthen bonding, linking and bridging social capital to improve and maintain the resilience of farming systems.

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1 Introduction

The SURE-Farm project aims to analyse, assess and improve the resilience and sustainability of farms and farming systems in Europe. Farms and farming systems face a whole range of social, ecological, economic and political disturbances and changes, such as market fluctuations, severe weather events, climate change, new technology, changes in governance structures and so forth, operating at a range of scales (local, regional, national and global). Some stresses on the farm system can be predicted (e.g. retirement of farmer), while other shocks are more uncertain and unpredictable (e.g. flooding, sudden price drop, illness). Farmers, therefore, need the ability to cope with and adapt to these disturbances while at the same time maintaining their ability to adapt in the future (i.e. avoiding lock ins and path dependencies) (Folke et al., 2003). In other words, they need to build resilience (Fazey et al., 2007, Milestad and Darnhofer, 2003, Milestad et al., 2010). Learning is considered an important component for resilience that is building in socio-ecological systems (Biggs et al., 2012, de Kraker, 2017, Folke, 2006), not least because resilience is about dealing with, adapting to and responding to change (Cundill et al., 2015). Thus, knowledge periodically needs revision and approaches to management require constant adaption to changing circumstances. The ability to learn about and respond to change fosters resilience (Armitage et al., 2009, Folke et al., 2005) and there is a general consensus that adaptive capacity and social learning are interrelated concepts (Raymond and Cleary, 2013, Thi Hong Phuong et al., 2017, Yuen et al., 2013).

Reflecting the SURE-Farm resilience framework that recognizes the three capacities of resilience as robustness, adaptability and transformability, this deliverable seeks to better understand the role that learning plays across these resilience capacities. Through 11 farming system case studies across Europe, the objectives were to (i) identify farmer attributes that enable or constrain learning; (ii) understand the networks of influencers on farmer decision-making; (iii) identify the external factors that enable or constrain learning; and (iv) assess European farmers' learning capacity in the context of the resilience capacities of robustness, adaptability and transformability.

The following sets out the conceptual framework for the project, outlining the literature that has informed the methodology and analysis. This is followed by a brief summary of the case studies and a description of the methods adopted. Summary results for each of the 11 case studies are presented, followed by a synthesis of the results in relation to the project's objectives. The conclusion discusses the analysis in the context of the SURE-Farm resilience framework.

1.1 Conceptual framework

Learning can be defined as a change in knowledge, skills or attitudes that may result in behaviour change (de Kraker, 2017, Muro and Jeffrey, 2008). Learning can occur through the transmission

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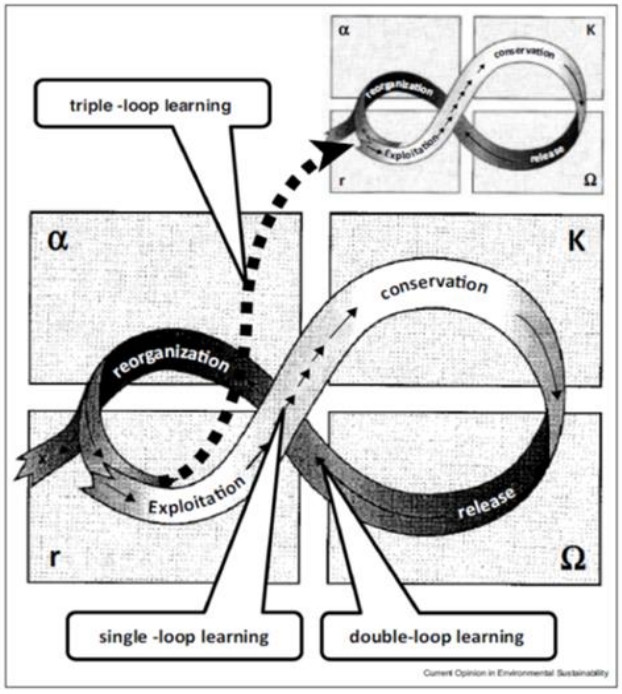
of information (i.e. learning new facts), by experimentation or 'learning by doing' (Milestad et al., 2010) and through sharing knowledge and learning from others. Social networks play an important role in facilitating social learning, and are often referred to in the literature as communities of practice (Lave and Wenger, 1991) and networks of influence (Oreszczyn et al., 2010).

Pahl-Wostl and Hare (2004) define social learning as "an iterative and ongoing process that comprises several loops and enhances the flexibility of socio-ecological systems and its ability to respond to change" (p. 195). De Kraker (2017) conceptualises learning throughout the adaptive capacity cycle as single-, double- and triple-loop learning (Figure 1.1 The role of learning in the adaptive capacity cycle (from de Kraker 2017).Figure 1.1). In different stages of the adaptive capacity cycle, learning plays different roles – in the 'front loop' it is associated with incremental innovation towards further growth, while the 'back loop' is associated with more radical innovation in response to crises in the system. A third 'transformational' type of learning occurs when learning innovations developed during the back loop are taken up in the front loop at a higher level. These three forms of learning reflect the typology which distinguishes single-loop learning (incremental change, learning about the consequences of specific actions (Reed et al., 2010)), double-loop learning (more fundamental change, rethinking underlying assumptions and redefining goals) and triple-loop learning (paradigm change, questioning norms and values underpinning current assumptions and actions) (Argyris, 2003, de Kraker, 2017, Pahl-Wostl, 2009,



Pahl-Wostl et al., 2013).

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Figure 1.1 The role of learning in the adaptive capacity cycle (from de Kraker 2017).

However, rather than adopting the hierarchical typology of social learning implicit within the single-, double-, triple-loop formulation, other scholars distinguish between cognitive, normative and relational learning (see Table 1.1Error! Reference source not found.) as, they assert, a focus on these learning types allows for a systematic assessment across different cases and social units of analysis (Baird et al., 2014, Haug et al., 2011, Huitema et al., 2010, Munaretto and Huitema, 2012). Single-loop learning can be loosely aligned with cognitive learning and double- and triple-loop learning with normative learning. These researchers adopt this approach as they argue that analysing learning effects in terms of their nature (i.e. cognitive, normative, relational) rather than their perceived value is preferred as it avoids the hierarchical understanding of learning of other constructs, which implicitly suggests that higher levels of learning are preferable. As Baird et al. (2014) argue, attention in research studies on cognitive learning is just as important as normative learning, recognising that at times a cognitive change can lead to fundamental effects, so they treat the three types of learning as equally important. Further, the explicit inclusion of 'relational' learning emphasises a key dimension for adaptive co-management.

Table 1.1 Typology of learning effects (Baird et al., 2014, Huitema et al., 2010).

Type	Definition/indicators of learning effects
Cognitive learning	Acquisition of new knowledge; restructuring of existing knowledge
Normative learning	Changes in norms; change in values; change in paradigms; convergence of group opinion
Relational learning	Improved understanding of mindsets of others; building of relationships; enhanced trust and cooperation

Similarly, Mezirow (1995) suggests that learning can be instrumental (acquiring new knowledge or skills), communicative (understanding and reinterpreting knowledge through communication with others) or transformative (change in attitudes, behaviour or social norms). Kilvington and Allen (2009) and Kolb (1984) purport that learning is both about content (views, ideas, values, information, data) and process (group interactions, relationships, networks, ways of problem solving). Kolb's (1984) learning theory suggests that people have experiences and learn as they reflect deeply on those experiences. They derive abstract concepts from these experiences to apply what they have learnt through active experimentation (see Figure 1.2 The learning process

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(adapted from Kolb 1984).Figure 1.2). Thus, learning requires practice (actual and imagined), variation in practice (what others experience) and reflection/good thinking.

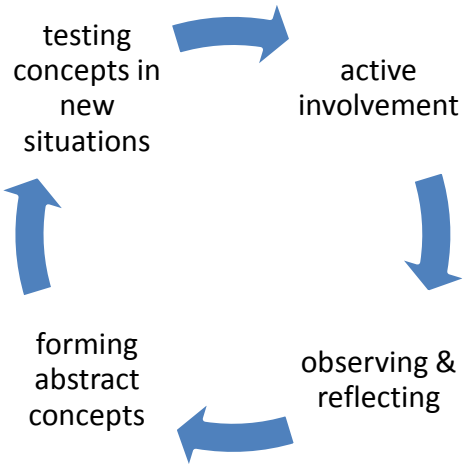

Figure 1.2 The learning process (adapted from Kolb 1984).

Farmer decision-making is influenced by diverse **cognitive and affective factors** that contribute to farmer's subjective construction of risk and how to deal with it. Thus, individual farmers' (and groups') attitudes, values, beliefs, assumptions, perceptions, self-identity (Maye et al., 2017), place attachments and worldviews, along with subjective norms (Ajzen, 1991), represent the perceptual filters through which farmers' view the world and their place in it.

Wenger (1998) introduced the concept of **communities of practice**, transforming theories of learning away from the learner as an individual who internalises knowledge transmitted by others to learning as participation in the social world through relational networks (Lave and Wenger, 1991, Deroïan, 2002). Oreszczyn et al. (2010) suggest that a community of practice involves "groups of people who share a common pursuit, activity or concern" (p. 405). Brown and Duguid (2001) purport that communities of practice are repositories of both formal and informal knowledge and are the key to any form of change process. While Brown and Duguid (2001) use the term **networks of practice** to include those beyond a community of practice who may exert influence, Oreszczyn et al. (2010) refer to a wider **web of influencers**. Boundaries are a key feature of communities or networks of practice as they provide a sense of identity to those within and shape who a person decides to interact with. Learning can occur across boundaries and shared boundary objects can act as a bridge. Thus, knowledge flows are complex involving iterative, reflective, continuing interactions (Oreszczyn et al. 2010).

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Alongside cognitive factors and farmers' networks of influence, learning may be enabled or hindered by various external factors such as institutional and policy structures, market systems and access to new technology etc.

Figure 1.3Error! Reference source not found. presents the conceptual framework developed for this task. Drawing on Oreszczyn et al. (2010) and Baird et al. (2014), amongst others, we contend that farmers' decision-making is likely to be influenced by diverse cognitive and affective factors that contribute to farmers' subjective construction of risk and how to deal with it. In addition, farmers' knowledge networks or networks of influence will also contribute to their learning and influence their decision-making. We add a further dimension to the framework - external influences - to consider the context within which farmers make decisions, asserting that learning and adaptive capacity may be enabled or hindered by various external factors such as institutional and policy structures, market systems and access to new technology etc.

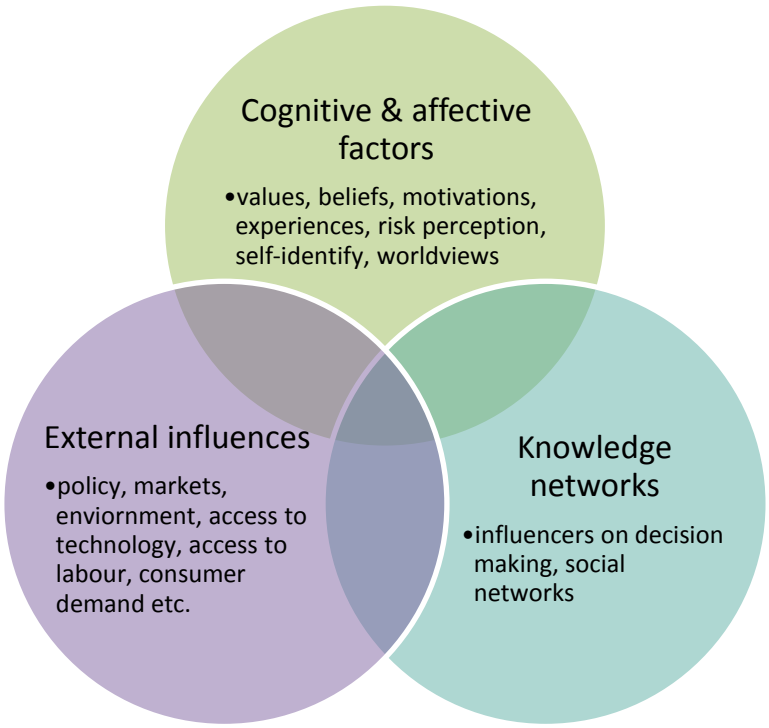

Figure 1.3 Conceptual framework for exploring farmers' learning capacity.

The following chapter outlines the methods adopted in this study, followed by a summary of the individual case study results in chapter 3. These are then synthesized in a comparative analysis in chapter 4, and finally some overall conclusions are given in chapter 5.

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2 Methods

2.1 Case Studies

Research for this task was conducted in all of the 11 SURE-Farm case studies (Figure 2.1), consisting of arable farming (UK, Germany, Netherlands and Bulgaria), livestock (Spain, France, Belgium and Sweden), mixed farming (Romania), horticulture (Poland) and perennials (Italy).

Summaries providing the context for each of the case studies can be found in Appendix 1.

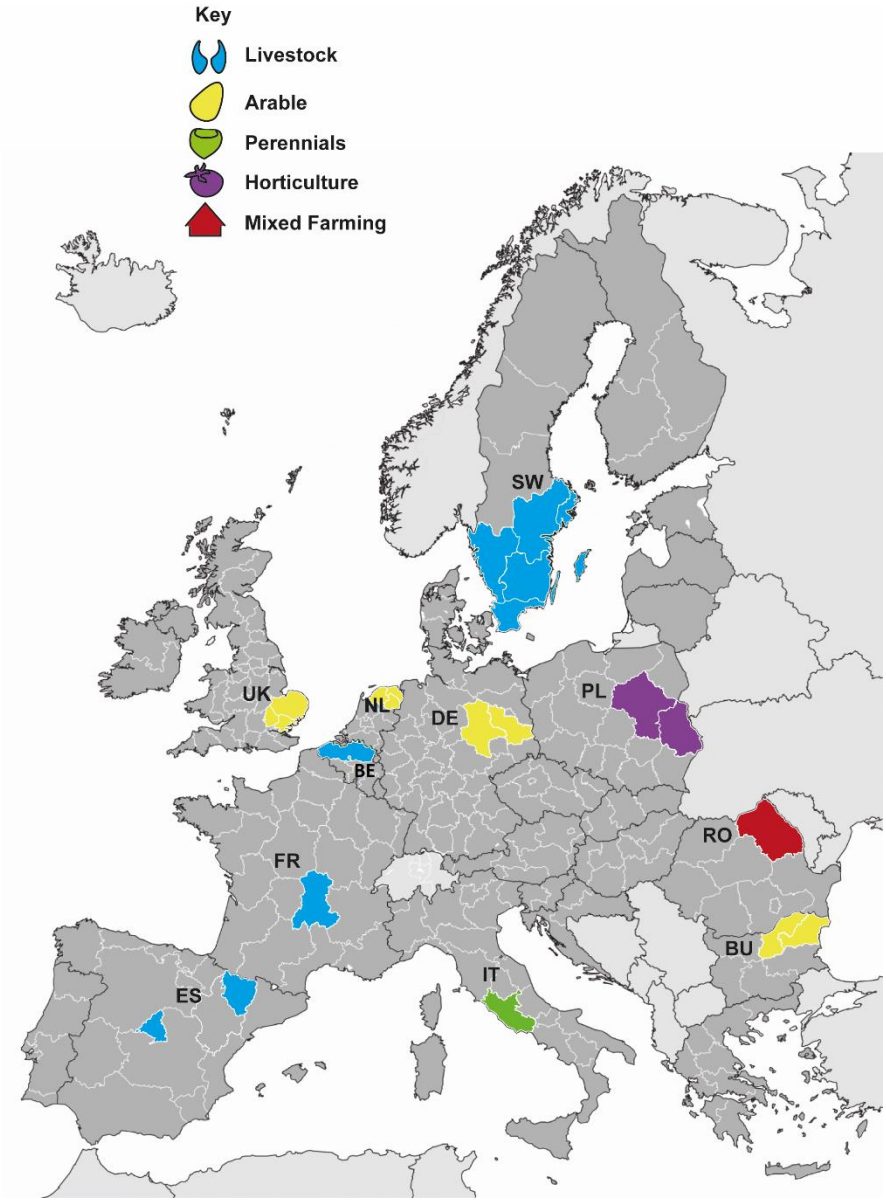

Figure 2.1 Map of 11 SURE-Farm case studies.

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2.2 Research design

Semi-structured interviews combined with an influence mapping exercise were used to address the task objectives, guided by the conceptual framework outlined in chapter 1. The interviews sought to identify the influencers on farmers' decision-making, explored how attitudes, beliefs and external factors influence decision-making, identified the learning strategies that farmers adopt and assessed what enables or constrains learning. Interviews were conducted in all 11 case studies.

An iterative approach was adopted with interviews conducted in two rounds. The first round took place between April-July 2018, and the second between October 2018-January 2019. This allowed case study partners to analyse data from the first round interviews and to collectively reflect on the approach and outcomes, with any adjustments made to the research approach for the second round of interviews.

The interview consisted of two parts. The first part involved a series of semi-structured questions that sought to understand the challenges that respondents face and the strategies that they implement to deal with these (see Appendix 2 for a copy of the interview guide). Questions sought to better understand both the external factors that influence decisions, but also farmer attitudes, values and motivations. Farmers were asked to provide accounts of when they had tried something new or learnt something new (e.g. change in crops grown, use of technology, investment, ownership, management structure…). Prompts included asking how they gathered information about the new activity (or way of thinking), how did they test it, did they adopt it and what was the outcome.

The second part of the interview was more structured and involved an interactive mapping activity to identify the 'networks of influence' associated with farmers' decision-making. Farmers were asked to identify the influences on their farm business decision making by placing Post-It© notes for each influencer on a circular grid (see Figure 2.2), adapted from Oreszczyn et al. (2010). Influencers perceived to have the most influence on their decisions were placed in the centre of the grid, with those with least influence placed towards the outside. Respondents were initially asked to identify influencers 'off the top of their head'. They were then provided with a list of possible influencers to check if they have missed any. This enabled a consistent approach to the consideration of the same set of influencers across all case studies. As the influencers were placed on the map, respondents were asked to describe the reasons for placing them in the middle or outside of the grid.

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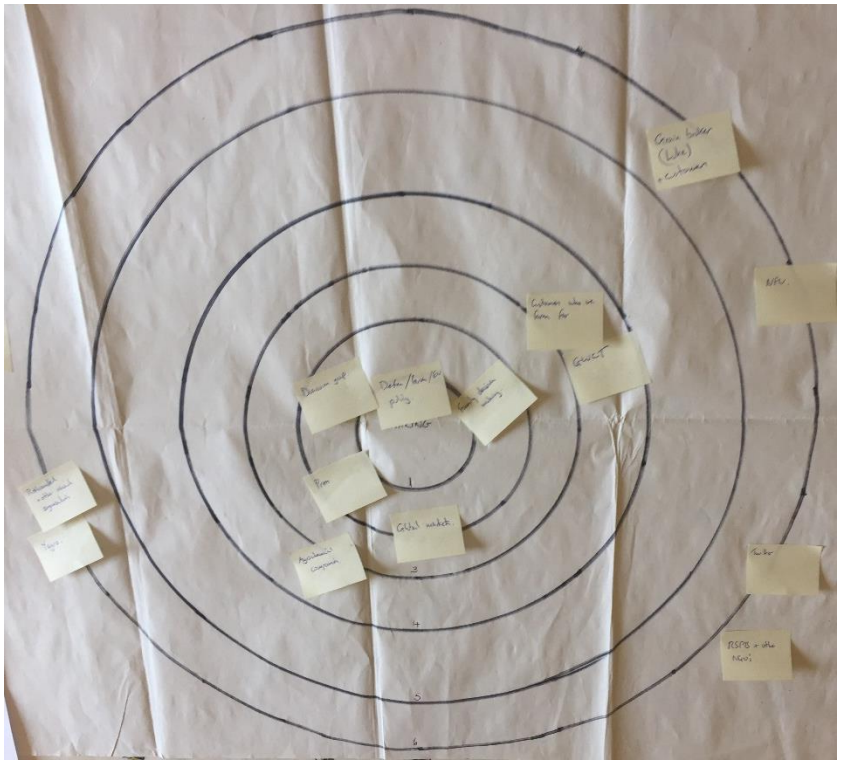

Figure 2.2 Example of an influence map from UK case study.

After completion of the mapping, participants were asked to reflect back to a time when they undertook a change on the farm and asked to adjust the influence map to reflect their key influencers at this time. If participants had not made any major changes, they were asked to consider a time in the past (e.g. 20 years) and reflect on where their influencers had changed over that time. The Post-It© notes were moved around the grid to reflect this change and both the initial 'current' and the subsequent 'change/past' maps were recorded (by photographing) (Figure 2.3).

All interviews were audio recorded (with participants consent) and transcribed verbatim.

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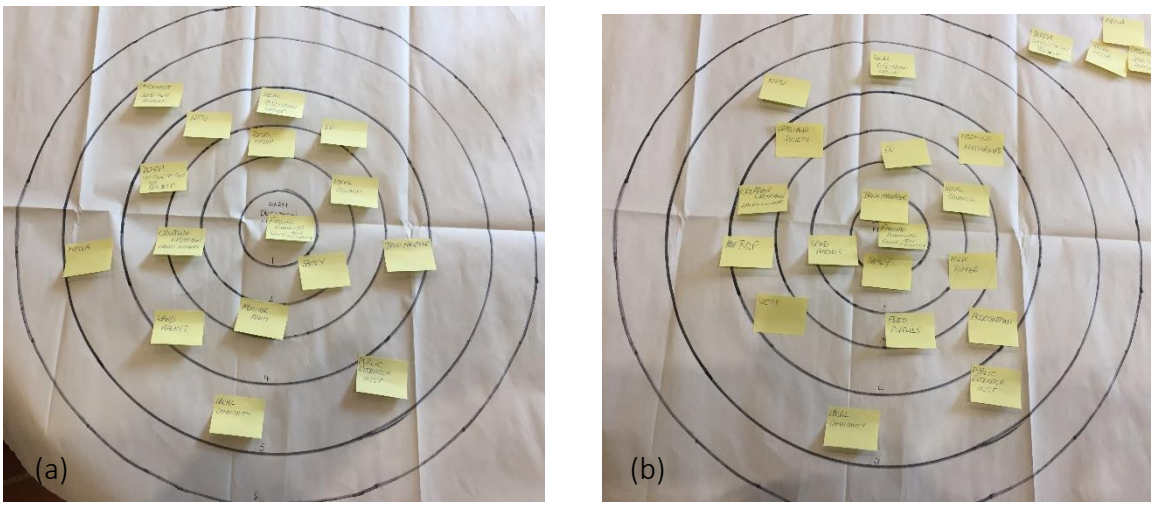

Figure 2.3 Example of two influence maps from the same participant, showing change in influencers between (a) current decision-making and (b) during a transition period on the farm.

2.3 Preparation

In order to ensure consistency in the research approach across the 11 case studies, the task lead (UoG) prepared detailed guidelines and an interview guide for conducting the interviews and analysing the data. In addition, a training workshop was held during the partner meeting in Madrid in April 2018, prior to commencement of the fieldwork. A follow up workshop was held during the partner meeting in Halle in September 2018 to report back on the first round interviews, discuss any issues that arose and plan for the second round of interviews.

2.4 Recruitment

Each case study was tasked with achieving six interviews in each round, with a total of 12 interviews per case study, although this total was not achieved in four of the case studies due to difficulties in securing sufficient respondents (Table 2.1). Participants were selected purposively to enable a diverse range of respondent types to be included in the sample. The aim was not to reach statistical representativeness, but rather to cover as much diversity as possible with as few respondents as possible. As the aim of this activity is to explore farmers' learning and knowledge networks, case study partners aimed to include farmers with different levels of engagement with social/knowledge networks and a diverse range of experiences. Recruitment of respondents in most cases was also based on pragmatic considerations, such as using the same respondents for these interviews as for the demographic (T3.1) and/or biographical narrative interviews.

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Approaches to recruitment of participants in the case studies included using 'gatekeepers', such as a farmers' union, agronomist or extension service, to identify appropriate respondents, as well as the researchers' own personal networks, social media and internet searches. In addition, snowball sampling (Montello and Sutton, 2013), where respondents suggest other farmers in their network who they think might be willing and suitable to be included in the study, was used. Invitation emails or letters were sent to potential participants, explaining the context and purpose of the research, why their participation would be valuable, what benefits they might receive from taking part and what the anticipated outcomes of the research might be. The letter/email explained that participation is voluntary and they would not be identified in the outputs from the project. All participants were required to sign a consent form at the start of the interview. Along with seeking permission to use the data, the consent form also formally recored that the participant understood how their anonymized data will be used and stored.

Table 2.1 provides an overview of the number of interviews conducted in each country. Details of the recruitment process in each case study can be found in Appendix 3.

Table 2.1 Number of interviews conducted in each case study

Case Study	No. interviews	Case Study	No. interviews
Bulgaria	9	Poland	9
Belgium	13	Romania	14
France	7	Spain	14
Germany	12	Sweden	12
Italy	12	UK	18
Netherlands	10		
Total: 130			

2.5 Analysis and reporting

All interviews were transcribed and subjected to qualitative analysis. The task lead (UoG) prepared a common codebook (see Appendix 4) that was utilised by all partners to guide their analysis. The purpose of the common codebook was to provide a broad framework to ensure consistency in the analysis across all case studies. However, partners were permitted to add in additional coding

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specific to their case study, and were not required to use all the codes in the codebook if they were not relevant. All partners provided input on the codebook at the Halle meeting to ensure it was suitable for all case studies. Five partners (UK, Spain, Sweden, Belgium and Bulgaria) used the software NVivo to code their data, the Netherlands used AtlasTi, Germany used MaxQDA and Poland, France, Italy and Romania coded their data in Word.

Each case study prepared a country report including extended summaries (in English) of each of their interviews, a list of codes, code descriptions and exemplar quotes from the transcripts, and a discussion addressing the following questions which collectively addressed the four objectives of the task:

1. Who/what are the most important influencers on farmer decision-making, and why?
2. Do these influencers change over time in relation to different decisions/risk management?
3. How do farmers' attitudes and beliefs influence their decision-making?
4. What external (to the farm) factors influence decision-making, and how?
5. What learning strategies do farmers adopt for managing risk and adapting to change?
6. What are the most important factors in enabling learning in the adaptive capacity cycle?
7. What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

The task lead imported the case study reports into Nvivo and these were coded thematically based on addressing the research objectives. This allowed for an assessment of areas of consensus and difference between the case studies.

The influence map data was recorded in an Excel file for each case study, which was combined into one dataset for analysis. Across the 11 case studies, a total of 283 influencers were identified – these ranged from generic influencers, such as 'family', to the more specific, e.g. 'son'. For analysis, this set of influencers was consolidated into a final set of 19 influencers, including individual, organisational and other influencers (see Table 2.2). Two summary maps for each country were prepared, for current and change/past scenarios, to provide a visual representation of the data. Analysis involved exploring the consensus and difference across the case studies in relation to the key questions and themes listed above, and across the different farming systems (arable, livestock, horticulture, mixed, perennials).

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Table 2.2 Summary of the 19 influencer categories identified in the 11 case studies.

INDIVIDUALS	
[1] Farming advisors • Crop advisors • Poultry advisors • Feed advisors • Feed advisors (independent) • Consultant • Agronomist • Consultant 'boerenbond' (Belgian agricultural organisation) • Adviser of "provincie Oost-Vlaanderen" • Consultant "triple AAA" (specific way of breeding)	• Succession planning advisor • Advisor organic farming • Technical advisers • Consultancy company • OJCA (County Office for Agricultural Consultancy) • Marketing advisors (diversified business) • CAA (Centre for Agricultural Assistance) • ADR (Agency for Development Nord-Est Region) • Agrii Fronteir • Solicitor • Veterinarians
[2] People on the farm • Family • Spouse • Business partner • Children • Brothers	• Mother • Father • Uncles • Nephews • Parents • Employees
[3] Other farmers • Farmers abroad • Farming neighbours • Other farmers in the region • Farmer colleagues	• Farmers in general • Colleagues (non-farming; from off-farm part-time job) • Neighbours (local population) • Monitor farms
[4] Consumers • Public	• Guests visiting the Bed and Breakfast • Tourists visiting the region
ORGANISATIONS	
[5] Financial influencers* • Accountant • Accountant (fiscal) • Accountant (business-economics) • Bank manager • Business advisors / partner • Business associations • Personal coach (for business strategy) • Bank (liquidity) • Insurance Companies • CAF (Centres for Financial Assistance) • Banks • Financial Institutions	• AFIR (Agency for Funding the Rural Investments) • APIA (Agency for Payments and Intervention in Agriculture) • Local investor • ISMEA • Business Associations (e.g. Kalgrup Ltd, Association of Fruit and Vegetable Producers SADPOL) • Collaborator of 'boeren op een kruispunt' (Belgian non-profit institution) • Business associations (Svensk Fågel/Svenska Ägg) • FAVV • Land agents • Real estate agents
[6] Research institutions* • Academic and research organisations	• The Arable Group • Public research institutes

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• Contacts at research organisations • Researcher from ILVO (specialist large scale stables) • Ministry of enterprise and innovation (swe: Näringsdepartementet) • NIAB	• Processors and Growers Research Organisation (PGRO) • University • Teacher of son / school teachers • ADAS
[7] Government influencers • Politicians • RPA • Ministry for Agriculture (e.g. Defra; Ministry of Agriculture and Rural Development of the Republic of Poland • EU • EU/Ministerie LNV (Ministry of Agriculture) • Government • Government – law • Government – advice • Policy makers local • Policy makers federal • Policy makers general • Governmental Agencies • Swedish Board of Agriculture (SJV)	• VLM ('Vlaamse landmaatschappij') (branch organisation of policy domain 'environment') • Advisor of VLM • (Dutch) Water boards [in Dutch: "waterschappen", i.e. regional water authorities] • National manure legislation; VLM • ANSVSA - DSV (National / county Sanitary Veterinary and Food Safety Authority) • Mestbank' inspector • FEVIA (Federation of belgian food industry) • Health and Safety Executive (in Poland National Labour Inspectorate) • Jurist • Ministry (Tourism) • Historic England
[8] NGOs/ environmental/ conservation organisations • Environmental lobby groups working with farmers (e.g. Game conservancy, RSPB) • Grassland Society • LEAF • Suffolk Wildlife Trust • FWAG • Environmental/landscape agencies e.g. National Fund for Environmental Protection and Water Management)	• Environmental lobby groups working with farmers • Agri-environment local offices • Environmental writers • Natural Reserve • Consultant conversion to organic farming (Johan Devreese) • Organic certification bodies
[9] Direct customers • Clients • Supermarkets • Local market • Butchers • Local shoot • Restaurants	• EEG / Avicon; German Renewable Energy Act and company which buys energy • Milk buyer • BQP (pigs) • Grain broker • Specialised fruit and vegetables shops in town • Dairy company • Dovecote Park
[10] Suppliers • Main • Other • LUMA (Oil supplier) • Machinery Supplier • Seed companies • Plant breeders • Input suppliers (for processed food products)	• Yagro • GBM (Seed supplier) • Company representatives / sales people • Individuals from chemical companies • Labour agency • Contractors • Employee (off farm) • Chicken hatcheries/Hen Parent generation sellers

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• Feed Supplier	• "Specialist niche cropping companies (for those growing specialist crops)
[11] Buying groups	• Kronfågel, Kronägg, Reko etc. • CAMGrain
[12] Cooperatives • Producers organisations • Organsations (incl. cooperatives, Ag Min)	• Co-operative Farm audits • Agrifirm (cooperative for feed and seed supply, buys grains and wheat as well from farmers)
[13] Farmer associations • AHDB (in Polish:National Union of Fruit and Vegetable Producer Groups: KZGPOiW) • Local Agricultural Consortium • Coldiretti (National Agricultural Association) • Assofrutti (PO) • Farmers Association	• Arsial (Regional Association Promoting Agriculture) • Royal Agricultural Society of England (in Poland Agricultural Chambers) • National Farmers Union (NFU) (National and local) (Trade unions of farmers) • "The Federation of Swedish Farmers (LRF) " • Bauerverband (Farmer's association) • LTO (Dutch Farmer Union)
[14] Processors • Product Processing (Companies) • Packers/Slaughterhouse	• Budweiser Barley • "Dairy company
OTHER	
[15] Local influencers • Local gov/council • County agricultural authority (branch of the Ministry of Agriculture) • Land owners	• County local authority • Local community • LAG (Local Action Group) • Thieves • County Administration Board (LST)
[16] Media (general) • Media campaigns against milk consumption, animal welfare scandals	• Local press • Tourism blogs
[17] Social media	
[18] Internet	
[19] Farming press • Specialized agricultural advertising	• Specialised radio/TV broadcasts • Trade press

*Financial influencers and Research institutions were referred to either as organisations (e.g. the bank) or as individuals (e.g. accountant, bank manager).

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3 Summary results for case studies

The SURE-Farm concept of resilience capacities provides a useful heuristic for considering learning across the adaptive capacity cycle. When assessed for robustness, adaptability and transformability, some differences across the case studies were revealed (Figure 3.1), although it should be noted that these assessments comprise the qualitative judgements of case study partners. The arable farming systems (Bulgaria, Germany, Netherlands and UK) comprised farms that were mainly robust or adaptable, with some that had transformed, and it is worth noting the similarity between the assessments of the four arable case studies. The livestock case studies demonstrated different levels of resilience, most likely due to the varied nature of the livestock activities across the case studies. Thus, French and Belgian farms were assessed as mostly robust, Spanish farms were adaptable and Swedish farms were either robust or adaptable, but some had transformed. The horticulture case study in Poland was considered adaptable, while mixed farms in Romania were mainly transformable and the hazelnut farms in Italy was either robust or transformable. The high levels of transformative farms in Italy and Romania is likely due to the particular phase in these farming systems, with the hazelnut sector in Italy undergoing rapid growth, and mixed farms in north-east Romania undergoing a radical shift from subsistence to market-oriented businesses.

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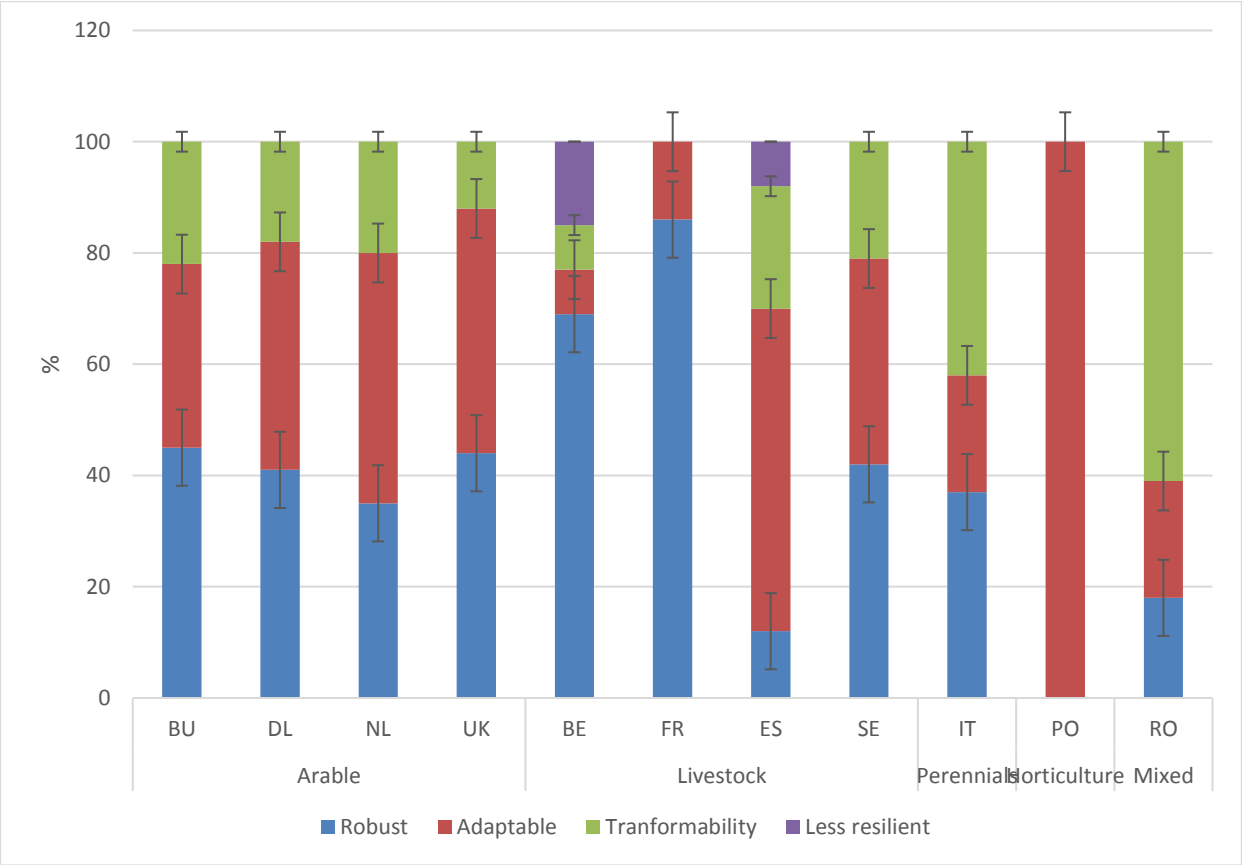

Figure 3.1 Resilience capacities of case study farming systems (% of respondents categorised per capacity).

The following sections in this chapter present summary results for each of the case studies. Key findings at the country level help to identify the patterns of influence at case study level before being used to compare across the case studies in Chapter 4. More detailed reporting can be found in the individual country reports in Appendices 5-15.

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3.1 Belgium

The Belgian case study focused on dairy farming in Flanders where the number of farms is decreasing, however the average farm size has increased over the last 20-30 years. Alongside this, there has been a steady increase in overall milk production, which peaked after milk quotas were abolished in 2015. The majority of farms are family run.

3.1.1 Networks of influence

Apart from farmers' own experience, the most important influencers on decision-making are vets, family members, accountants, bank managers, advisors, farming friends and neighbours and land owners. The farming press, the internet and social media are also important sources of information. All respondents spoke about one specific person that they trust and which they consult for day-to-day on-farm decisions. This 'first point of contact' may be a family member, an advisor (e.g. vet) or accountant. What is common is that this primary influencer is a person that the farmer trusts, has regular contact with and is perceived as independent (i.e. not trying to sell something to the farmer). Feed sellers, bank managers and other suppliers are the least trusted by respondents. The primary trusted person, however, can change over time, especially when implementing change on the farm. When farmers are considering large investments or taking loans, actors with specific advisory roles (such as bank managers, business advisors, accountants) become more influential. If the decision relates to diversification or farm enlargement, the local community play a role in the farmer's decision-making. Not all farmers actively seek out information sources when considering change. Some decisions are the result of changing attitudes and beliefs that have developed slowly over time.

3.1.2 Influence of attitudes and beliefs

There is a normative belief that farm enlargement and intensification are the best strategies to deal with low margins, a belief supported by government. However, some farmers observe that some large farms struggle financially and are very labour intensive, impacting on farmers' quality of life, thus they are open to doing things differently. Two types of farmer exist: one who is proactive and trying to anticipate future regulations and challenges, the other who is reactive and perceives that they have a lack of efficacy, responding to new regulations and other challenges as they occur.

3.1.3 External influences

External factors that influence farmers' decision-making include banks (i.e. the availability of finance), volatility of milk prices, changing European and regional policies (e.g. potential loss of subsidies, more stringent manure legislation), the biophysical conditions of the region, input

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availability and prices (e.g. feed, labour, land), public opinion, the media, policy, uncertainty about succession, extreme weather events and farmer wellbeing.

3.1.4 Learning strategies

Learning strategies include, firstly, a sound agricultural education and the acquisition of the appropriate skills and knowledge. As the farmer gains more experience, he or she is better able to make independent decisions. Secondly, farmer-to-farmer learning is important, occurring through farm visits, experimental fields, events organised by research centres or meetings organized by governmental institutions. Some farmers learn from neighbouring farmers, while others learn from overseas farmers, particularly for innovative ideas. Farmers' networks allow the exchange of ideas and experiences, and the opportunity to experiment together. For some farmers, experimentation is a key learning strategy, although trials are not always successful and it is crucial for farmers to reflect and learn from their mistakes as well as successes. A key attribute for learning is being open to new ideas, innovation and alternative practices, although some farmers find it very difficult to get out of a business-as-usual mindset. Thus, a key factor in the learning strategies that farmers' adopt is their character, interests, motivation and entrepreneurial spirit. Respondents that demonstrated the ability to see others' perspectives and reflect on this, particularly in terms of negative media coverage recognised the need for the farming community to respond and adapt to this, rather than see themselves as the 'victims'. Furthermore, those who had a clear vision on the wider farming system were able to better reflect on their own behaviour and assess why they made certain decisions, compared to farmers who only focused on their own situation.

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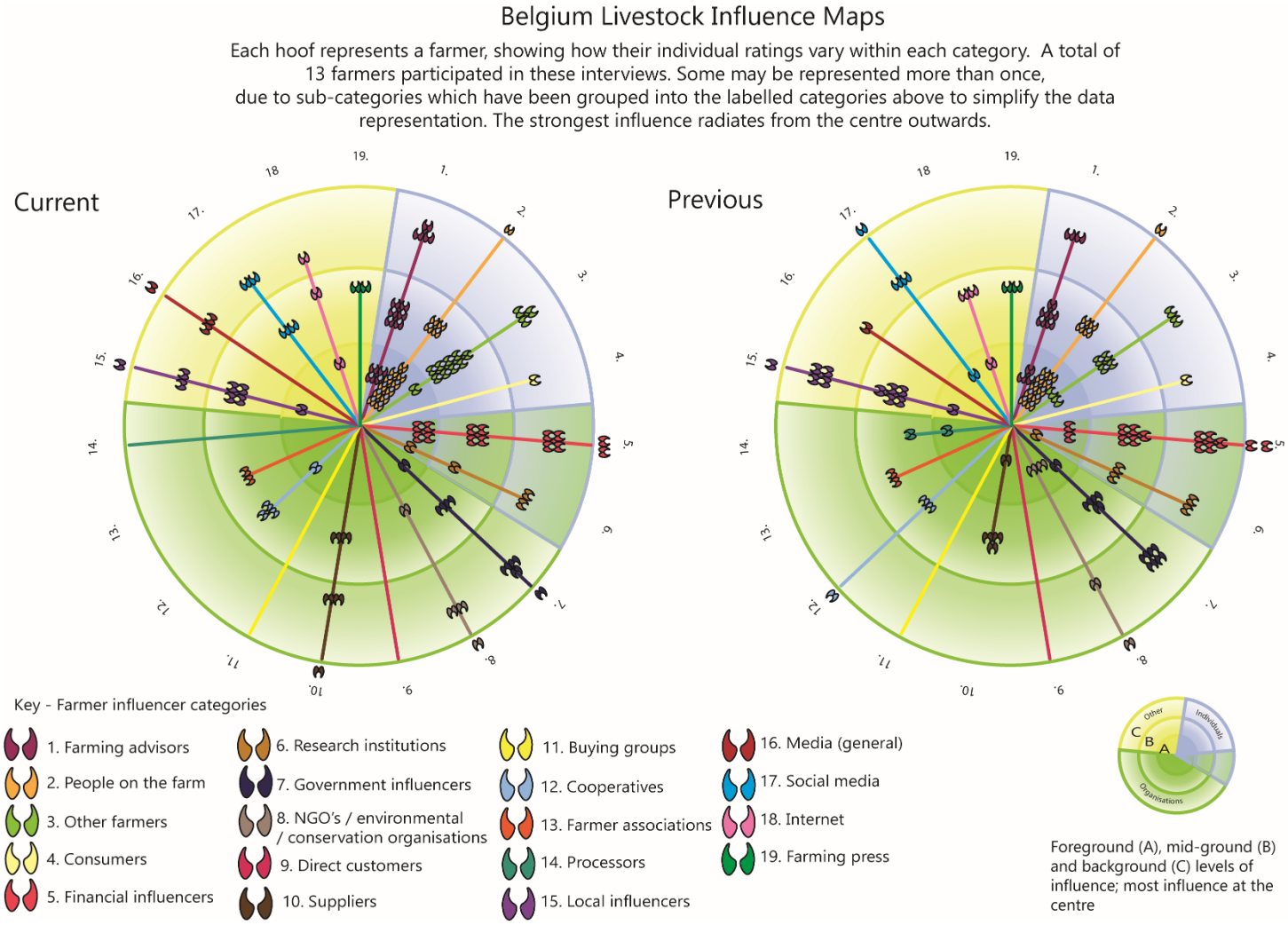
Figure 3.2 Current and previous influence maps for Belgian case study.



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3.2 Bulgaria

This case study consists of arable farming in the North-East of Bulgaria, a region known as 'the granary of Bulgaria' and constituting 40% of Bulgaria's arable land. Since 1990, the large-scale collective farms of the Communist regime have been restored to the families of their pre-Communist owners, resulting in a rapid transformation of the sector. This prompted the beginning of entrepreneurship and operating under a free market economy, entry to the European Union in 2007 and a steep increase in land prices. A key issue is the lack of skilled labour due to rural depopulation which started during the Communist era and has exacerbated after 1990.

3.2.1 Networks of influence

The most important influencers in this case study are family, farming friends, employees, agronomists and suppliers. The bank is also important, but the influence of research institutions and insurance companies is limited. The farmers would like to see improved collaboration with research institutions, but feel that currently farmers are more up-to-date with the newest technologies and innovations than researchers are due to underfinance of science and education. Although not influential in their decisions, the farmers mentioned organisations such as the Grain Producer Association and the Association of Farmers in Bulgaria as important mediators and representatives of farmers in negotiations with policy makers. The most trusted influencers are family members, farming friends and representatives of trade companies (both for inputs and sales). The internet is an important source of information, as are training days and seminars organised by agribusiness companies and farmers' associations. The main change in influencers over time relates to an increase in influence from the farmers' children as they grow up and contribute to the decision-making on the farm. Information sources have changed, with an increase in the use of the internet and social media, alongside the more traditional seminars, fairs and exhibitions.

3.2.2 Influence of attitudes and beliefs

As respondents witness climatic changes, there is an ongoing shift in beliefs towards natural resource protection and recognition of the negative impact that monoculture agriculture has on soil health. Public opinion about farming also influences this shift in attitude. However, the short-term leases on land make it difficult to invest in long-term soil fertility. Associated with this is farmers' shift towards the use of new technologies that enable them to farm in a more environmentally-sustainable way (e.g. no-till, precision farming, use of ICTs etc.). In addition, farmers' views are also influenced by the nostalgic pre-Communist memories of their parents and grandparents.

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3.2.3 External factors

A key external influence on farmer decision-making is the institutional framework, with respondents indicating the lack of a regulatory framework that is sustainable in the long-term as a barrier to transformation and innovation. This, together with over 50% of the farmed land operating under short-term leases, means that despite their ambition to change their farming practices, farmers are forced to continue monoculture farming. Other external factors include access to finance for investment in machinery, availability of skilled labour, price volatility, irregularity in seed inspections and the lack of capacity to develop crop varieties that are most resilient in the biophysical conditions of North-East Bulgaria.

3.2.4 Learning strategies

The main learning strategies adopted by respondents relate to improving efficiency in production costs and securing assets so that there is less dependence on external factors. In this regard, experimentation was important for all the respondents, focusing on new technologies, new crop varieties and trying out different crops on different plots across the farm. Farmers often learn from other farmers through training seminars, exhibitions and other events where farmers can network, particularly learning about the experiences of those who implemented some - innovation. The ability to reflect on their own experience, being open-minded to different viewpoints and being self-critical is also important. For Bulgarian farmers, a key challenge was to learn how to act as entrepreneurs in a market economy after decades of a centrally planned system.

In general, Bulgarian farms demonstrate adaptability. They have adapted production from conventional to more environmentally-friendly farming, but challenges to the ongoing resilience of this farming system include climate change, a fragmented land ownership (with a lack of legislation to secure longer leases), a lack of skilled labour and a lack of long-term policies and regulations.

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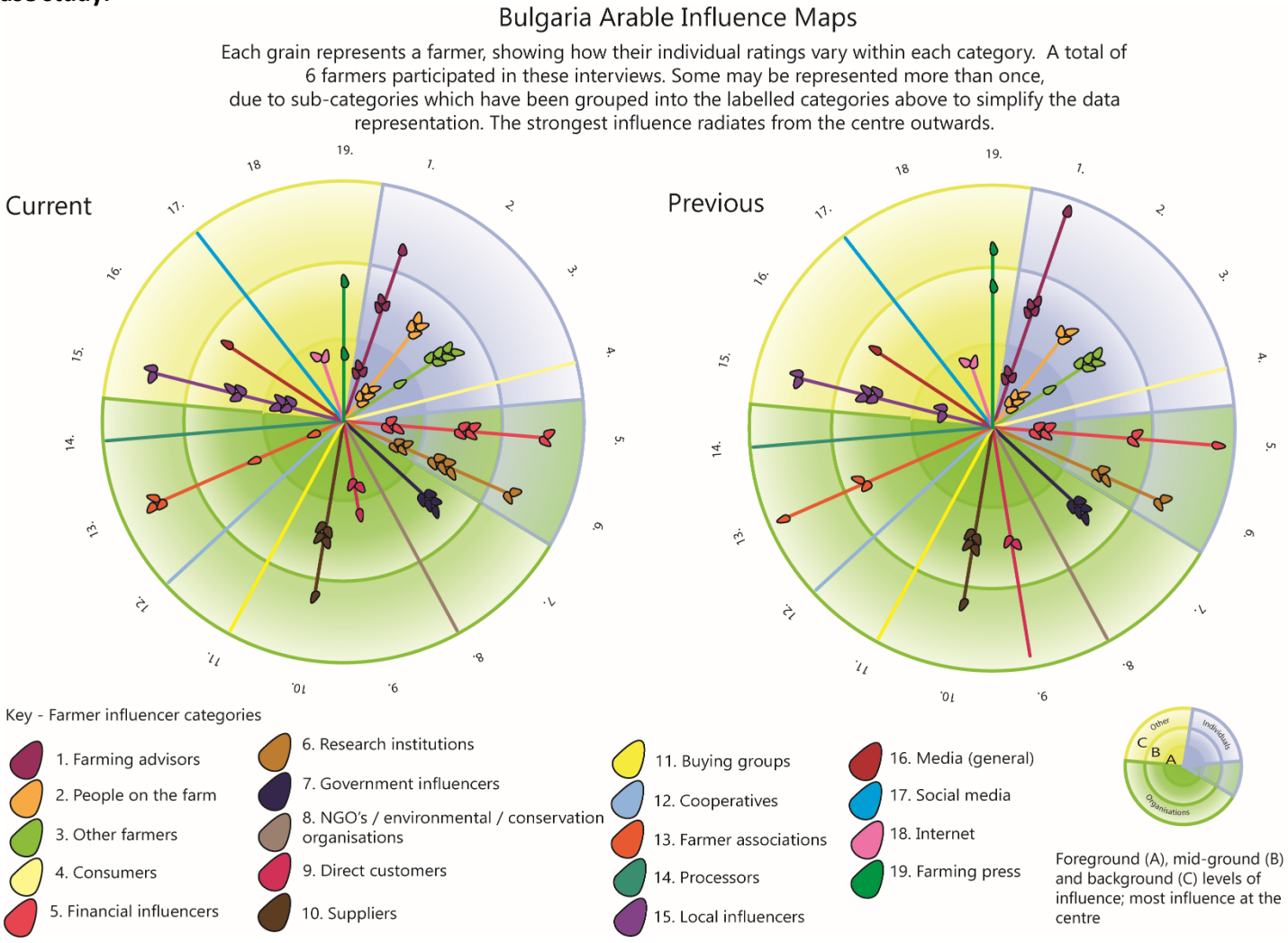
Figure 3.3 Current and previous influence maps for Bulgarian case study.



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3.3 France

This farming system case study consisted of beef production in the Bourbonnais region in central France. The average size of farms is 88 ha, although the number of farms has decreased by 25% since 2000.

3.3.1 Networks of influences

The main influencers include agricultural cooperatives, family members (particularly the former farmer), neighbouring farmers, trusted accountants and the Chamber of Agriculture. In general, organizations and individuals with the greatest influence on livestock producers' decisions are those with whom the farmer has an emotional bond (e.g. friendship or family) or organisations they have been involved with or worked at previously. The internet and farming press are important sources of information. Generally, the degree of influence of family members, former farmers, other farmers, accountants and the farming press remains constant over time. However, if the former farmer is not family, he or she may become less important.

3.3.2 Influence of attitudes and beliefs

The identity of the farmer is very much influenced by intergenerational activity, with incoming farmers wanting to respect the traditions of the farm by keeping livestock on it (even when it is only marginally profitable). Indeed, often two or more generations will be working on the farm at the same time. Thus, rather than transforming, these farmers will look for adapted solutions to continue breeding activity on the farm (e.g. increase herd size, increase farm size, change approach to sales etc.). Some of the respondents had converted to organic production, both for economic reasons (in order to improve the price achieved for meat), but also ideological (farmers want to produce in a way that is more environmentally-friendly and for health reasons). Conversion often occurred at the point of farm succession.

3.3.3 External influences

External influences on decision-making include the volatility of the meat or weanling prices, climate change, access to land, policy and CAP subsidies, changes in labour standards and societal expectations (public health, animal welfare, environmental considerations). A flexible financial basis or the ability to secure loans are important in enabling experimentation and learning. Further, the presence of the necessary value chain actors (e.g. a slaughterhouse) is required to enable some forms of change.

3.3.4 Learning strategies

Cooperation and learning from others is a key strategy adopted by farmers, particularly in the form of selling cooperatives and mutual assistance (e.g. in case of accident), but also through

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sharing ideas and experiences. However, trust is key as they won't develop an idea from someone they don't trust. Observing societal expectations may trigger a change in the farmer's practices. Learning from past experiences is important, learning from both successes and mistakes. Skills and knowledge acquisition is achieved through the internet, radio, television and the press. Farmers' characteristics are crucial for changing and learning. Open-mindedness and reflexivity is important to enable a farmer to reconsider his own practices or test new options, including new technology. Such farmers tend to be more open to experimenting or testing out new innovations, including testing pasture or crop composition, trying different breeds, trying different market approaches to maximise selling prices, trying out diversification activities or adding value to products. Most farmers that had implemented changes had seen it on another farm, read about it and talked to experts and other farmers.

Due to the climatic and economic context of suckling cow production, farmers are constantly looking for solutions to increase their resilience, notably through adding value to their products. The Bourbonnais livestock sector will face several major challenges in the coming years: reduction in meat prices and meat consumption; an increase in drought conditions; and changing societal expectations.

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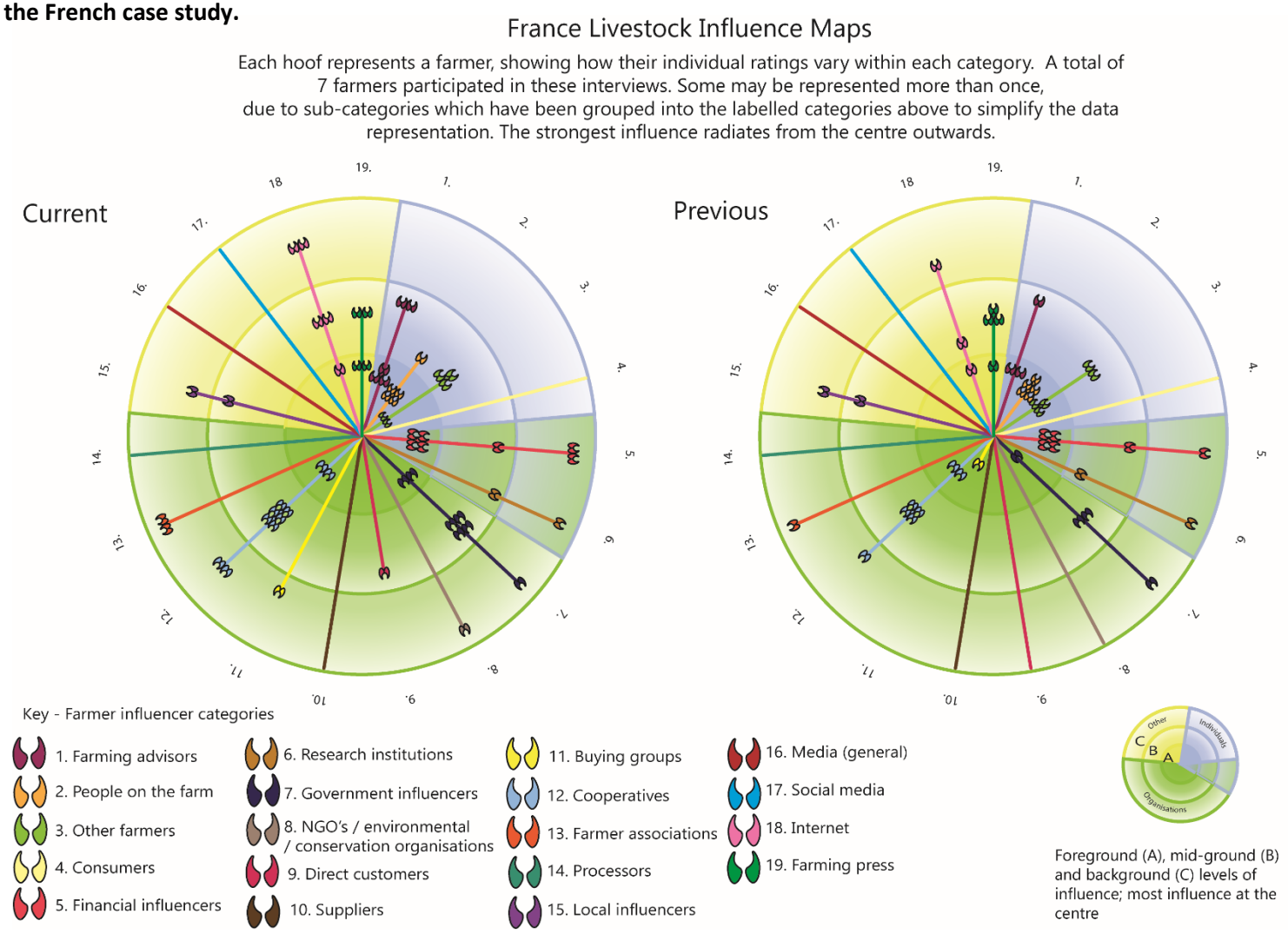
Figure 3.4 Current and previous influence maps for the French case study.



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3.4 Germany

The German case study is located in the Altmark, in the German Federal State of Saxony-Anhalt and consists of large-scale corporate arable farms. The Altmark's current agricultural structure was shaped in the 1950s and 60s during the time of the former German Democratic Republic, when farms were transformed into state farms and collectivised cooperatives. After the German reunification, much of the land remained in former collective farms, which transitioned into co-operative farms or limited liability companies.

3.4.1 Networks of influence

Most of the respondents indicated that their own experience is the major influence on their decision-making, and they have relatively few individual or organisational influencers. However, the bank is an important influencer, determining whether the farm can receive a loan for future investments. Within the farmers' immediate circle are their employees, other co-op members and neighbouring farmers. The respondents discuss issues with colleagues on the farm in day to day situations. In more specific larger cases, they speak with other farmers and also seek outside help from consultants as well as attending conventions or lectures. Unlike the other case studies, family members were not seen as an important influencer on decisions, unless they were also farmers. Regulatory bodies and policymakers were seen as influential, mainly in terms of setting the boundaries within which farmers can operate. The respondents all actively read some form of agricultural news and/or literature (literature being defined as more scientific). This kept them informed on events and new ideas, which would give them the opportunity to research more as well as find conventions on a new subject. The farmers' association provides updates but its influence is peripheral and not as trusted as the general agricultural news and literature sources. The area does not have reliable internet, so this is not a main tool that farmers use to seek information. Radical changes in influencers have not changed over time.

3.4.2 Influence of attitudes and beliefs

Respondents did not speak much about their attitudes and beliefs, focusing on their role as the farm manager. As is typical in Germany, the farmers interviewed are risk averse, and feel stressed by the constantly changing regulations. This prevents them from making long-term investments and plans. They are also cautious about testing new ideas, trying out new changes on a small-scale first. Transformability is rarely seen in this case study, except in the case of biogas, where the guaranteed subsidies and prices provided by the German government essentially negated all risks associated with biogas investments. The respondents, however, feel somewhat abandoned by the government, indicating that they increasingly have to compete with lower prices on the global market, but increased regulations increases their costs. Respondents did not speak about

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reflecting on how to do things better, but rather they were passive, seeing things happening to them that were beyond their control.

3.4.3 External influences

Policy and regulation are the number one influence on farmers' decision-making, with farmers feeling constrained in the decisions they can make themselves. They do not feel consulted about new policies and regulations, thus they are unprepared to mitigate new risks. Other issues include increasing prices for buying and renting land, bureaucracy in administration, public opinion, extreme weather events, poor regional infrastructure and a shortage of skilled labour.

3.4.4 Learning strategies

Much of the respondents' learning was associated with improving existing practices (for robustness), including improving their social relationships (e.g. annual parties for landowners) and public relations practices. Respondents also experiment with direct marketing to manage the risks of being price takers; trying out new labour recruitment ideas; and experimentation with new ideas such as organic, testing out new extreme weather-resistant crops or diversifying crops. Respondents were open to hearing about new ideas, but were cautious about putting these into practice until they had thoroughly tested them first. There was some engagement in peer-to-peer learning such as visiting a path-breaking farmer, although there was no interest in long-term cooperation with peers.

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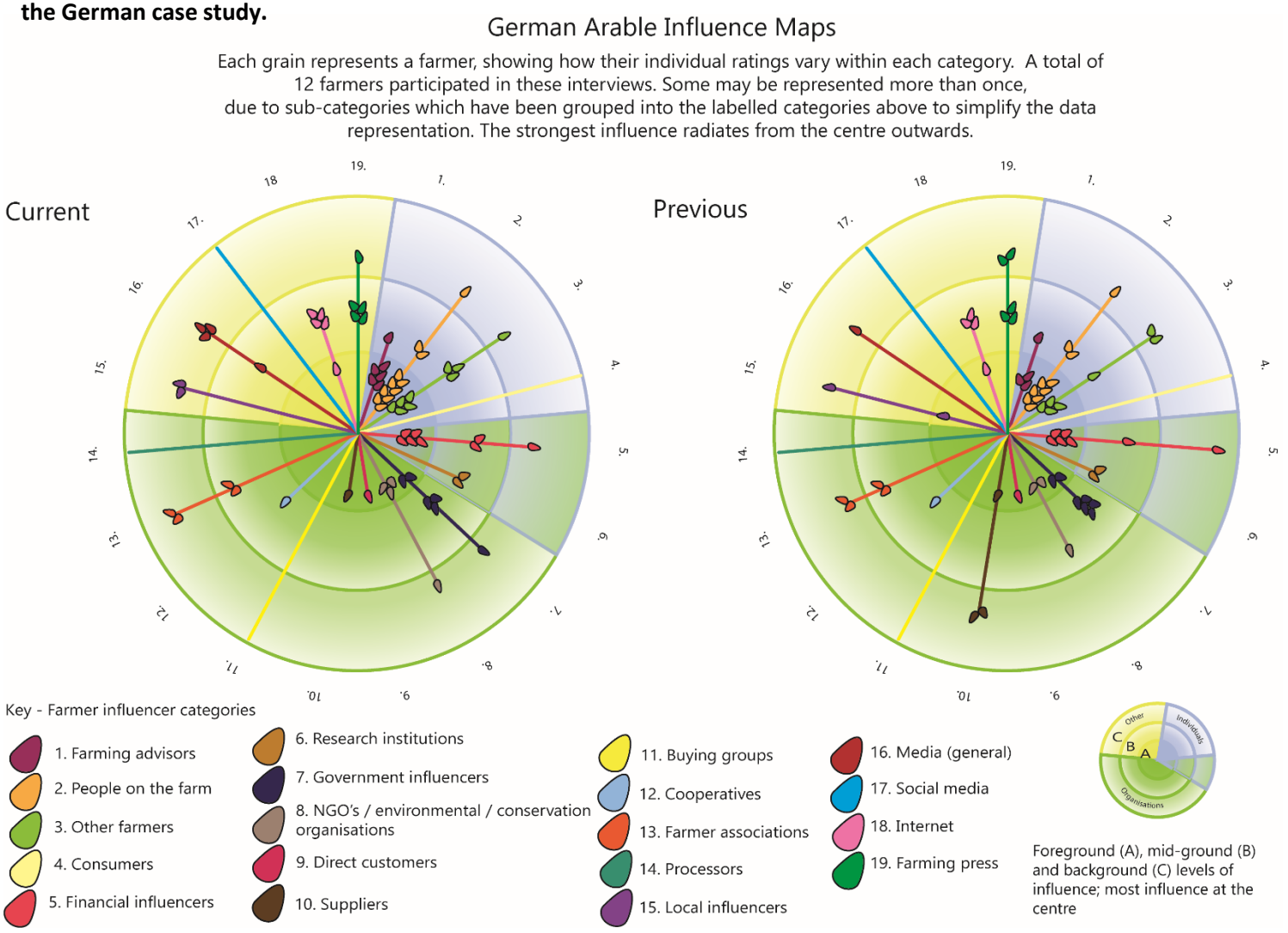
Figure 3.5 Current and previous influence maps for the German case study.



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3.5 Italy

The Italian case study is hazelnut production in Viterbo in the Lazio region. There are over 6,000 hazelnut farms in Viterbo, with 86% of these under 10 ha. Most are run by families on a part-time basis.

3.5.1 Networks of influence

The most prominent influencers on decision-making are family members, most of whom work on the family farm. Changes, such as converting to organic, or enlarging the farm size are decided by the family jointly and are often influenced by the incoming young generation. Public institutions have an influence, mainly due to the delay in providing pillar II subsidies. Advisors, such as agronomists, are important influencers, providing scientific-based input on technical decisions related to both agronomic and administrative tasks. Indeed, suggestions to try out new techniques in production often come from the agronomist. The local farming community is important for conveying information. However, as the predominant mindset is towards conventional farming, those who convert to organic have to overcome normative judgements from their neighbours. Farmers' associations (i.e. Producer Organisations) influence decision-making through access to EU funds, seminars and meetings which introduce new technical skills, administrative suggestions and an opportunity for peer discussion. Machinery suppliers, financial advisors and public research institutes are also important influencers with the internet providing a useful source of information, particularly for keeping track of international prices and new techniques. When undertaking changes, the importance and significance of these influencers does not radically alter, with the family still at the centre of the decision-making process.

3.5.2 Influence of attitudes and beliefs

Many of the decisions to develop the farm stem from the passion and interest that the next generation show in taking over the family farm business. Regarding conversion to organic, personal beliefs and values play a pivotal role and their commitment to the benefits of organic must be stronger than the prevailing social norms regarding conventional production.

3.5.3 External influences

The high profitability of the hazelnut sector is a strong external influence, prompting young people to remain in the family farm business. Alongside this, the availability of new technology to mechanise cultivation (which has improved health and safety for labour) and political institutions that determine the policy and regulatory environment in which producers operate is also influential. A main challenge is pests, along with drought and unseasonal frosts.

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3.5.4 Learning strategies

Farmers in this case study have a strong sense of community and there is a high level of peer-to-peer learning. They learn from others by observing what other farmers are doing and by attending seminars, meetings and other events, where they can discuss policy, agricultural techniques and other issues with experts and other farmers. Cooperation is widespread, primarily to compete with wholesalers and, more recently, to provide insurance. Farmers are generally flexible and open to new ideas, many of whom are pioneers in trying out new techniques. Thus, respondents indicated that experimentation is important for trying out new ideas, and this often occurs with the support of machinery suppliers and/or research institutions in terms of investigating how to improve agronomic activities (e.g. fertilisation, plantation structure). There are two types of farmers: first adopters, who are innovative and try out new things coming from research or technological development; and followers, who apply new technologies once they have been tested by other first adopters.

Farmers mainly rely on their own experience and experimentation, which helps them to remain robust. Experimentation and information-sharing can further stimulate adaptation of the farming system to changes in the sector (e.g. conversion to organic as a response to market instability). Transformation occurred in the past, when vineyards, crops and livestock were substituted for the more profitable hazelnut production.

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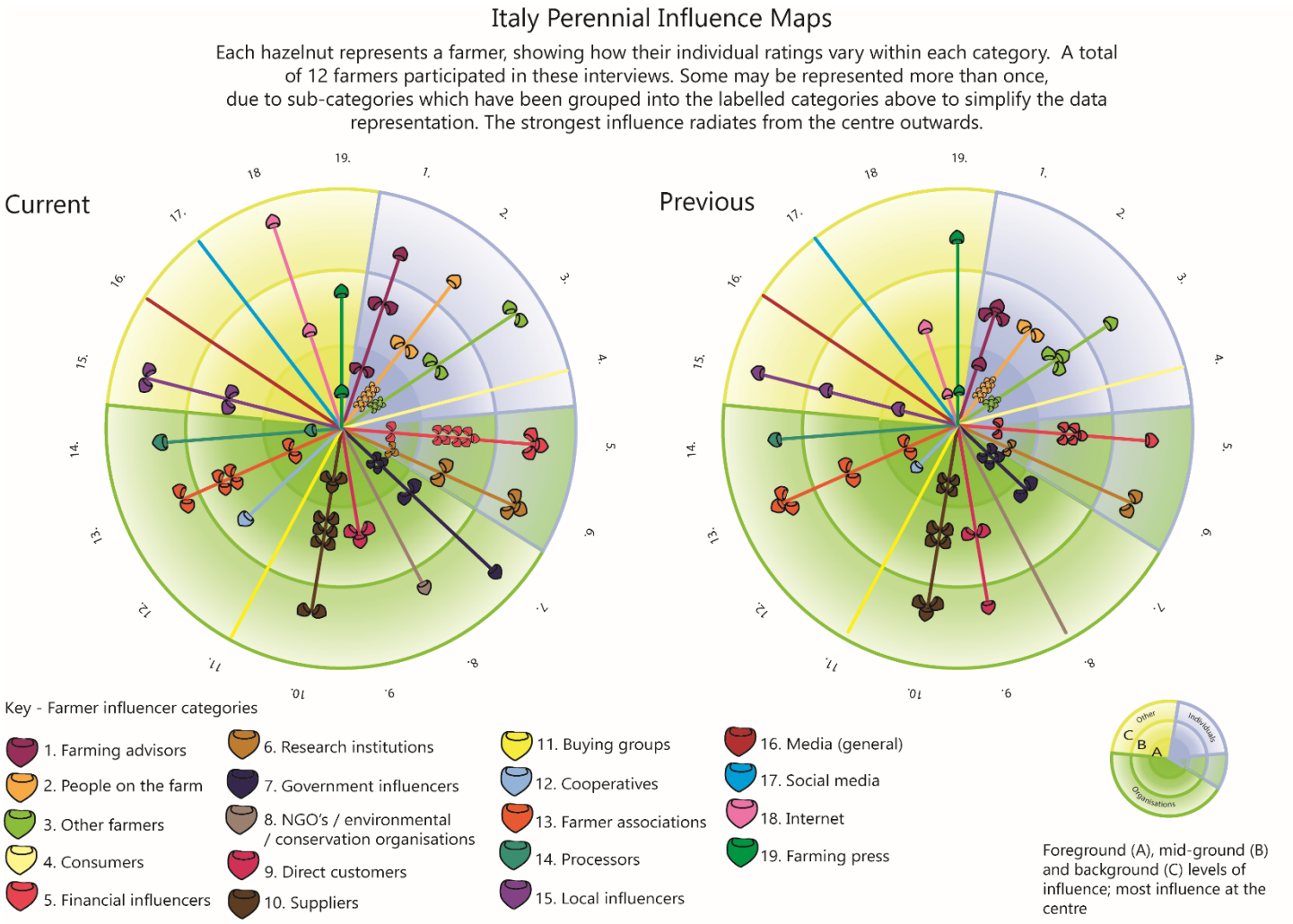
Figure 3.6 Current and previous influence maps for the Italian case study.



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3.6 Netherlands

The Dutch case study is arable farming in the regions of Veenkoloniën and Oldambt in the northern part of the Netherlands. There are limited possibilities for crop rotation in Oldambt due to the heavy clay soil, which only allows a limited number of crops to be grown (primarily wheat, some sugar beets and rapeseed). The Veenkoloniën is a region with peat soils, and starch potatoes and sugar beets is common, with winter wheat cultivated to maintain and improve the soil quality, rather than due to profitability. Veenkoloniën and Oldambt have one of the lowest economic performances in the Netherlands.

3.6.1 Networks of influence

The most important actors from whom farmers learned were: farming colleagues, study clubs, agronomists, and family members. The actors with a big influence were generally positive influencers (e.g. family, farming colleagues, agronomist, accountant), while actors with a relatively small influence (e.g. Ministry of Agriculture, EU) had a negative influence on farmer decision making. The most trusted actors were the ones who had a large and often positive influence (e.g. family, agronomist, colleagues, accountants). Some farmers indicated that the longer they collaborated with someone, the more trust they had in him or her. Change in influencers was more likely to occur when big changes were being considered as farmers looked for new sources of information.

3.6.2 Influence of attitudes and beliefs

Farmers' risk attitudes, self-identity, subjective norms, values, and beliefs were found to be the most important cognitive and affective factors that influenced decision-making. Farmers who were less willing to take risks often struggled to make changes and big decisions on their farm. They preferred to delay these decisions until more information was available. On the other hand, farmers who were more risk taking, experimented more with new crops and were more open to new technologies. In this context, farmers who were more willing to take risks were more open to learn. Older farmers or farmers with uncertainty about succession were less willing to take risks, such as making big investments, than younger farmers. Subjective norms that influence decision-making include: (i) the general expectation that the son should take over the farm and not the daughter; (ii) that farming is hard work and it is expected that you work more than people with desk jobs; (iii) family members are expected to take over the family farm and not any third party; and (iv) there is a strict division between conventional and organic farmers, indicating that it is often expected that conventional farmers cannot collaborate with organic farmers.

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3.6.3 External factors

Farmers often perceived external factors as negative influencers as these external factors sometimes introduced restricting boundaries, rather than opportunities. Farmers found it hard to deal with external factors because they had no influence at all on them. The three most important external factors were: crop protection and manure regulations; policy changes; and (often negative) media attention.

3.6.4 Learning strategies

Five key learning strategies that helped farmers to prepare for future risks: seeking out new information, learning from others in study clubs, being open to new ideas, reflexivity, and experimentation. These learning strategies helped farmers to acquire knowledge and improve their understanding about risks and farm practices. Seeking out new information and learning in study clubs helped farmers to be better informed about future challenges. Learning from others enabled them to share new ideas and discuss practices, experiment together, and extend their social contacts. Farmers with a bigger network were well-connected to peers and their network of influence, which made it easier to overcome shocks and stresses. Most farmers preferred discussions in small groups, as this led to more in-depth information. Some farmers were a bit disappointed about study clubs, as they often did not learn as much as expected. Farmers who were open to new ideas (e.g. from researchers, colleagues, cooperatives, network events or citizens) felt better prepared to overcome future challenges because they were more likely to experiment and try out new solutions proposed by others. In addition, reflexivity is crucial for farmers to better understand which specific farm practices will need to be improved to deal with future risks. We found indicators that farmers who enjoyed innovation and experimentation were better able to adapt themselves to shocks and long-term stresses. Experimentation included trying out new crops, technologies, farm inputs or new practices to improve soil quality, including experimenting with new machinery or no-till farming.

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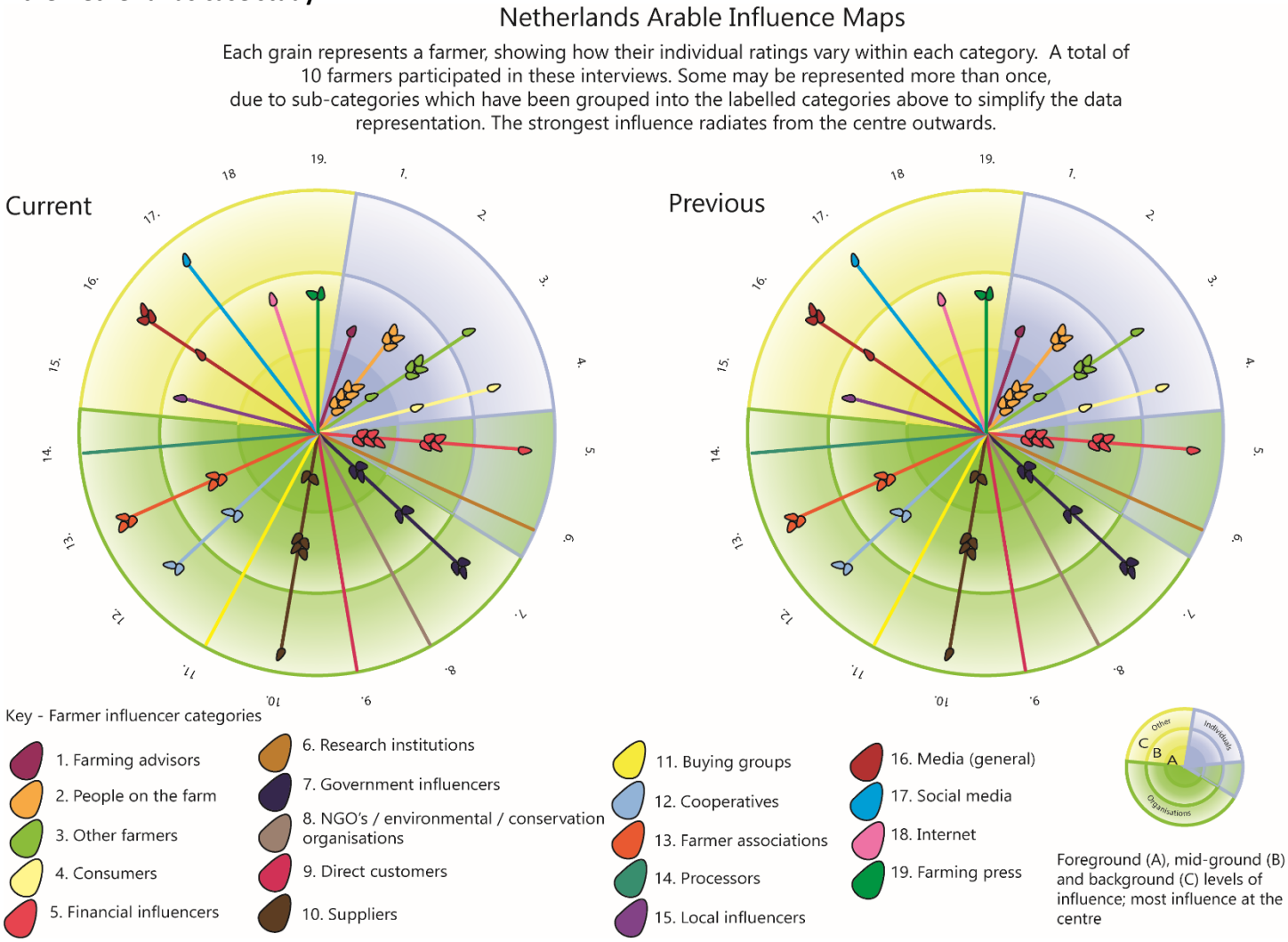
Figure 3.7 Current and previous influence maps for the Netherlands case study.



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3.7 Poland

The Polish case study area covers two NUTS2 regions Mazowieckie and Lubelskie located in the central-east part of Poland and focuses on horticultural production (fruit and vegetables) in small and medium family farms. Vegetable production in this area accounts for c.a. 9% of total vegetable production in the EU, and it is also the largest producer of apples in the EU.

3.7.1 Networks of influence

The most important influencer on farmers was family, with closest family members having the biggest influence, such as spouses. In the case of young farmers, this was mainly parents. A significant influence comes from farming neighbours, but mainly in the areas with highly developed farms. This is often through producer groups. Customers and traders were also influential, as well as public research institutions (and their publications, conferences and seminars). For all respondents, the internet was an important source of information. There was an increase in participation in domestic and foreign conferences, seminars, trainings, fairs and exhibitions. Influences on farmers changed after the period of transformation and after Poland joined the EU. Alongside this, farmers use of the internet has grown, particularly to obtain information, track market trends, purchase equipment and sell products. The role of advice by trade and production companies has increased, as has that of financial advisors. At the same time, the role of agriculture and horticulture research institutes and universities in dissemination and the role of state advisory institutions (such as Agricultural Advisory Service CDR) has significantly decreased.

3.7.2 Influence of attitudes and beliefs

A significant influence on the attitude change of the majority of surveyed farmers was the system transformation (which began in 1989) and the accession to the European Union (2004). According to stereotypical beliefs, Polish farmers are perceived as anti-reformers, opposing the ongoing changes. Farmers in this study have provided examples that contest those beliefs. Through undertaking economic activities, drawing from best experience both domestic and foreign they took advantage of the opportunities that occurred in the market and created new patterns of economic and social behaviour in their local communities.

A motivation to farm was also key, with many of the respondents working outside of agriculture before returning to the family farm. Respondents also demonstrated a high degree of self-reliance and independence in their decision-making. How respondents perceived their identity was also important, with most indicating that "farmer" does not reflect the modern nature of work in agriculture. Two identity groups emerged: those who consider themselves as traditional farmers,

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and those who identify as entrepreneurs (which for them is more than being farmers because they do more than cultivating land and growing plants, but also marketing, management etc.).

3.7.3 External influences

External factors that influence decision-making include the agricultural land market, the shortage of seasonal workers, access to CAP funds, increased competition and embargo on exports to Russia, inefficient intervention policy on the fruit and vegetable market, and the withdrawal of effective affordable plant protection products.

3.7.4 Learning strategies

Prior to the transformation (1989) the main strategies were based on learning form the experience of parents, relatives, friends, neighbours and through education in agricultural schools and colleges. All respondents also pointed to the importance of professional literature, mainly books and magazines. More recently, respondents rely less on books and more on magazines or information published on the Internet (on Polish websites). They are aware that the sources they are reading need to be carefully selected and then verified whether it is trustworthy (by talking to others, etc.). They see a great importance in exchanging experiences with other farmers in the industry, e.g. members of producer groups, producers encountered at fairs, exhibitions, seminars, conferences or study trips.

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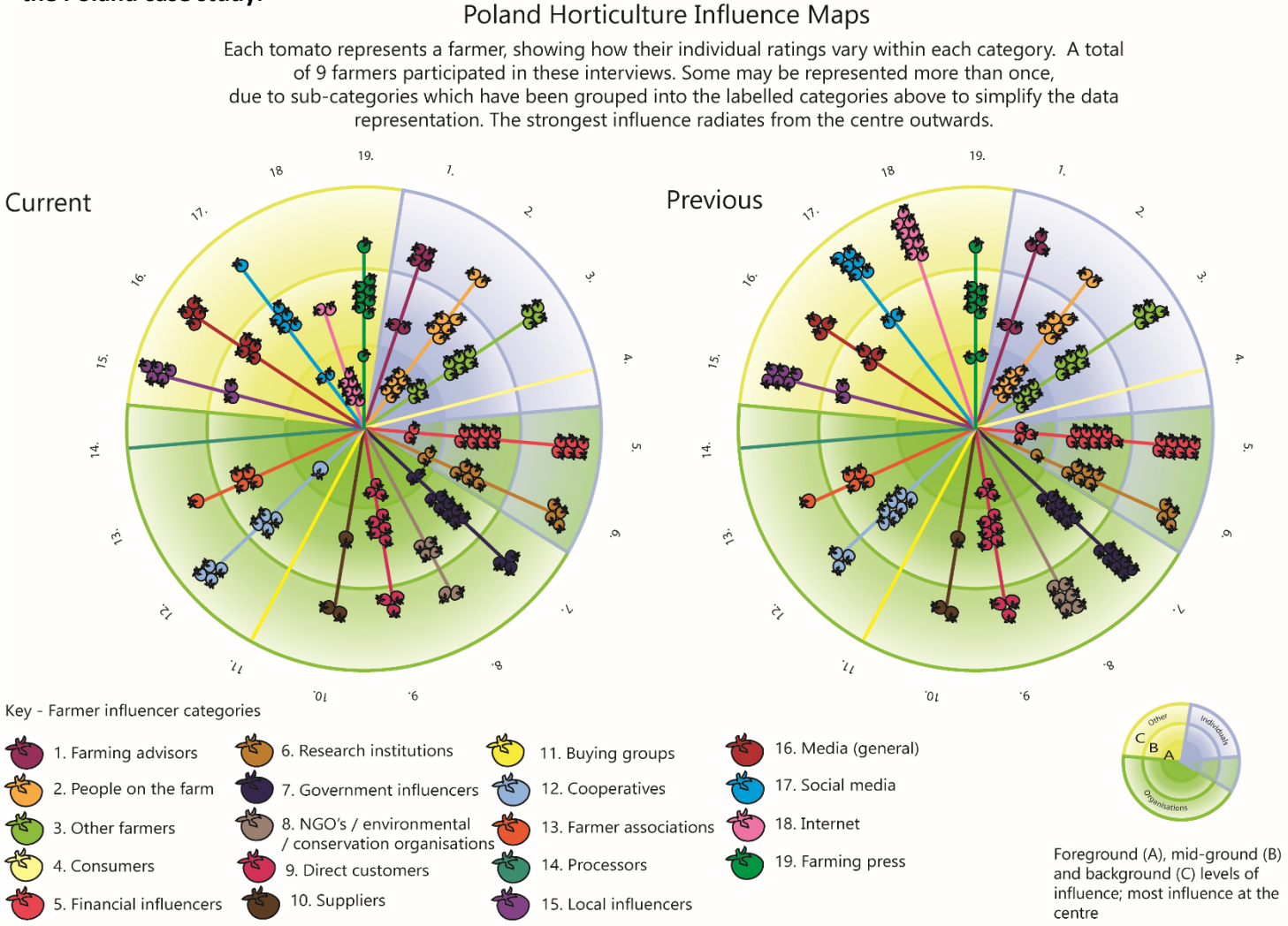
Figure 3.8 Current and previous influence maps for the Poland case study.



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3.8 Romania

The case study in Romania consists of mixed farms in the North-East region, where 73% of farms are mixed (arable and livestock). The majority (95%) are small farms under 5 ha, either owned or rented.

3.8.1 Networks of influence

Family members are identified as the most influential on decision-making, followed by the agronomist, researcher and university professors. The influence of local farmers either increases through partnerships or decreases because of conflicts. Banks are among the least influential, as most small farms are reluctant to take out loans, while the APIA (Payment and Intervention Agency) is important. Customers are important influencers, including markets, farm shops and individuals. Specialised TV broadcasts are important sources of information, as are NGOs who help farms and facilitate meetings and fairs. The influence of Local Action Groups and processors has diminished over time, with farmers seeing large processors as bad business partners as they pay low prices for milk. The internet has grown to be a very important source of information.

3.8.2 Influence of attitudes and beliefs

Being open to new ideas is the main driver for learning that generates change at the farm level, alongside their attitude towards risk. Those farmers who are risk-takers are more likely to look for new innovations to increase the value-added of their business, alongside those who seek to develop their business and/or are keen to develop farming techniques that are more environmentally-friendly.

3.8.3 External influences

External impacts on decision-making include a lack of skilled labour, the degree to which the farmer has an off-farm job (providing relative financial stability) and access to technology.

3.8.4 Learning strategies

Farmers' approach to learning is influenced by economic triggers, pre-existing off-farm skills and openness to innovation. Experimenting with new ideas was an important learning strategy, allowing farmers to learn from their own experience and by implementing change a little at a time (including trying out new varieties, cultivars, animal breeds or new technologies). Being able to seek out new information was also important, including identifying where to look for information. However, a barrier to learning is a lack of confidence in market stability, uncertainty about succession and attachment to a traditional way of farming in the area which is based on semi-subsistence (rather than developing into a market-oriented business).

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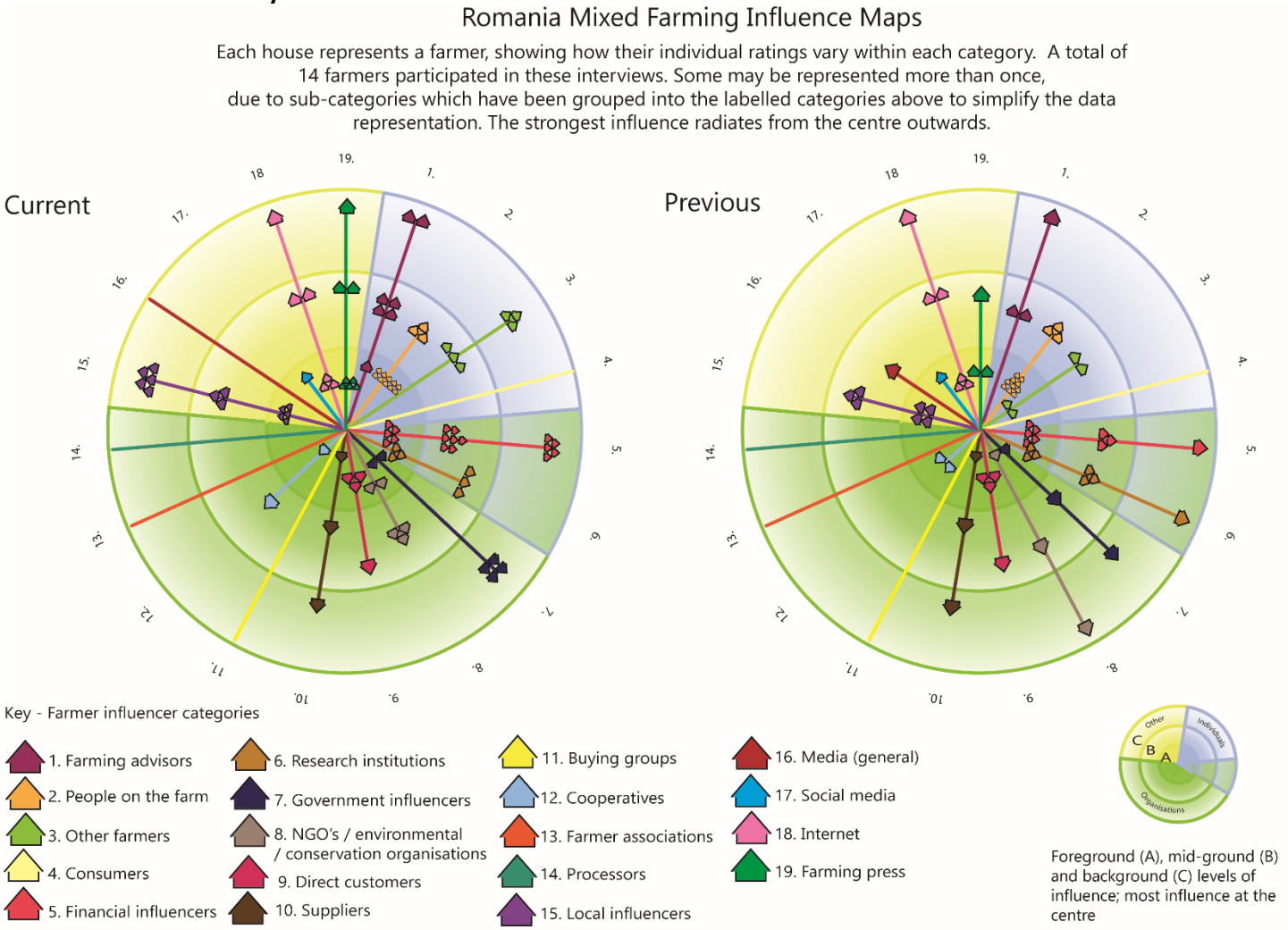
Figure 3.9 Current and previous influence maps for the Romania case study.



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3.9 Spain

The Spanish case study covers two specializations and regions: extensive sheep farming in Huesca and extensive beef farming in Sierra de Guadarrama (Comunidad de Madrid). Huesca is located in North-East Spain in an area of low population density, a decrease in farm numbers and ageing farmers. The Sierra de Guadarrama (Comunidad de Madrid) is located in a mountain range close to Spain's capital city of Madrid. The area is over-populated and farm numbers have declined. Though there are two regions in the case study, the assessment specifically focuses on extensive farming in Huesca.

3.9.1 Networks of influence

Families are the most influential, followed by vets and other farmers. Additional influencers have been identified such as research institutes-universities, internet, local and regional government offices and financial institutions. Other farmers provide a network of knowledge sharing and opinion exchange. Farmers' unions, associations and cooperatives are common mid- or background influencers. While local administrations have a major role in informing farmers, they do not have a high influence. Suppliers and buyers have some influence. Sources of information including farming and local press, internet, media and social media, as well as scientific publications are background influencers. The number of influencers has increased over time, explained by technological progress and new forms of organisation in the farming system. That being said, the main influencers, family, vets, farmers' unions and other farms, has remained constant over the past 20 years, although local farmers' unions and cooperatives are more influential today.

3.9.2 Influence of attitudes and beliefs

Respondents demonstrated a deep attachment to their work and animals, and this influences their decision-making, particularly in terms of whether to change the specialization. There is also a sense of a rural identity and a responsibility for maintaining the rural population. Two types of farmers emerged: those who embrace cooperation and undertake experimentation, social learning and sharing knowledge – these farms are most likely to innovate; and individualist farmers who take more drastic and linear approaches such as cost reduction, intensification or transformation. The respondents felt abandoned by the authorities, and believe that there is not institutional interest or support for extensive farming. These feelings can constrain farmers from improving their farms.

3.9.3 External influences

Key external factors that influence decision-making include the decreasing profitability in the farming system. This is a result of the decoupling of payments under the CAP, the stagnation in

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sheep meat real prices and increasing input costs (feed prices and labour costs). This has forced farmers to learn about solutions to reduce costs and ensure their sales by increasing their participation in cooperatives. Further the increased bureaucracy has led to an increase in participation in farmers' organizations. Other factors include a lack of skilled workers, a societal trend of decreased lamb consumption and the lack of succession.

3.9.4 Learning strategies

Learning strategies include 'learning by watching' – farmers observe what other farmers do and learn from them; experimentation – trying out new things and implementing change incrementally (e.g. improvements in animal handling, investment in breeding improvements, electric or virtual shepherds, drones, GPS collars etc.); collective learning – learning with other farmers through discussion groups or other forums; and seeking out information, such as in the media, research reports and training sessions. One of the most important factors for enabling learning is the farmers' confidence in the future of the sector and trust in actors in the farming system.

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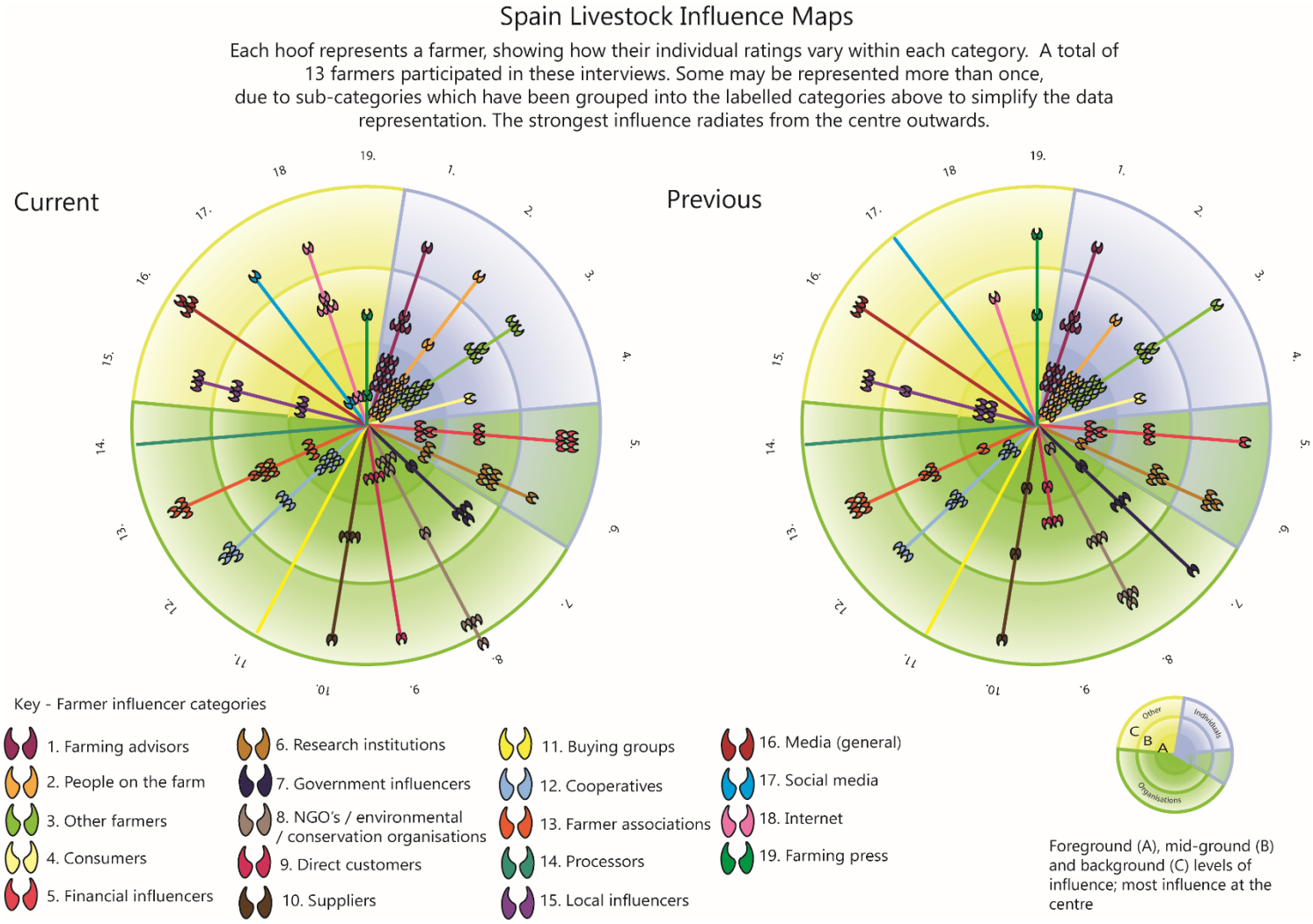
Figure 3.10 Current and previous influence maps for the Spain case study.



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3.10 Sweden

The Swedish case study consists of high value egg and broiler production in southern Sweden. Broiler production is dominated by a few large chicken production companies that each contract a number of farmers. The large-scale egg producing companies also contract egg farmers, but appear to be more flexible than the broiler sector and have more actors.

3.10.1 Networks of influence

Important influencers include family members, often the upcoming generation. Production, financial or business advisors were important, and may provide insights on new technologies. Family members and advisors were generally the most trusted influencers. Farming neighbours were important to exchange knowledge and experiences, as well as a source of inspiration. The farming press and the internet were also considered important sources of information. Buying groups were important (e.g. the main production company) for planning production related activities. Authorities were mainly seen as an obstructing factor, whereas the politicians were the least trusted.

3.10.2 Influence of attitudes and beliefs

Personal beliefs and values influence farmers' decisions, particularly around whether to invest in new technology. A key attribute for learning is that farmers have an entrepreneurial spirit, an open mind and a willingness to innovate and test out new ideas. While some farmers underline the need for dialogue, cooperation and support from family and other farmers, others rely more on their own experience. Farmers' personality affects their ability to learn from others, for instance, some are more prone to engage in social exchanges, take in other people's opinions and generally value other people's input.

3.10.3 External influences

External factors that influence decision-making are weather (e.g. the 2018 drought) and regulations that determine the boundaries within which the farmer can operate.

3.10.4 Learning strategies

Strategies for learning vary between individuals but included seeking out information from a variety of sources, improving their knowledge through education, knowledge exchange and learning from experience. Being open to new ideas was seen as important when facing new challenges. Farmers thus demonstrated a willingness to learn new things and many were open to taking in new knowledge and having an open mind when trying to solve problems. When learning new things, farmers adopted a 'learning by doing' approach, experimenting with solutions and

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then adapting their practices based on what they learnt. Respondents also learn from actively reflecting on their past decisions and evaluating the outcome of those decision-making processes.

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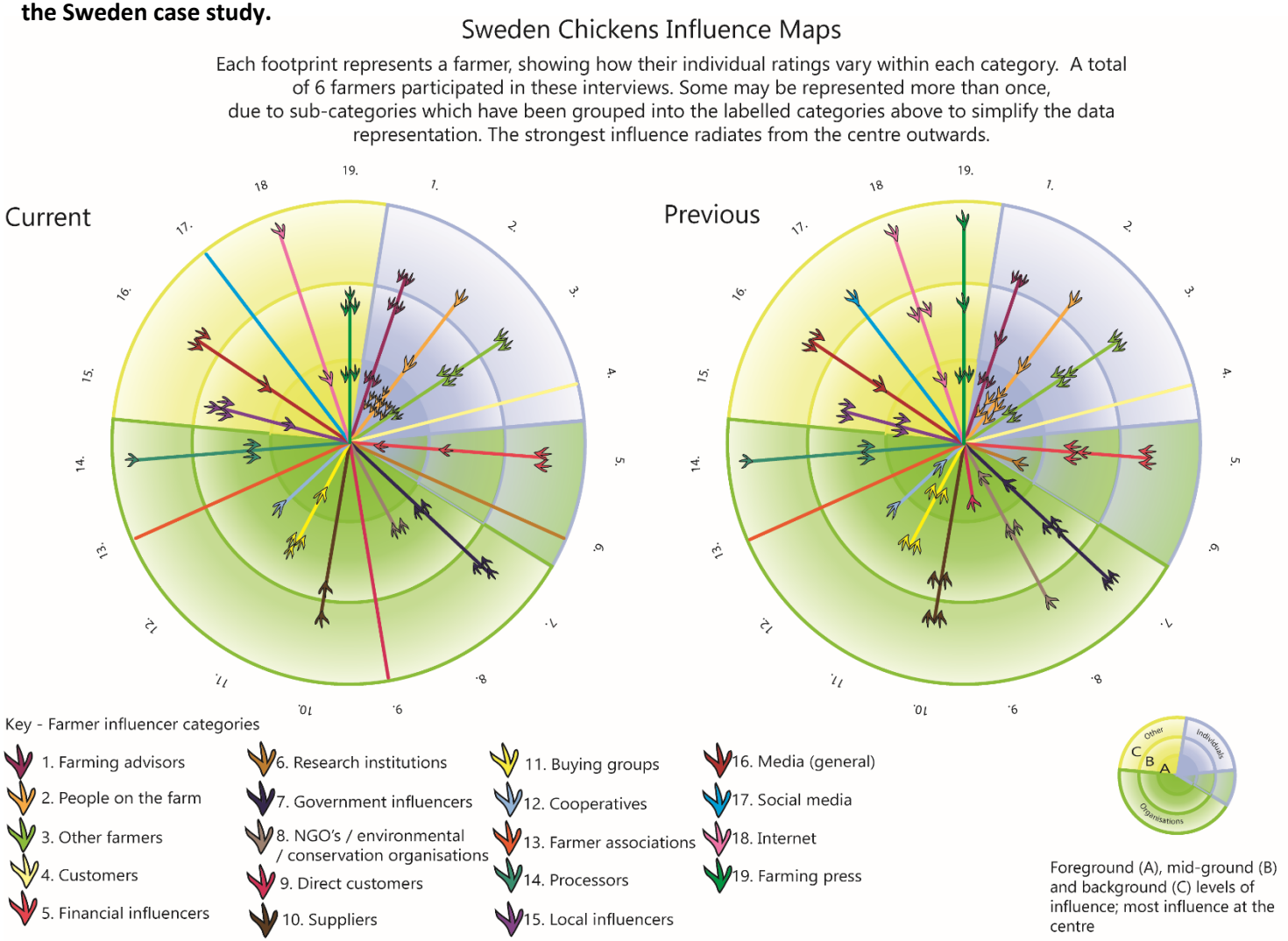
Figure 3.11 Current and previous influence maps for the Sweden case study.



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3.11 UK

The UK case study consists of arable farming in the East of England. Agriculture is a major industry in the region, with the value of the output from farming in 2016 being £3.4 billion (DEFRA, 2016). The East of England is known as the UK's 'breadbasket' and is responsible for one third of the country's cereal production, as the climate and soils are well suited to growing cereals and other combinable crops. About half (54%) the agricultural land in the East of England is used for growing cereal crops, such as wheat and barley, for both human and animal consumption (DEFRA, 2016), with a further 29% classed as general cropping. Sugar beet is grown in rotation with cereals with the area producing more than two thirds of England's sugar beet crop. Other crops such as carrots, potatoes, oilseed rape, fruit, salad crops and pulses are also grown. The region is also important for pig and poultry farms.

3.11.1 Networks of influence

The most important influencers for the farmers interviewed are family members. In most cases, the farms are family farms with several family members having a role in the farm management, so decision-making is shared. Agronomists were also influential, and their role has evolved from input on plant protection products to having a much broader knowledge of the agri-environmental scheme landscape. Financial advisors were mid-ground influencers, and for most respondents other farmers were important. Other individual influencers were business partners, employees, landowners and contractors. Public research organisations were the most influential organisations, although respondents felt that there was a lack of government-funded research. Seed companies and brokers were moderately influential, and government departments were either perceived as highly influential (as they provide the boundaries in which farmers operate) or moderately influential. Some respondents indicated that customers, supermarkets, land agents, environmental NGOs, the NFU, buying groups, AHDB (the Agriculture and Horticulture Development Board), the farming press and social media are somewhat influential. An important aspect is the degree to which farmers trust their influencers. So, those in their inner circle such as family, friends, employees, trusted independent advisors etc., tend to be more trusted than politicians, the media and external input suppliers (who are perceived as promoting their own product).

3.11.2 Influence of attitudes and beliefs

Respondents did not speak extensively about how their attitudes and beliefs influence their decision-making, although a number of factors emerged during the interviews. Firstly, farmers attitudes toward farming shapes the decisions they make, whether this is a belief that they are stewards of the land and have a duty to preserve the soil health for future generations to farm; or are environmentally-minded and seek to improve conditions for wildlife across their farm; or

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see farming primarily as a business that needs to make a profit at all costs. Their attachments to particular ways of farming, often associated with their own identity (e.g. "I am a dairy farmer") can also drive decision-making, and may hinder adaptation if too inflexible. Associated with this, is farmers' attitude towards risk, with those who are risk takers happy to try out new, experimental, ideas on their farm, perhaps taking on large amounts of debt. Others are more risk averse, and shy away from exposure to high levels of debt and prefer to continue working in the same way they have always done where possible.

3.11.3 External influences

For the UK case study, a key external influence on decision-making is Brexit. For some they are holding back on further investment in the farm until they have a clearer picture of what the future of British farming will look like, while others are investing in expensive machinery now while they still have the single farm payment. Other factors include regulation (changes), access to technology and the different views on the use of technology between the generations in families, environmental limits and family crises.

3.11.4 Learning strategies

Learning from others, particularly other farmers, is a key learning strategy for respondents. This involves talking to farming neighbours, engaging in discussion groups, observing what other farmers are doing and seeking out advice from other farmers. This is particularly useful when farmers want to try out something new and engage in trials. Some farmers highlighted that this networking and self-organisation between farmers has increased since ADAS was privatised – previously the government led knowledge sharing and best practice through public research organisations such as ADAS, since then manufacturers, who undertake research on their products, have influenced farmers, but farmers felt that this was not always in their best interests. A number of farmers spoke about Monitor Farms, an initiative facilitated by AHDB where groups of farmers who want to improve their business by sharing performance information and best practice come together around a network of host farms across the country. For some this develops into close cooperation with their farming neighbours in order to save costs. Cooperation is a risk management strategy, whether it be sharing equipment or forming a cooperative or buying group. Experimentation was also an important learning strategy, with farmers trying out new things on their farm and seeing how they worked. This was often done a little at a time, in combination with learning about the new approach through seeking out information and talking to other farmers. Experimentation may occur both in terms of agricultural production, but also for diversification activities. Respondents also spoke about the need to be open to new ideas, to be flexible and reflexive.

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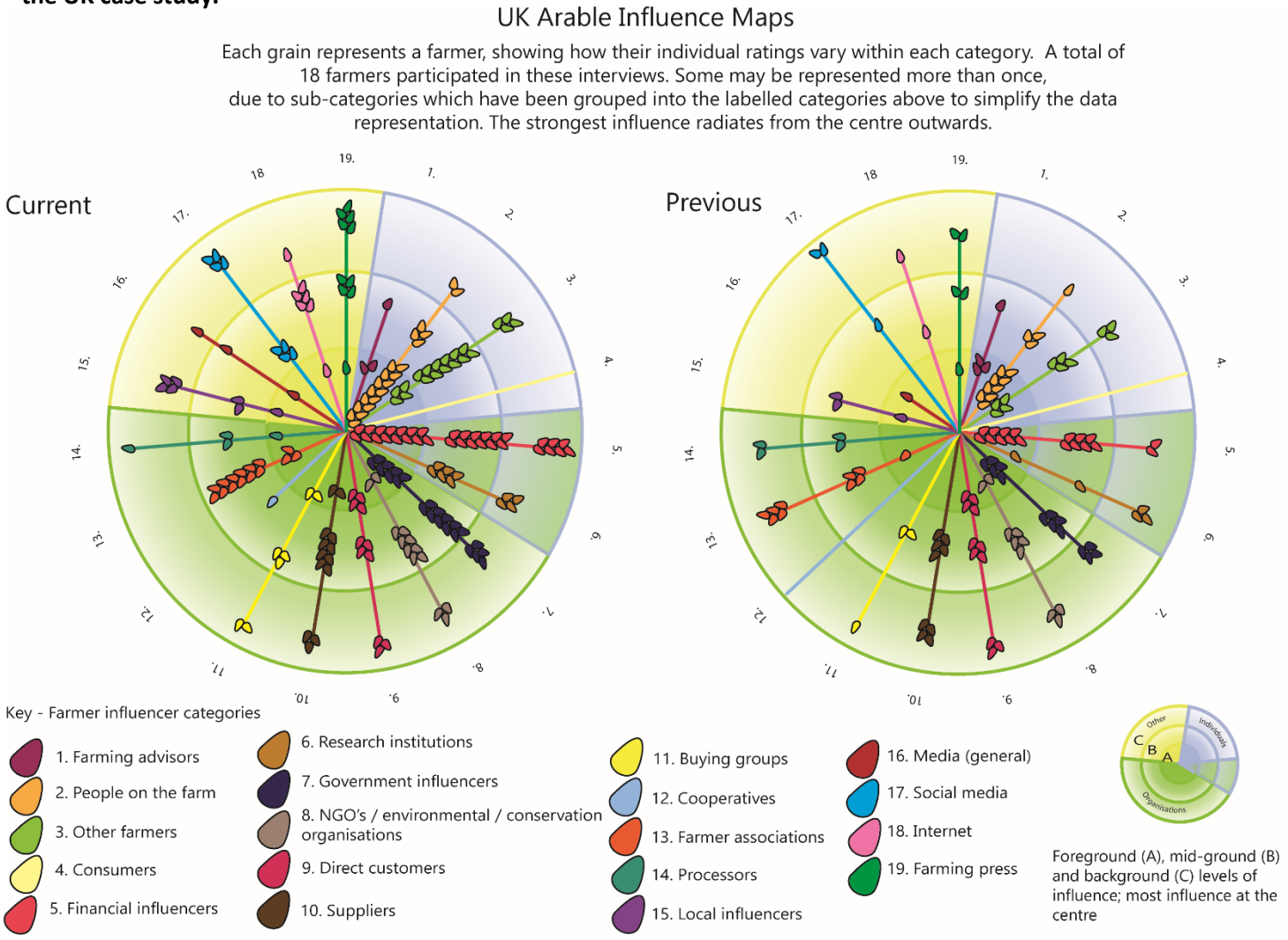
Figure 3.12 Current and previous influence maps for the UK case study.



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4 Comparative results and discussion across farming systems

This chapter presents a synthesis of the case study results, considering: (i) the learning strategies that farmers adopt for managing risk and adapting to change; (ii) the cognitive and affective factors that influence farmer learning; (iii) farmers' networks of influence; and (iv) the external influences on farmer learning. The chapter concludes by distinguishing between 'proactive' and 'reactive' learners, and by conceptualising farmers' networks of influence across the dimensions of an inner 'ring of confidence', wider sources of information and broader external influences.

4.1 What learning strategies do farmers adopt for managing risk and adapting to change?

Across the case studies, the risk strategies that farmers adopted involved different forms of cognitive, experiential and relational learning. In many cases, these strategies and learning were prompted by the need to deal with various ongoing or sudden challenges, including volatile commodity markets, an increasing frequency of extreme weather events, shifting policies and changing societal expectations. This section outlines the learning strategies that were identified across the case studies.

4.1.1 Agricultural education and learning new skills

Across the case studies, farmers spoke about the importance of having the necessary skills to run the farm, either through a formal agricultural education or through skills acquisition and attending training courses.

4.1.2 Learning from own experience

Farmers in most case studies indicated that a major source of learning is through one's own experience. This is gained over time and through trial and error, adapting to changing circumstances and learning from what has worked in the past. In some case studies, such as France and the UK, farmers worked outside of agriculture before becoming a farmer, with the ideas and skills from other industries providing useful tools that they could apply to farm management. Others, for instance in Poland and the UK, had worked abroad, observing and trying out different farming techniques in different countries. One Polish farmer indicated: "Of course, the experience gained abroad, the experience in all kinds of planting techniques, harvest techniques, preparation of cultivation for the final stage of harvesting. It all had an impact, I got practical experience." Experiential learning builds slowly over time and increases the farmers' autonomy in decision-making and the ability to learn from past mistakes or successes.

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4.1.3 Seeking out new information

Farmer learning involves constantly seeking out new information across a wide range of issues – including market prices, technology, inputs, cultivars, breeds and land management techniques etc. This involves having an enquiring mind, and not just settling for the status quo. Farmers use a wide range of sources when they seek out information, including online information, the farming press, social media, engaging with advisors and other farmers. They may also participate in discussion groups or attend events, fairs and exhibitions. In some countries (e.g. Romania) specific TV programmes aimed at disseminating information and innovative ideas to agricultural businesses is an important source of information.

4.1.4 Peer-to-peer learning – broadening networks

In all case studies, farmers indicated that they learn from other farmers. This learning can take many forms, from talking to neighbouring farmers or farmer friends, engaging in farmer discussion groups, observing what other farmers are doing through field visits or interacting with farmers around the world through social media. As one UK farmer said: "It's about getting out and learning from other people… I enjoy going out to meetings and sharing knowledge, listening to what other people are doing. I think it's an important part of learning and it's continual learning" (UK2). This is particularly useful and important when farmers want to try something new or engage in trials. It can also be useful to learn from others how not to do things. More organised forms of learning from others may occur through being involved in cooperatives or other forms of mutual sharing/assistance. For instance, cooperatives are common in the hazelnut sector in Italy, both in terms of providing stronger market power when dealing with wholesalers, but also as a forum for sharing information and experiences. Having a strong social network is important for peer-to-peer learning to take place.

Not all farmers are open to learning from others, however. The Spanish case study distinguished between those who have a cooperative attitude and those who take a more individualistic approach. Those with a cooperative attitude will invariably be involved in experimentation, social learning and sharing knowledge, thus are more likely to innovate and improve their existing management systems. Conversely, individualistic farmers may look for more linear strategies such as cost reduction, intensification or indeed transformation to a completely different activity.

As well as learning from others, peer-to-peer learning involves farmers being willing to share their own knowledge and experience with others.

4.1.5 Learning from non-farmers

Alongside learning from other farmers, respondents indicated that they often learn from non-farmers, including advisors, technological consultants, financial advisors and scientists.

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4.1.6 Being open to new ideas

A key strategy for learning is being open to new ideas and innovation. Those who are open to new ideas are more willing to test new techniques and practices and experiment, which can help them to identify new management strategies. For instance, a Dutch farmer managed a B&B as a diversification activity. The farmer asked guests for feedback, who provided her with lots of new ideas, some of which she went on to implement. Being open to new ideas involves being flexible and willing to try something new or different. Even when they can see a good example of innovation from another farmer, some are unable to apply similar approaches to their own context. For example, a Romanian farmer spoke about a farming friend who had spent time in the UK and developed contacts there, to whom he now supplies pork products from his farm in Romania. When asked if he would consider trying such a venture himself, the interviewed farmer replied: "I didn't think too much about it… it would be necessary for those people [potential clients] appreciating my kind of products to find me – how would they know where to find me? And where should I advertise? I don't know…" This farmer, rather than looking for opportunities, could only see the barriers to innovation in this instance.

4.1.7 Trying out new ideas and experimentation

Many of the interviewed farmers were keen to experiment with new practices on their farm, although some were reluctant. Those who are reluctant may fear failing and making mistakes, with an associated loss of money. Experimentation occurs across a range of activities, such as trying out new extreme weather-resistant crops, diversifying into new crops, changing cattle breeds, testing out new plant protection products, testing small plots of organic or no-till cultivation, as well as trying out new labour recruitment or product marketing techniques. However, experimentation is not always driven by farmer choice, sometimes it is a logical response to a particular challenge (such as climate change impacts, price volatility) as part of the risk management strategy. Experimentation usually happens on a small scale first, before being rolled out across the farm if the results are successful. Generally farmers who are keen to experiment are better able to adapt themselves to shocks and stresses. It is often important to have support when experimenting, such as through farmers' associations, cooperatives and research institutions. This is also important for providing advice and guidance, access to technology and sharing the experiences of others.

4.2 The influence of cognitive and affective factors in farmer decision-making

Farmers' decisions are influenced by a range of cognitive and affective factors, including **beliefs, attitudes, motivation** and **characteristics**.

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4.2.1 Beliefs

Farmers' beliefs will influence their approach to farming and their motivation to learn. Their beliefs towards farming shapes the decisions they make, whether it is a belief that they are stewards of the land and have a duty to preserve the soil health for future generations to farm, are environmentally-minded and seek to improve conditions for wildlife across their farm, or see farming primarily as a business that needs to make a profit at all costs.

Beliefs about farm size and intensification also influence decision-making. For example, two farmers in the Belgian case study shared the belief that increasing the farm size and intensifying are the only strategies to deal with low margins: "Nowadays, with 100 cows, you can't do anything" (BE13). Other respondents, however, are aware of examples where larger farms have financial problems or these farmers, due to the long work hours and pressure of managing a large herd, do not have a good quality of life. These examples stimulate farmers to reflect on their own situation, and on their long-standing convictions, or even to question current ways of dairy farming in general. These farmers seem to be more open to new practices or strategies to do things differently.

4.2.2 Attitudes

Firstly, farmers' attitude to risk will influence their decision-making, and thus their approach to learning. Farmers who are more willing to take risks are more likely to engage in innovative and experimental practices, and will be open to new ideas, experimentation, learning from others and perhaps take on large amounts of debt. Risk averse farmers often continue to operate as they have always done, feeling comfortable with what they know and are familiar with, and feeling uncomfortable making big changes. This can make it difficult for them to make changes and big decisions on their farm, leading to becoming locked in to a behaviour that is not resilient, as expressed by one UK farmer referring to his farming neighbours: "And they've already got their idea of how it should be and stick to it. And a lot of them have been like that all their lives. And they're stuck in a rut in a way. And they fear changing because their neighbours are all still doing what they've always done. So it's like a bit of a tribe and they all stick together" (F13). Alternatively, risk averse farmers may be proficient in making small changes to their farm business in order to remain robust. For example, those farmers who are averse to taking financial risks may be better able to deal with shocks and stresses, such as price volatility or crop failure, than farmers who have high levels of debt. Two farmers in the Netherlands indicated that taking risks was part of farming (and this was also reflected in their self-identity) and that you have to take risks to survive as a farmer (e.g. by regularly investing in new technologies). In this context, farmers who were more willing to take risks were more open to learn. Younger farmers appear to be more open to taking risks than older farmers, or farmers where there is uncertainty about farm succession.

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Secondly, changes in farmers' attitudes, often over time, can prompt changes in their behaviour. Thus, while adaptation or transformation is often prompted by economic considerations, it can also be ideological, with farmers wanting to transform the way they farm in order to better protect the environment and respond to climate change (e.g. shifting to organic or no till). For example, in the Italian case study, where a number of farmers converted from conventional to organic hazelnut production, personal attitudes, beliefs and values played a pivotal role in the decision-making process. In hazelnut production in Italy there is a deep rooted cultural tradition of conventional farming which, together with a lack of examples of successful organic conversion, hinders the change towards more sustainable production methods due to a fear of acceptance by their farming peers. As one Italian farmer commented "I grew up with the idea that organic is bad, as it is not productive". Thus, when a farmer does convert, their values and beliefs must be stronger than the cultural norms in the area. Again, there is a difference between the generations, with younger Italian hazelnut producers feeling less locked in to previous ways of operating and more likely to embrace new technologies that are more sustainable. Thus, a more sustainable way of thinking directs the learning process and drives farmers' to seek out information and ways of operating their farm that align to their ecological ideology. Similarly, for egg producers in Sweden, attitudes towards animal welfare influence decisions: "The motivation is that we all really can't stand caged hens. So the psyche, I would never do it, I would think it was hard and my dad has the same opinion when it comes to it" (SE1).

For farmers in north-east Romania there is a shift in attitudes of farmers from subsistence or semi-subsistence, to a more market-oriented business. This involves learning how to produce and market their products in order to profitable, and may involve a shift in the type of products produced.

4.2.3 Motivation

A key motivation for farmers is their identity, and explains how farmers adjust their behaviour based on their own internal perceptions of how one should farm (Hyland et al., 2016). In the Netherlands, some farmers had a strong self-identity as a conventional farmer. This indicates that they identified themselves strongly as a conventional farmer and see farming as their role in society. These farmers (NL2, NL4 and NL5) did not think well of their organic farming colleagues. On the one hand, they were eager to learn from other conventional farmers, but on the other hand, they were not open to learn from non-farmers or from organic farmers. Farmers who had a weaker self-identity were more open to ideas from non-farming actors. For example, NL6 was a farmer who had a weaker self-identity as a farmer and he learned from non-farming actors (e.g. his customers and the media).

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In Poland, the self-identity of respondents related to the transition from the previous traditional economy to a modern commodity farm. Over half of Polish respondents identified themselves with the profession of a farmer or a fruit-grower, while for others, the term "farmer" did not reflect what they perceived as the modern nature of agriculture. These respondents used words such as "entrepreneur" and "agricultural producer", because they indicated that farmers do more than cultivating land and growing plants, but also must engage in marketing, management etc. Thus, in Poland two farming identities emerged: the traditional identity as a "farmer" and the modern identity as an "entrepreneur".

In Spain, there is an attachment to the region and its traditions that can be considered as rural identity; such a feeling leads to the implementation of strategies that address the threats of the territory, such as to not abandon it. Thus, these farmers feel responsible for maintaining the villages and the rural population.

In the UK case study, farmers' attachments to particular ways of farming, were often associated with their own identity (e.g. "I am a dairy farmer") which can drive decision-making, and may hinder adaptation if too inflexible. Similarly, in Belgium, farms are usually transmitted from father to son, with incoming farmers wanting to respect the tradition of the farm by keeping livestock on it. Thus, they generally persist in livestock, even when it is financially less viable than in the past. They are usually passionate about keeping livestock and so consequently these farmers look for adapted solutions in order to be able to maintain breeding activity on the farm: increase of herd size, more land, change in selling process etc. Very often two, or three, generations work on the same farm. On the one hand this is very enriching: experience comes from the oldest, energy and new vision from the youngest, which brings innovations or changes on the farm. On the other hand this can be conflictual, and persistence of the ancestral production system can constrain any kind of change or learning on the farm.

Another motivation for farmers relates to a lifestyle choice. In the UK, a number of respondents spoke about how they appreciated the ability to live and work in the outdoors and in nature, providing their children with the opportunity to grow up in such an environment. A number of these farmers had worked outside agriculture before returning to the family farm. Similarly in Poland, most of the respondents had worked outside of agriculture. Their decision to return to the family farm was motivated by the hope of a "better life".

However, some farmers indicated they feel they have a lack of efficacy, due to a variety of external factors, such as policy, regulation and markets. These farmers are less proactive and tend to react to new regulations once they are in place, rather than anticipate and adapt in advance.

In the Belgian case study, the most important values that influenced decision-making were: (i) to

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treat others as you wanted to be treated; (ii) to enjoy farming, (iii) to take good care of your land; (iv) to spend enough time with the family. These values often influenced farmer decision-making. For instance, farmers took good care of their land to ensure good land quality and high yields. This stimulated farmers to learn about good land stewardship by attending study clubs, experimenting with cover crops, or conducting research about the amount of organic matter in the soil to gain insights in the soil quality of his land.

In a number of case studies (Belgium, France, Italy, Poland and Romania) some of the respondents indicated that a primary motivation is the desire to be independent. These farmers cautioned against surrounding yourself with too many advisors, so that you are unable to decide for yourself. Thus, knowing when to seek expertise and knowing when to take decisions yourself, is a learning process in itself.

4.3 Farmer knowledge networks in European farming systems

Across the case studies, farmers identified a range of individual and organisational influences, together with other forms of influence (such as internet and media).

Table 4.1 summarises the influence map data from the SURE-Farm case studies, identifying fore-, mid- and background influencers. As Table 4.1 suggests, the main influencers on European farmers' decision-making are individuals such as family members, financial advisors, other farmers and advisors (such as agronomists or vets), as well as local influencers. Influential organisations include financial influencers (e.g. banks), government bodies, research institutions, suppliers and farmers' associations. The farming press, general media and the internet provide an important source of information and, in some case studies, social media is a useful information and communication tool. In addition, a number of respondents (particularly in Belgium, Germany, Netherlands, Romania and Sweden) indicated that the main influence on their decision-making is themselves.

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Table 4.1 Individual, organisational and other influencers on farmers in 11 European case studies.

	Arable				Livestock				M[1]	H[2]	P[3]	
	BG	DE	NL	GB	BE	FR	ES	SE	RO	PL	IT	Total
Individuals												
Farming advisors												77
People on the farm												169
Other farmers												118
Consumers												4
Organisations												
Financial influencers*												210
Research institutions*												70
Government influencers												108
NGOs/env organisations												50
Direct customers												39
Suppliers												56
Buying groups												10
Cooperatives												51
Farmer associations												60
Processors												9
Other												
Local influencers												73
Media (general)												28
Social media												23
Internet												44
Farming press												51

Key: Green = foreground influencer; Amber = mid-ground influencer; Red = background influencers; Blue = responses distributed across fore, mid and background; Blank = not mentioned or mentioned by two or fewer respondents. M[1]= mixed farms; H[2]= horticulture; P[3]= perennials. Total=number of mentions across all case studies. BG-Bulgaria; DE-Germany; NL-Netherlands; GB-United Kingdom; BE-Belgium; FR-France; ES-Spain; SE-Sweden; RO-Romania; PL-Poland; IT-Italy.

An analysis of the influence maps suggests both some commonalities and differences between the case studies (see Table 4.2). For most case studies, **people on the farm** are considered the most important influencer, except for the UK and Poland where they were the second most

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influential. Family members are the most influential people on the farm across all studies, often because farms are organised as family partnerships. However, trusted employees are also important. In the Polish case study, the **internet** was perceived as the most important influencer, as exemplified by one farmer: "Currently most needed information is obtained from the Internet…. everything can be found in the internet and it is possible to order seeds faster and cheaper…. Owners also look for the information about market tendencies in the internet" (PL1). **Financial influencers** were also important and feature in the top 3 in seven case studies, including first place in the UK. Banks are important for providing access to loans in order for investments on the farm to be made, while accountants can provide useful financial advice. Insurance companies were rarely mentioned, although four farmers in Italy indicated insurance companies are a mid-ground influencer. **Other farmers** appear in the top 3 for six case studies, and includes interactions with neighbouring farmers and farming friends, engagement at farmer discussion groups, and wider communication with farmers further afield through social media. **Farming advisors** appear in the top 3 in four case studies, three of which are livestock farming systems, with the main advisor being the vet. **Government influencers** scored third place in the UK and Netherlands case study and reflected how farmers feel that policy and regulation sets the boundaries in which they can operate and make decisions. **Local influencers** were in third place in Romania and **research institutions** were important in Bulgaria. These findings suggest some commonality between the case studies, particularly in terms of the crucial role of people on the farm, but also some particularities in a number of case studies.

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Table 4.2 Top three influencers in each case study in the present.

	Top 3 influencers		
Case study	1	2	3
Arable			
BG	People on the farm	Research institutions	Financial influencers
DE	People on the farm	Farming advisors	Other farmers
NL	People on the farm	Financial influencers	Government influencers
UK	Financial influencers	People on the farm	Government influencers
Livestock			
BE	People on the farm	Financial influencers	Other farmers
FR	People on the farm	Financial influencers	Farming advisors
ES	People on the farm	Farming advisors	Other farmers
SE	People on the farm	Other farmers	Farming advisors
Mixed			
RO	People on the farm	Financial influencers	Local influencers
Horticulture			
PL	Internet	People on the farm	Other farmers
Perennials			
IT	People on the farm	Other farmers	Financial influencers

An important aspect is the degree to which farmers **trust** their influencers. So, those in their inner circle such as family, friends, employees, trusted independent advisors etc., tend to be more trusted than politicians, the media and external input suppliers (who are perceived as promoting their own product), as identified by this UK farmer: "Anybody selling anything I think we'd have a question whether it was good advice. So yes, there's definitely an element of trust, which is really why we've got family at number one because we are a very open and frank family, I don't think we have any secrets from each other" (GB12). A number of influencers (such as regulatory and policy bodies) have influence on decision-making, but this is often perceived as a negative influence, e.g. in constraining rather than enabling what the farmer can do. A number of farmers also indicated that the most important influencer in their decisions was themselves – they trusted in their own judgment and therefore placed themselves at the centre of the influence map.

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4.4 Are webs of influencers stable over time?

It is important to note that the point of reference that respondents across all case studies used to assess whether their influencers had changed over time varied. Some respondents referred to a particular moment of change (such as going organic or no-till) which may involve a very different set of influencers, while others simply reflected back 10 or 20 years in the past or talked about how influencers changed gradually over time. Thus, it is difficult to make a full assessment of the degree to which farmers' webs of influencers change over time. However, some general patterns can be identified from the findings, illustrated in Table 4.3.

Table 4.3 Top three influencers in each case study in the past.

	Top 3 influencers		
Case study	1	2	3
Arable			
BG	People on the farm	Financial influencers	Farming advisors
DE	People on the farm	Financial influencers	Other farmers
NL	People on the farm	Financial influencers	Government influencers
UK	Financial influencers	People on the farm	Government influencers
Livestock			
BE	People on the farm	Financial influencers	Farming advisors
FR	People on the farm	Financial influencers	Other farmers
ES	People on the farm	Other farmers	Farming advisors
SE	People on the farm	Other farmers	Farming advisors
Mixed			
RO	People on the farm	Financial influencers	Local influencers
Horticulture			
PL	People on the farm	Other farmers	Financial infuencers
Perennials			
IT	People on the farm	Other farmers	Suppliers

Trusted influencers tend to be stable over time (family, employees, trusted advisors). However, as contexts change, so do relationships and the influence of different members of the web of influencers. During times of change or large investments, particular advisors (e.g. financial advisors, specialist researchers) may become more central influencers. In the Belgian case study, when decisions are being made about enlargement or diversification on the farm, the local

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community or non-farming neighbours appear on the influence map. Thus, the support (or disapproval) of the local community appears to play an important role in farmers' decision making here, especially when the business decision impacts the nearby residents in one way or another (e.g. by change in the landscape view, by frequency of transport by tractors, etc.). Similarly, when farmers consider buying (more) land, these local stakeholders move into the grid because relations are playing an important role in farmer-to-farmer or farmer-to-landowner agreements. These relations are often a result of years of engagement of the farmer in the local community. Further, in a number of case studies (e.g. Belgium, Germany, Poland, Spain and the UK) public opinion (through the media) has increased in influence. Sources of information have also changed, mainly due to the development of ICT and social media. Thus, while previously the predominant sources of information were often through seminars, fairs, exhibitions and events, in addition to advisors, today online resources are unsurprisingly much more prolific.

For the arable case studies, the Netherland and UK influencers remained fairly constant over time. Similarly, influencers in the livestock case studies and the mixed farming case study (Romania) remained generally constant. The internet was less influential in the Poland case study in the past, and in Italy suppliers were more important in the past.

4.5 What external factors influence farmer decision-making, and how?

4.5.1 Policy

Policy and regulations have the ability to constrain or enable farmers' decision-making. The predominant opinion across the case studies reflected polices or regulations that hinder farm development. For instance, where farmers are keen to respond to challenges by adjusting their practices, policy and regulation may not support this. For example, one Belgian farmer spoke about a professor who is advocating organic farming practices and agroforestry: "I find it fantastic what that man is up to, but you need a policy that supports it. We cannot do it alone. You cannot ask the farmers to just do it the other way. It is not possible. We need support to be able to convert. We need an adjusted policy framework. And that is totally absent for the moment." Indeed, for farmers in the German case study, policy and regulation was identified as the primary influence on decision-making, with farmers seeing these as burdens. The main issue was that farmers felt they had little control over their own decision-making, and very little influence in the design of new policies. Thus, they feel unprepared and unable to mitigate risks, because they are unable to anticipate future policies.

Similarly, in Belgium, some respondents were critical of the government's strategy of only stimulating intensification and farm expansion. This deters farmers who wish to operate more

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extensively, perhaps organic, or to engage in the sale of dairy products locally. For farmers in Bulgaria, there is no long-term national strategy that outlines a sustainable vision for the future development of the sector. This deters farmers from investing in new innovations and long-term changes, as they are not certain what the long-term policy will be.

Because many farmers are dependent on farm subsidies, they must therefore adjust their practices to any new regulations. However, policy change often occurs rapidly after a CAP reform, which is problematic for farmers who have made large investments prior to the reform and it takes time to adjust. For instance, the last CAP-reform introduced the decoupling of direct payments. For arable farmers in the Veenkoloniën in the Netherlands, who cultivated a lot of starch potatoes and wheat, this was a major external influencer and resulted in substantial financial losses as the CAP-subsidies were reduced significantly for these crops. The largest starch potato cooperative in the region, Avebe, played an important role by helping farmers receive a better price for their starch potatoes, compensating for their losses in direct payments. Therefore, together with Avebe, farmers learned about how to overcome the decoupling of the CAP payments.

Changing regulations also influence decision-making. Many of the respondents across the case studies identified changes in plant protection products (e.g. neonicotinoids, glyphosate) as having a significant impact on their decisions, resulting in uncertainty due to the unavailability of suitable alternatives (e.g. there are no alternatives available for neonicotinoids and glyphosate). In the Netherlands, farmers struggled to adjust to these changing regulations and were often not able learn from this. An explanation for this might be that the crop protection regulations recently changed and that farmers will need more time to adopt or develop alternatives for these crop protection products. In Poland, farmers are seeking to introduce plant varieties that have improved resistance to diseases.

Bureaucracy was also identified as an issue, particularly in terms of the administrative burden associated with applying for agri-environmental grants or the fear of costly fines for failing to comply with ever-changing bureaucratic demands. In Bulgaria the lack of coordination between government departments and their lack of capacity was cited as adding to the bureaucratic burden.

However, new policies and regulations can enable the stimulation of new farm practices (e.g. greening of the CAP results in adjusting crop rotation). In the German case study, the EEG policy to guarantee biogas prices was cited as positive, and stimulated farmers to learn about the new technology and opportunities to expand and transform their business. For those farmers who discussed their decision to become involved with biogas, the farmers spent extensive amount of

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time researching privately with literature as well as going to conventions and utilizing their farmers' networks to visit the path breaking farms to see how they implemented biogas. Similarly, in the Netherlands, financial compensation for the generation of renewable energy under the Stimulation of Sustainable Energy Production (SDE+) grant scheme, was perceived by farmers as an example of a positive influence of a newly introduced policy. These grants stimulated farmers to invest in sustainable energy and had a positive influence on farmers' decision-making.

4.5.2 Economic and financial factors

Economic factors are a key influence on decision-making. These include price volatility, access to markets, availability of funding or loans and subsidies. In order to persist, farms needs to be profitable. Of all the case studies, hazelnut production in Italy is highly profitable and a growing sector; it is the second largest producer of hazelnuts in the world. For other farming systems, such as arable, livestock and horticulture, achieving good prices for their products is on ongoing challenge, and needs to be balanced with the cost of inputs. Many are price-takers, such as in the extensive beef sector in France. Here if the price of meat or weanlings drops below the cost of production, farmers must look to alternative strategies such as selling on the farm, processing the meat or selling to other customers. Similarly, in Spain, the decrease in sheep meat prices has impacted on farm profitability and farmers are seeking solutions to reduce their costs (e.g. animal feeding based on fruit pulp, intensifying animal feeding and investing in new technologies) or more local distributors that offer better prices than wholesalers or cooperatives.

In the Polish case study, the market was identified as the biggest influence, as expressed by one farmer: "First of all – economy – supply, demand….and prices. Those are market information and those information influence direction of the farm …. When it comes to the selection of varieties, the biggest source of knowledge is demand. It is known that no-one plants cheapest varieties, but those more expensive." A further challenge in Poland is the increase in competition and the embargo on exports of fruits and vegetables to Russia. As a result, farmers self-organised themselves and created producers' groups in order to reduce transaction costs.

Access to loans or other funding is also important, for instance SDE+ grants in the Netherlands and SAPARD (Special Accession Program for Agriculture and Rural Development) in Poland. In Belgium, it is harder for farmers to get bank loans since the financial crisis: "The bank will come over to see what we want, what we can and may do. If the bank does not go along with our plans to invest, it will soon be over. Banks have a lot of decision power" (BE5).

4.5.3 Demographic factors

Factors such as availability of labour and the presence of a successor influence farmers' decisions. Most of the case studies indicated that getting labour, particularly skilled labour, is becoming

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increasingly difficult, as explained by a Bulgarian farmer: "Years after year it is getting harder for labour... there is no qualified people, even if you find them, they have the document (diploma, certificate) but they do not have the practice. The outflow of quality people out there is very high ..." The lack of skilled labour is largely due to technological advancement in farming requiring skilled operators and the fact that wages for agricultural work are generally quite low. These factors prompt farmers to learn about and implement labour-substituting technology or by restructuring the farm so that family members can cover the labour requirements. In Romania, having an off-farm job can give farmers the financial security to implement innovative ideas and experiment on their farm.

4.5.4 Social norms

Subjective norms reflect farmers' perceptions of social pressures to behave or not behave in a certain way (Beedell and Rehman, 2000). They play a significant role in determining decision-making and, thus, what learning farmers seek to undertake. For instance, in Belgium, the prevailing attitude, supported by government, is for large-scale enlargement and intensification of dairy farms. As farmers see other farms enlarging, this reinforces their perception that this is the most appropriate strategy. Traditions and customs are influential in Romania, with attachments to a traditional way of farming in the case study region.

In Italy, there is a cultural tradition for conventional farming, making it challenging to convert to organic. Farmers' must have strong beliefs in the merits of organic hazelnut production in order to overcome the social norm of conventional farming. Similarly in the Netherlands, another example of a decision driven by social norms was demonstrated by two farmers who were sceptical about organic farming and indicated that they would rather quit farming than become an organic farmer.

In a number of the case studies, prevailing social norms included the general expectation that family members will take over the family farm, particularly sons; the acceptance that farming is hard work; and recognition that there is a strict division between conventional and organic farmers, suggesting that conventional farmers rarely collaborate with organic farmers. Some of the farmers challenged these social norms, which sometimes resulted in being ostracised in their farming community. For instance, one organic farmer's daughter in the Netherlands, rather than the son, was interested in taking over the farm, but his peers found this strange. This, together with the fact that he was farming organically, created some tension between them. Gender also was a factor in the Swedish case study, with the egg sector dominated by male producers and supply chain actors, which was challenging for female producers.

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4.5.5 Environmental factors

An implicit factor in decision-making is the biophysical conditions in which the farmer operates, such as soil type or climate, setting the boundaries for what is possible in particular agro-ecological contexts. In addition, climate change drives decisions and practices. For instance, in the Bourbonnais region in France, the climate has moved towards dry summers, with impacts on crop selection and grazing management. Farmers try to learn from these extreme weather events to adapt for future episodes. Across the case studies, learning from the experiences of extreme weather and adapting their practices accordingly was important.

4.5.6 Land availability

In a number of case studies, availability of land and tenure influenced (long-term) decision-making. For example, in Bulgaria, over 50% of farmed land is rented on short-term contracts, resulting in a persistence in monoculture farming due to the reluctance to invest in crop diversification (e.g. cost of new machinery etc.).

4.5.7 Availability of technology

Some respondents spoke about the difficulties in accessing new technology, and information about technology. These barriers influence decision-making and thus can either stimulate or deter learning.

4.5.8 Media and public opinion

Public opinion was cited in most case studies as an influence on decision-making. There was a perception that consumer demand is changing with a reduction in demand for meat products and a desire for food that has been produced to high environmental and animal welfare standards. In Spain the overall trend of decreasing lamb meat consumption is affecting the sector by making farmers implement relevant changes in farm specialization and organization. For instance, Protected Geographical Indication (PGI) status has been pursued to ensure quality products and attract the customer. It is worth highlighting the decision to belong to cooperatives to ensure the sale of their entire production, to find new markets, or get some product promotion to mitigate the reduction of consumption.

In the Netherlands negative media attention is one of the key external factors influencing decision-making and perceived risks. Negative media attention discouraged farmers, but they felt that they learned for this in terms of taking the media as a proxy for how society thinks about agriculture and their expectations. However, social media offers an opportuning for learning from a wide range of others, including farmers and other actors around the world.

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4.6 Conceptualising the results

4.6.1 Farmer attributes that enable (or constrain) learning

Farmer attributes, such as interests, motivation, entrepreneurial spirit and personality, are important in influencing the degree and type of learning that is undertaken. These attributes are more important in determining learning behaviour than other factors such as having spare time to devote to learning. From our analysis across the case studies, we identified two broad categories of learner: the 'proactive learner' and the 'reactive learner'.

Proactive learners are likely to be willing to take risks and apply proactive risk management strategies. They are open to new ideas and seek out new information. They do not wait for problems to occur, but seek to constantly improve their business and their activities, anticipating and adapting to future changes. In the literature, these farmers may be considered innovators or early adopters (Diederen et al., 2003, Rogers, 1995). They welcome innovation and will experiment with new technologies and new approaches on their farm. Such farmers have a positive attitude and high self-efficacy (Bandura, 1977). They are reflexive, critically assessing what they do and the information and learning they receive from others. A key attribute is their ability to convert knowledge into action, and translating their learning from non-farmers into farmer practice that can be applied. They also have an enquiring personality and will engage with other farmers and non-farmers across their social network to share experiences, expand their knowledge and value other people's opinions and input. These farmers tend to have a clear vision of the wider farming system which helps them to better reflect on their own behaviour and specific farm situation. Flexibility is an important attribute for learning, with the ability to modify their activities to suit market demand or shifting policies.

Reactive learners tend to be risk averse and deal with the consequences as and when they occur (van Winsen et al., 2016). Thus, they may be fairly passive, perceiving a lack of self-efficacy and a sense that things happen to them that are beyond their control. They prefer to operate a business as usual model, keeping to tried and tested methods that they know have worked in the past. This lack of flexibility can lock them into a way of operating that constrains their ability to learn about (potentially more resilient) ways of working. When they do innovate, they prefer to wait until others have experimented first and then adopt when they are confident that it will work. They are less likely to engage in social networks than proactive learners, preferring to observe other farmers' behaviour and reflect on whether it would apply in their own circumstances. Alongside this, attachments to a particular farming way of life or an occupational identity may make them reluctant to undertake radical adaptations or transformations on their farm. Their focus tends to be narrowly centred on their specific farm situation rather than considering the broader farming system.

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Our study also revealed differences in learning across the generations. Younger farmers are more likely to engage in sharing experiences or seeking out information through online resources and social media, whereas older farmers tend to prefer more traditional forms of communication such as the farming press and books. Change often occurs on the farm at the point of succession, with the new entrant actively seeking out new ways to improve the profitability of the farm business. This may involve the introduction of new technologies, seeking out niche markets, diversification or a shift in activities. In such cases, the new entrants demonstrate proactive learning characteristics. However, in some case new entrants are reluctant to make any changes to the farm, preferring to maintain the farm activity as it is (this may be because the farm is functioning well or because they are not confident in undertaking changes). Alongside type of learner, an important factor that enables learning is confidence in the future of the sector. The farmer must perceive that there is a future in the sector (for him/herself and for future generations) in order to invest time and energy into learning and developing the farm business. A lack of confidence in the future of the sector may prompt the introduction of new activities, transformation of the farm activities or even leaving the sector altogether.

4.6.2 The role of webs of influencers on learning and decision-making

The role of a farmer involves a wide range of skills; and as both practitioners and managers they need to seek out information on a broad range of topics from a diverse range of people (Sligo and Massey, 2007, Oreszczyn et al., 2010), as demonstrated in the influence maps from each of the case studies in chapter 3. In many cases farmers do not make decisions in isolation (Ingram, 2008), but, as Oreszcyn et al. (2010) purport, decision-making and learning occur through the complex social systems in which farmers live and work and are important environments in which to consider their capacity for learning (Rose et al., 2018).

As outlined in section 4.3, the degree to which the farmer trusts influencers and the level of confidence they have in the source of advice or information is crucial (AIC, 2013). Drawing on work undertaken by the Agricultural Industries Confederation (AIC, 2013) that identifies farmers "inner ring of confidence" and Oreszczyn et al.'s (2010) networks and webs of influencers, we distinguish between three levels of influencers (see Figure 4.1 European farmers' webs of influence.Figure 4.1).

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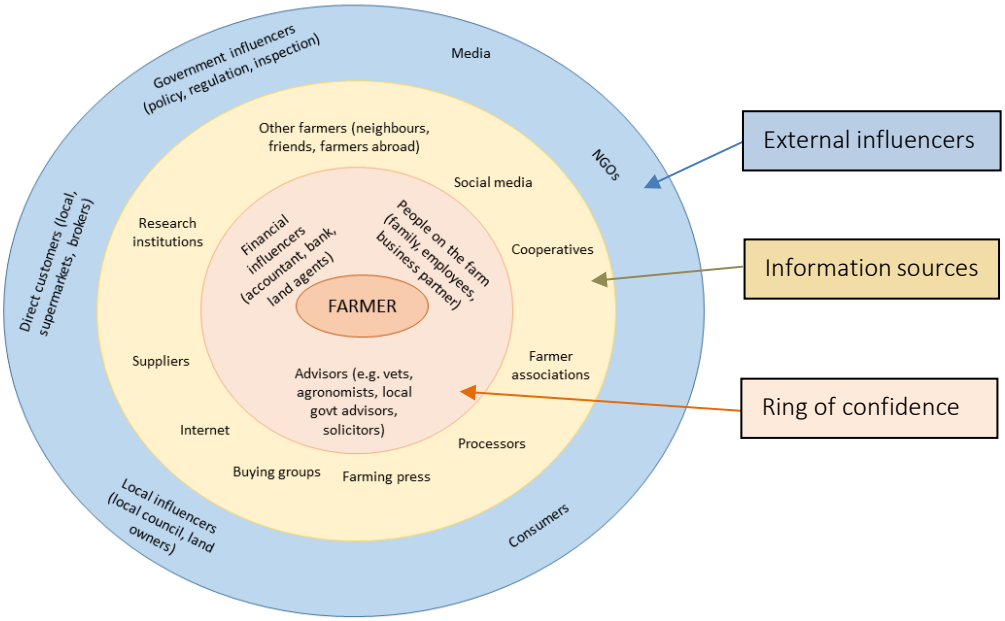

Figure 4.1 European farmers' webs of influence.

First is the "ring of confidence", comprised of trusted professional and personal advisors, including family members, who in effect constitute the farmer's business management team. These tend to be individuals who are personally known to the farmer, have a good knowledge of the farmer's farm and the farmer is confident in their advice (Ingram, 2008, AIC, 2013, Dwyer et al., 2007). Trust in advisors is particularly important when making risky decisions.

Outside this inner ring is "information sources", consisting of individuals and organisations that farmers may consult for advice (that are external to the inner ring of advisors, but provide advice or information to the farmer) at various moments in time. They provide advice or information which the farmer can draw on to make a decision. Indeed, in some instances farmers may be less confident in the advice they receive from influencers in this category, particularly if they feel the advice is not coming from an independent source (e.g. advice about plant protection products from a chemical company).

Beyond this are the "external influencers" that the farmer does not (often) consult but they can provide the context within which farmers operate, such as the legislative framework, social expectations, NGO narratives, local planning contexts and the media portrayal of farming. As our results from across the case studies show, external factors can influence farmers' decision-making and, thus, their willingness or ability to learn. Policy was identified as setting the boundaries within

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which farmers operate – where policies enable and/or encourage behaviour change, allow for adaptation or incentivise farmers to learn (e.g. learning about the potential for bioenergy production on their land). Thus, an enabling policy environment is crucial for fostering a learning environment.

Having a secure financial basis and access to appropriate loans or funding for future investment is also important at stimulating farmers to learn. This, together with access to new markets or an understanding of shifting consumer demands, can prompt farmers to adjust their thinking about their farm practices and seek out new farming techniques, supply chains or marketing strategies. Clearly the availability of appropriate technologies or innovations is also an important driver in new learning.

Social norms that reinforce traditional ways of farming in a farming system can constrain resilience by locking farmers into a business-as-usual approach. This can be reinforced by the reluctance of the older generation of farmers to engage with new ideas and innovations.

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5 Conclusions

By comparing the resilience capacities of the case studies to the identified learning strategies and learning attributes, we found learning to be an important component in the adaptive capacity cycle, and across the resilience capacities of robustness, adaptability and transformability, as summarised in Error! Not a valid bookmark self-reference..

Table 5.1 Learning strategies and attributes across resilience capacities.

	Learning strategies	Learning attributes
Robustness	• an agricultural education • experimentation • seeking out information • observing other farmers • adapting practices to new regulations • adopting tried-and-tested practices	• confidence in own decisions • relying on own experience • commitment to prevailing ways of working • risk averse • reflexivity
Adaptability	• peer-to-peer learning (farm visits, experimental fields, events, farming neighbours, farmers abroad) • consulting non-farming experts • experimentation • engaging in social networks • horizon scanning - anticipating future changes and challenges • actively seek out new information	• open to new ideas & innovations • motivation to engage with others • eagerness to learn • ability to be flexible • critically assessing sustainability of current practices • confidence in future of the sector • willing to take risks • ability to convert knowledge into action • valuing the opinion of others
Transformability	• seeking out new contacts or knowledge networks • drawing on experience working abroad or in other sectors • experimentation	• change in values/attitudes • vision of the farming system • willing to take risks • having entrepreneurial spirit • willing to radically change farm activities • high levels of self-efficacy

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Robustness-enhancing learning is demonstrated by the attributes of both reactive and proactive learners, as outlined in the previous chapter. They rely on their own experience, reflecting on past experiences in order to adjust their current activities in response to shocks and stresses. Such farmers are committed to maintaining the existing operational logic of the farm. While robust farmers are willing to experiment, they prefer to wait until others have tried out the new practices first. For example, a robust farmer is likely to make small adjustments in response to challenges, such as switching to buying young stock instead of breeding them themselves in order to reduce costs, enabling the farm to bounce back from moderate stresses. .

Adaptive learning requires farmers to be open to new ideas and innovations, remain flexible, and be willing to take risks and engage in social networks to learn from others. They are able to critically assess their current practices and make changes where needed. Such farmers are likely to learn from other farmers through farm visits, experimental fields, their farming neighbours and farmers abroad (through social media or overseas visits). They are also willing to experiment with new technologies or innovations on their farm and will be horizon scanning to anticipate future changes and challenges. Findings suggest that those farmers who are open to experiment are also better able to adapt themselves to shocks and stresses. These farmers reflect the proactive learner type outlined in the previous chapter. An adaptable farmer scans the market and has adjusted what s/he produces to improve profitability. S/he also engages with and learns from other farmers believing that "a personal exchange between farmers is very important."

Transformative learning describes a process where people gradually change their views on the world and themselves (Muro and Jeffrey, 2008) – it often occurs in the face of a 'trigger' or crisis to which they need to respond (Maarleveld and Dabgbégnon, 1999, Pahl-Wostl, 2002, Dougill et al., 2006). These dilemmas or crises cannot be dealt with using existing knowledge or actions. Farmers that are able to transform their farm business are willing to radically change their farm activities in order to grow or improve the business, or to enable their farm to become more sustainable. They have high levels of self-efficacy and are willing to radically change their activities if needed, often resulting in a shift in their way of thinking or their attitudes. They will actively seek out new contacts beyond their current social networks and will be at the forefront of trying out new innovations or technologies. A farmer demonstrating transformability may well be the one of the first farmers in a region to begin growing a new crop or in adopting a new technology. However, reactive learners may also transform, when they can no longer sustain their business in its current form. Thus, they may be forced to either radically transform their farm or leave the sector.

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5.1 Concluding remarks

This study clarifies some important concepts relating to farmers' learning capacity and its role in resilience-building. Through the case studies, we have distinguished between farmers who are proactive and reactive learners. As discussed, in terms of resilience, reactive farmers may be robust, enabling their farm to recover from moderate shocks and stresses (see Figure 5.1). They are less likely to be able to adapt though, persisting where possible in their tried and tested ways of working. In response to major shocks, they may be forced to undertake transformation or exit farming. However, proactive learners, while enabling robustness and transformability, are also able to adapt (Figure 5.1). As identified, these farmers are more entrepreneurial and are able to anticipate and prepare for future challenges. They can identify and respond to business opportunities, translating what they observe and learn from others into practice on their own farm. Farmers who align more to the reactive learner type may struggle with this and find it difficult to overcome what they perceive as barriers beyond their control. This suggests there is a need for an advisor to fulfil this function for the farmer, to allow him or her to enhance their adaptive capacity. This may be a role for a financial or business advisor. Given that such advisors were seen as important influencers across most of the case studies, we suggest there is an important role for them to play beyond providing funds, loans and general business advice. They may also fill this 'learning gap' for reactive farmers through coaching farmers and putting together future-proofing business plans. As our study shows, farmers are more likely to listen to trusted advisors, so such a role would need to be filled by someone within the farmer's ring of confidence, who understands the land being farmed and the motivations of the farmer. Indeed, there may be further roles for wider personal development skills training drawing other business sectors. For instance, there is much evidence across a range of business sectors that emotional and social intelligence can contribute to better individual performance and business profitability (Cherniss, 1999).

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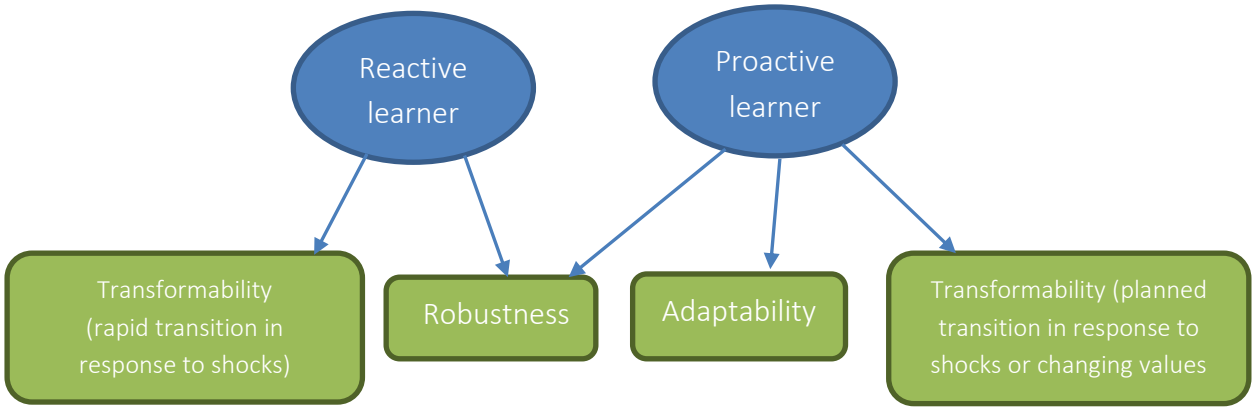

Figure 5.1 The resilience capacities of reactive and proactive learner types.

A challenge here - often not apparent in other business sectors - is that farming is often more than a job or a livelihood, it is a way of life, with farmers feeling a strong self-identity to what they do. As our study shows, attachments to particular ways of farming can hinder adaptation, so where possible careful consideration needs to be given to enabling farms to adapt while maintaining their core identity. Thus, to enable adaptive learning to take place involves shifting farmers' social norms about farming. This is exemplified through the Romanian case study, where there is a shift from farms as subsistence enterprises to market-oriented businesses, and in Poland where they recognise they are not just 'farmers' but also 'entrepreneurs'. Thus, there is a transformation in not just in how farmers operate but in how they identify themselves. Farming is a dynamic industry and, therefore, farmers need to have the capacity to respond and adapt to change.

As our study shows, learning occurs within a farmer's ring of confidence, thus these individuals and organisations have an important role in facilitating farmer learning. However, the webs of influencers suggest that farmers' networks are often limited to a small group of trusted advisors. Expanding this knowledge network out to those beyond the farmer's immediate circle could help to bring new innovative ideas from other farmers and those beyond the sector. Many farmers in the case studies indicated that they learn from other farmers, both by observing what they do and also through sharing ideas and experiences. In some case studies, opportunities to do this are becoming well developed, but for some, particularly in the former communist states (Bulgaria, Poland, Romania, East Germany), social networks for farmers are in their infancy, as are the agricultural systems in these regions since the restoration of land from state to private ownership. Farmers in these newly developing farming systems often learn through seeking out online

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information and attending agricultural shows. Nevertheless, there is scope for improving farmer knowledge networks and opportunities to exchange ideas, with lessons to be learnt from other countries with more developed farmer networks (e.g. benchmarking, farmer discussion groups etc.). In addition, a number of case studies called for better communication between scientists and farmers. Such alignment could help to improve the adoption (and design) of new technologies. Policy has a role to play in this by supporting the establishment of farmer-farmer, farmer-scientist and farmer-other business networks, implying a need to support and strengthen bonding, linking and bridging social capital to improve and maintain the resilience of farming systems.

Indeed, alongside appropriate support, coaching and learning networks for farmers, it is crucial that there is a resilience-enabling policy environment that provides long-term security and a clear strategy for the sector. An important component of this is providing an environment which enables experimentation and stimulates learning. This may involve support for experimentation in order to reduce the risk, especially where markets are volatile (which may encourage risk averse farmers to be confident in trying out new ideas) and policies that stimulate learning, such as facilitating farmer-to-farmer networks.

This report provides a broad synthesis of the findings from the case studies. A more in-depth discussion of individual case study findings can be found in the appendices.

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Appendix 1: Case Study Contexts

A1.1 Belgium

In Flanders, the average farm size (expressed as number of animals and agricultural area) increased over the last 20-30 years, while the number of farms is decreasing. Farms are evolving from medium sized to large and very large farms. This tendency is still continuing and is seen for all agricultural sectors. Ownership has been relatively stable in the last 20 to 30 years, almost all farms are family farms. Ongoing mechanization and automation of agricultural production, allows scale enlargement and intensification while the main labor force on farms is family labor. However, farmers do invest more in paid labor force over the years. Whereas a total of 63940 annual working units (AWU) was recorded in 1990, only 40240 AWU were employed on farms in 2013. About 92% of total labor force in 1990 is family labor, this steadily declined to 76% by 2007. Both subsidies and financial support from financial institutions allow farmers to invest in new machinery and scale enlargement of the farms. Farms are becoming more specialized, more focussed on either animal or crop production, although mixed farms still exist.

The overall number of agricultural holdings has substantially decreased from 56 560 farms in 1990 to 23 980 farms in 2016. A similar decreasing tendency applies for total labor force expressed in annual working units (AWU). With the average age of farm managers increased from 48 years in 2004 to 52 years in 2013, ageing of the farmer's population is a critic issue. Also, the percentage of farmers without a prospective successor is increasing. In addition, more and more family labor force is part-time employment: between 2013 and 2016, there was an increase of 49 percent.

Agriculture in Flanders is also capital intensive. In 2007, 42% of total agricultural labor force was directly employed (AWU) on farms above 100 ESU. In 1990, only 8% of labor force is employed on farms bigger than 100 ESU. In 1990, only 1% of the farm labor force is directly employed on holdings with legal entity. The remaining 99% is employed on sole holders' holdings. In 2007, labor force employed on holdings with legal entity raised to 15%. On larger farms (>100ESU), this raised to 24% (Eurostat, 2009). More and more farmers have an additional job outside the company, with an increase from 109% between 2013 and 2016. There is a decrease in number of assisting spouses on farms, from 45% in 2013 to 37% in 2016 (Vilt, 2018). Despite a strong decline in the number of agricultural holdings and AWU, the total utilized agricultural area has slightly increased from 598 970 ha in 1990 to 613 190 ha in 2013. This suggests a structural change towards bigger farms over the last decades. Whereas the number of holdings up to 30 ha has been declining, the number of holdings cultivating more than 30 ha was higher in 2007 compared to 1990. Sector organizations, research institutes and governance are all supporting this tendency in scale enlargement and intensification. About 3 to 4% of the farms is disappearing each year, with an estimation of about 10 000 farms left by 2040.

These dominant trends – valid for almost all agricultural sectors in Flanders – are also illustrative for the structural changes occurring in the Flemish dairy sector. About 40 % of all Flemish farms with dairy cows has between 15 and 60 cows; 30 % has less than 15 cows; and 30 % counts more than 60 cows. Historical trends for dairy farmers are conform the dominant trend that is observed

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for most farm types in Flanders: the amount of dairy farms has decreased from 9856 in 2001 to 6658 in 2015; while the total amount of lactating cows has only slightly decreased (from 329728 in 2001 to 304304 in 2015). The ongoing intensification in the sector can be illustrated by the increase in average number of dairy cows per farm (e.g. from 33.45 in 2001 to 47.47 in 2015). Also, although the number of milk delivering farms decreased (from 9827 in 2001 to 5071 in 2015), the amount and quality of the milk delivered improved over the years (Departement Landbouw en Visserij, 2016).

Agriculture in Flanders is strongly dependent on export. This counts especially for the dairy sector. Dairy production exceed largely the degree of self-sufficiency. As a consequence, the sector is strongly influenced by foreign stressors and susceptible to changes on the global market. This position might change due to unexpected circumstances (ban from Russia) with large economic impact on these farms. Farms have difficulties to respond well to price fluctuations and changing demand, resulting in multiple crises. Volatility of product prices will have more impact on resilience as governmental interventions are limited (and this limitation will increase).

Major environmental challenges (GHG emissions, water quality, soil erosion) remain an actual topic in Flanders. Farmers will have to adopt far-reaching measures, that might interfere with production capacity (restructure livestock herd in Flanders). But this will depend on priorities in demand of society and how policy will respond on this demand. For dairy farmers, these trends will have major impact on the development of their farm.

A1.2 Bulgaria

Crop production is important and has long tradition in Bulgaria. North-East Bulgaria (CS region), where the research area is located, is known as "the granary of Bulgaria" and is of crucial importance. The relief is varied with semi-mountainous areas, river valleys and lowlands; climate is with well-defined four seasons; soils are among the most fertile in the country, suitable for growing of cereals, sunflower, industrial crops, fruits, vegetables; agriculture (in particular grain production) is a priority economic sector; on average the agricultural land amounts to 80-82% of the total area.

In 2016 the total arable land in Bulgaria increased to 3 480 991 hectares 40% of which is located in CS region.

97% of the total number of registered holdings in plant production in the country are physical persons who manage 32% of the agricultural area. The share of the sole traders and corporate companies is 2,5% as they cultivate 51% of the area. And 22,3% of the total holdings in Bulgaria (244 594) are set up in the CS region. In the CS region: 43% of the cereals, 42% of the oleaginous and 17% of industrial crops in the country are cultivated. The share of the CS region in the total crop production of the country by crops is following: 48% of wheat, 45% of barley and 56% of maize.

North-East Bulgaria is well-developed agricultural region as the production capacity is result from the natural conditions on the first place but also from the historical developments and

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transformations which had taken place. In this regard several facts have to be taken into consideration when the results of the interviews are interpreted: 1) Agriculture during the communist regime (1944-1989) was organized in large-scale, mechanized farms, producing for national and international consumption (the process of collectivization resulted in that over 92% of arable land belonged to the collective farms - complexes averaged between 36,000 and 100,000 hectares; private plots at very small size and share remained productive only for self-consumption). Specialisation (horizontal integration achieved by specializing in three or fewer crops and one type of livestock) was externally forced not only for the production units but also for the regions. North-East region had specialized in crop production with main field crops wheat, maize, and barley. Today, these developments have been considered as a tradition by the farmers interviewed now. Many of the farmers (it is valid for those who are over 55-60 and actually are considered as a first generation entrepreneurs in agribusiness) at the time of the restructuring process were at the beginning of their carrier and many of them have been working namely in those old structures, mainly on a managing positions (all of the interviewed farmers have university degree in agriculture and/or economics and/or law; later those of them that did not graduated agricultural university have been participating in different seminars and trainings in agricultural production processes). 2) After 1990, the large production complexes are dismantled; the property rights in land returned to their initial owners prior to collectivization (mainly to their inheritors which resulted in highly fragmented agricultural land and domination of small scale farms). The sector has passed through a rapid transformation as all operations were liberalized and the "new" farmers (either family, cooperatives and corporate) started to learn "how to do that business". Actually, this is the beginning of entrepreneurship in agriculture in Bulgaria. All over the country as well as in North-East region new farm structures started and the longest "farm story" we collected is 23-25 years. Thus, for some of the farmers who graduated agricultural universities it was crucial to train yourself in business and economic courses. At the beginning it was not easy because even in the universities tremendous changes have taken place and lecturers should study start to study, understand and teach the principles of free market economy and disciplines like economics, entrepreneurship etc. 3) After the year of 2000 – the period of preparation to and accession to the EU (2007) – the process of CAP implementation (SAPARD, RDPs and SAPS) has changed farmers' behaviour (increased investment opportunities) as well as the interest in farming (better profitability) and land relationships (characterised by higher competition and restricted access to the land which is main production factor in arable farming). All over the country as well as in North-East region land prices (rent and lease as well) increased several times (up to 10 times). 4) During the communist time a process of industrialisation of economy (together with land confiscation) push emigration from villages to towns and also played a role of disconnection of people from land management and food production – in the state farms all the workers were hired but not the owners and had no ideas and plans of continuation/succession and concerns of owners. Moreover, after the changes towards market economy, the emigration process had been reinforced (collapse of enterprises etc.) and not only from rural areas to the cities but also from urban areas towards abroad. One of the very negative consequences is lack of labour force (either in quantity and quality) for all the economic sectors but much more severe for agricultural. The last trend will sharpen since the generation which has

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been working in the old structures (it is important because these are the qualified workers who know the processes and have experience with the specificities of the regional/local conditions) has retired or will leave the production process in next 5 to 10 years.

A1.3 France

This study was conducted in the Bourbonnais region (more or less the department of Allier), located in Central part of France, and traditionally dominated by beef production. The agricultural branch reaches 5.1 % of the workforce of the region (2.5 % at the national scale). About 10 000 people work in farms in the department of Allier. The beef sector is the main activity of the region (42%), followed by the crops (16%) and the goat/sheep production (12%). 483 000 ha are available for agricultural activities. There are 5,523 farms in Bourbonnais, divided as follow:

- 200,000 cows in 3,102 Beef farms, Charolais breed, 62 cows in average (48 in 2000). Mainly specialized breeder system.
- 10,000 dairy cows
- 124,000 ewes

The number of farms decreased from 25 % between 2000 and 2010: - 33% for dairy cows, - 17% for beef farms, -52% for beef&dairy farms, -41 for the other herbivores, -42% for polyculture.

The average size of the farms is 88ha, which is quite big for the region: 1,924 small farms, 2,205 medium farms, 1,394 big farms. 72 % are individual farmers, 28 % are working in an association.

The region (Bassin charolais) traditionally sells the weanlings (male and female) to Italian butchers: 75,518 weanlings sold in 2014. The female are finished (butchery). The farms located in crops area also finish the males. Due to competition with Burgundy and Limousin (two regions which produce meat), lots of farms produce "off season": early calving (autumn) to sell the weanlings before the other region, which enables maintaining a higher price but involves higher production cost (concentrated food).

The region benefits from a number of official labels (label rouge): 1,472 farms produce under one label. Two slaughterhouses are certified for these labels and organic production. The direct sale is also increasing.

The sanitary crisis of 2015 (FCO) weakened the Bourbonnais farms, with a closure of the markets (example of the Turkish that bought lots of weanlings at a very good price but stopped it due to the FCO). More generally the market is unstable: fluctuation of prices, uncertainty of sales…

The "bocage Bourbonnais" has been claimed as a sensitive natural region, thanks to his emblematic hedges that stock carbon. Some farmers got involved in a GES reduction program, impulsed by industrials like Mc Donald's. However two consecutive droughts in the past two years have endanger the financial situations of the farms that were already facing with a low meat price.

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A1.4 Germany

The Altmark is located in the German Federal State of Saxony-Anhalt and represents important features of the large-scale agricultural structures of East German agriculture. The Altmark has a high proportion of grassland at nearly 27%. The soil quality is rather poor, and the yield levels in arable farming are rather low. The majority of the land is cultivated by farms with more than 200 ha and farm sizes are heterogeneous.

In terms of numbers of farms, individual full and part-time farms as well as partnerships are dominate in the Altmark. However, legal persons (mainly limited liability companies and producer cooperatives) only account for some 10% of the number of farms, they use almost 45% of the agricultural land. The farms have a high share of loan capital and rented land, and therefore a relatively low capital base. In addition, large stocks dominate the livestock production. Fattening pigs are mainly kept in herds of more than a thousand animals and dairy cows in herds of one hundred to more than five hundred. Around 40% of the dairy cows and 53% of the specialised dairy farms in Saxony-Anhalt are located in the Altmark, although the region covers only 23% of the agricultural acreage of Saxony-Anhalt (in 2007, StaLa, 2008 and StaLa, 2014), emphasising the relative importance of livestock production. The production of biogas is also an important part of the region's agriculture.

Only some 15% of the actual workforce in the agricultural sector in Saxony Anhalt is non-salaried family labour while 79% is permanently hired labour, the remaining 6% is hired seasonal labour. Some 50% of the workforce is working on corporate farms which farm 43% of the land. A further 25% are engaged by partnership farms farming some 29% of the land. The remaining 25% of the workforce is engaged on family farms, farming the remaining 29% of the land.

The Altmark's current agricultural structure was shaped during the time of the former GDR. In the 1950s and 1960s, farms were transformed into state farms and collectivised cooperatives. During this transition, land plots became increasingly bigger and the emergence of a regional specialisation in arable farming and livestock production happened. After the German reunification only a small percentage of farmers decided to reclaim their land and start again as independent farmers. This meant that most of the former collective farms became cooperative farms or limited liability companies. In addition, a substantial number of farmers from the western part of Germany as well as The Netherlands migrated to Eastern Germany. Dutch farmers are particularly engaged in livestock production and partly horticulture, although horticulture does not play a big role in the Altmark farming system.

A1.5 Italy

Italy is the second largest world producer of hazelnut, after Turkey, accounting for around 13% of total surface and production, in 2017 (FAOSTAT, 2019). Figure Figure 0.1 depicts a more thorough trade balance for Italy.

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More than one-third of Italian production comes from the Lazio region, where Viterbo's territory accounts for 97% of both surface and production, 21,000 hectares and 553,500 tons, respectively, in 2018 (ISTAT, 2019).

Hazelnut generates 73 Millions Euro of added value in the Lazio Region, according to last data available for the year 2015 (INEA, 2017). Viterbo hosts more than 6,000 hazelnut farms, of which 86% is represented by farms under 10 hectares (ISTAT, 2010). This means that most of the farms are managed on a family and part-time basis. The quality of the product is high in comparison with the international competitors.

The main area of hazelnut production is Monti Cimini, around the vulcanic Vico lake, where more than 80% of the farm population is specialised in hazelnut, using more than 55% of the whole utilised agricultural area (UAA) (see figure

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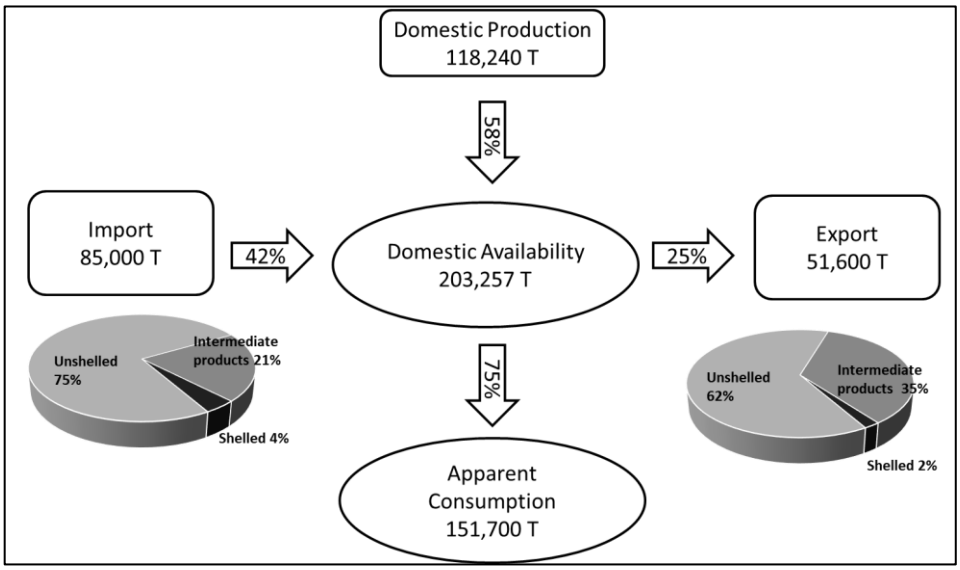
Figure 0.2 below)

Figure 0.1 - Italian Hazelnut Trade Balance, 2017



Source: Authors' elaboration on ISTAT (2017)

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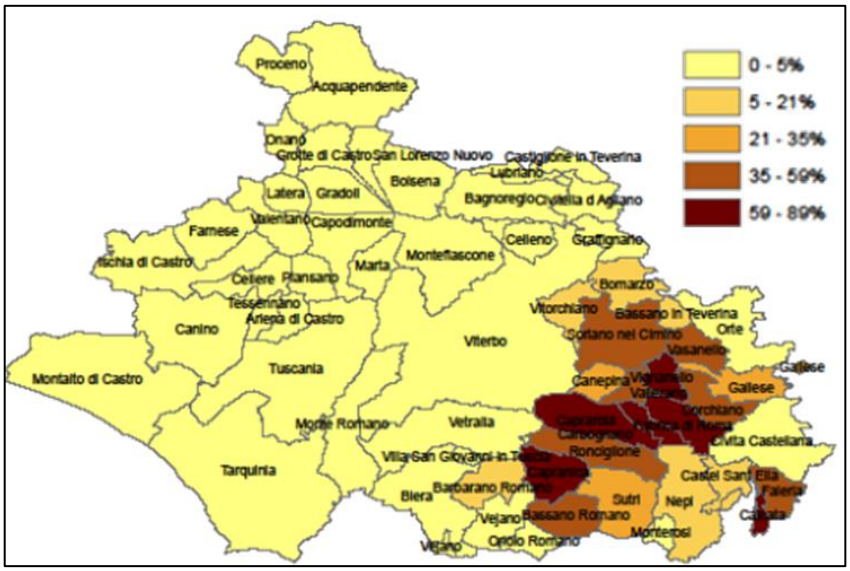
Figure 0.2 – Distribution of Hazelnut Surface within the Viterbo Province. UAA Hazelnut with respect to Total UAA, 2017.



Source: Authors' elaboration on ISTAT (2010).

A1.6 Netherlands

The Dutch case study is located in the Northern part of the Netherlands and consists of two regions; the Veenkoloniën and Oldambt. Although arable farming is one of the main farm types in both regions, there is are a lot of differences between both farming systems. We interviewed four farmers from the Veenkoloniën and six farmers from Oldambt. Most Dutch arable farmers suffered from a long-lasting drought last summer. This may affect the findings of the last 5 interviews, as they were conducted after the drought occurred (November - December 2018).

Historically, Oldambt used to be a rich region where farmers cultivated wheat. Back then farmers had fair incomes and could afford hiring contract workers. Nowadays, the situation has changed, and farmers survive by scaling up wheat production. There are limited possibilities for crop rotation, as the heavy clay soil only allows a limited number of crops to be grown (primarily wheat, some sugar beets and rapeseed) (Prins et al. 2011, pp.22-25; Municipality Oldambt, 2015). Because of the soils, the arable farming in this region is different from other arable farming regions in the Netherlands: here, cereals, sugar beets, and rapeseed are primarily cultivated (Immenga et al. 2012.).

The Veenkoloniën is a region with peat soils, and starch potatoes and sugar beets dominating farm plans (Prins et al. 2011, pp.19-22). Winter wheat is cultivated in order to maintain and improve the soil quality, rather than due to profitability (Immenga et al. 2012). Most farmers are members of cooperatives (*ibid.*). Oldambt is more fertile region, but the heavy clay soils limit the crop variety (Prins et al. 2011, pp.22-25). With the average estimated NPV per hectare of arable

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land of 2,541 €/ha, the region Veenkoloniën and Oldambt is characterized with one of the lowest economic performance in the Netherlands (Diogo et al. 2017, Table 1).

The shift from coupled to decoupled direct CAP payments had a negative impact on farm income in Oldambt and Veenkoloniën (Kuhlman et al. 2014). According to Immenga et al. (2012), potato farmer's in Veenkoloniën received between €450-750/ha of coupled direct payments, while after decoupling - only around €350-400/ha (incl. greening). In July 2003, due to a new erosion regulation, Dutch farmers were for the first time obliged to develop a farm erosion prevention plan based on the guidelines provided by the agricultural commission (Van-Camp et al. 2004). This regulation was particularly relevant for Veenkoloniën, where soil erosion had been largely observed.

The period between 2006 and 2010 served as preparation for the sugar quota abolishment, and the sugar sector was substantially restructured. The sugar quota was abolished in the EU in October 2017 after 50 years (EC 2017a). It is expected that such developments in the sugar market would allow expanding sugar beet production in both Oldambt and Veenkoloniën.

A1.7 Poland

The Polish Case Study Region is Mazovian region (org. EUFADN "Mazowsze i Podlasie") located in Central-East part of Poland. It consists of 2 NUTS2 regions: PL92 (Mazowieckie, or PL12) and PL81 (Lubelskie, or PL31). Mazowieckie is the capital region – the largest and most populous of the 16 Polish provinces. It occupies 35,579 square kilometres (13,737 sq mi) of east-central Poland, and has 5,324,500 inhabitants. The Lubelskie region is among the most agricultural regions of the country and also the poorest one. It is situated in the east of Poland at the external borders of both Poland and the EU with Ukraine and Belarus. It is one of the least developed regions of Poland and of total EU, with total population of 2,112,787 citizens in 2017 (Eurostat, 2018) out of which rural citizens are 1 144 thousand. The region is traditionally a hub for horticultural production (fruit and vegetable) in small and medium family farms, which determines its diversified landscape. However there exist also other types of farming systems in the region as follows:

- TFT1: small farms (<10 ha) + Family farms + Arable farming (Field crop farms);
- TFT2: medium farms (10-30 ha) + Family farms + Arable farming;
- TFT3: medium farms (10-30 ha + Family farms + Milk farms;
- TFT4: small farms (<10 ha) + Family farms + horticulture (fruits or/and vegetables);
- TFT5: small farms (<5 ha) + Family farms + poultry farm (farming based on purchased fodder inputs).

Production of the vegetables accounts for ca. 9% of total vegetable production in EU. Production of fruits is also an important sector in Polish agriculture. The share of fruits in the total value of

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market crop products in 2013 was over 15%. Poland is the largest in EU and fourth in the world producer of apples. Most of vegetable and fruit production in the region (both in terms of number of farms and their production share) is conducted in following types of farms:

- small (average area of a horticulture farm (type 2 according TF8) according to FADN 2015 is 6 ha – they are between EUR 8 000 and EUR 25 000; yet of the ones with permanent crops (type 4 according TF8) – 9.5 ha so – they are also between EUR 8 000 and EU 25 000 of SO.;
- family (it is a private property of the farmer and his/her family);
- hiring employees depending on the season (especially in the harvest time).

The main resilience problems identified in the region are:

- Socio-economic: emigration of workforce from the villages; outflow to non-agricultural activities of the young farmers who could be good managers of farms (succession problem), problem with small and scattered farm structure;
- Economic: market fluctuation of prices for the goods and production inputs, uncertainty of sales;
- Environmental: deficit of organic matter in the soil; water resources instability, susceptibility to erosion.

A1.8 Romania

The case study in Romania consists of mixed farms in the Nord-Est region (RO21). The last Farm Structural Survey (2016) shows that 73% of the Romanian farms are mixed (have utilized agricultural area and livestock). Of those, the largest share (22%) are located in the Nord-Est region. In terms of utilized agricultural area, 98% of the farms in Nord-Est region have less than 10 ha and 95% less than 5 ha. The livestock is composed (% in the region's total LLU) of: bovines (42%, mostly dairy cows), poultry (19%), sheep (15%), pigs (12%), and equidae (9%, mainly horses for transport purposes). A more recent development in the region is the intensification of bee farming.

In terms of specialization, FADN data indicate in 2016 a total of 79,840 mixed farms - field crops-grazing livestock combined (type 80 in TF8 classification, calculated with SO), of which 34% are located in the Nord-Est region.

The mixed farms in Romania have the following main features:

- small (95% of the total mixed farms in the area have less than 5 ha UAA);
- largest average of rented area (among the other regions) (2.49 ha according to FADN);
- family farms (it is a private property of the farmer and his/her family);

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- extensive;
- own work, low proportion of hiring employees depending on the season (especially in the harvest time);
- low paid labour input with low wages, one of the largest unpaid labour input among the other regions;
- total output, total output from crop production and livestock products, among the lowest in the country, but with important differences within the region;
- the same is true for Farm consumption, Farm net income, Farm net Value added/AWU an Family farm income/FWU;
- the collapse of industry in the early years of transition together with the restitution of land property pushed many urban inhabitants to return in the rural areas;
- the farms developed close to urban areas in order to take advantage of short transport distances, but reoriented as well to sales to touristic areas which developed in the region (traditional but mostly agritourism);
- on-farm consumption (more than 50% of the final production) is extensive;
- production is oriented to cereals (mainly maize and wheat), oilseeds (sunflower) and fodder crops.;
- animal husbandry developed continuously (mostly grazing – dairy cows, sheep and goats), and much of the milk production is locally processed.
- there are few producers' associations, consequently poor bargaining power in relation to large industrial processing units.
- international trade from the selected region is oriented mostly to Moldova and Ukraine, due to short transport distances.

Resilience challenges and risks.

A. Economic and institutional:

- opportunities for development from NRDP;
- fluctuation of prices for the goods and production inputs;
- uncertainty of sales – low degree of farmers' inclusion in value chains;
- high instability of fiscal policies for SME-s;
- poor infrastructure.

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B. Environmental:

- climate hazards (drought, flooding, hail);
- low use of chemicals;
- in certain areas in the region there are conditions for support for HNV and agri-environmental payments;
- recent increase of interest for organic farming.

C. Socio-demographic:

- in two of the three counties considered for the case study, Iasi and Suceava, there is a net immigration flow (the urban-rural flow is higher than the migration out of rural areas);
- in the third county (Vaslui), there is a net migration of workforce out from the villages to rural areas; as a result, there is a season-based lack of workers, especially during intensive periods of field-work;
- outflow of the young managerial staff to non-agricultural activities;
- emigration to other EU countries (Italy, Spain, UK, Germany);
- some part of working-age population resides rather on social benefits than on income from work;
- many children in the family, inheritance splits farms;
- inadequacy of education in rural areas (lack of vocational schools adapted to the real demand for skilled workers in agriculture-related activities, and services);
- inadequacy of medical services.

SWOT analysis for the Case Study region/sector	
STRENGHTS	WEAKNESSESS
- Benefit from the main types of landscape (Carpathians mountains, hills, plains, Danube, Black Sea) – to diversification of the labor force occupations in rural areas	- Large agricultural employment in total employment (26%) - Land fragmentation

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	- Inadequacy (mismatch) of education and training with the real demand of the rural labour market
OPPORTUNITIES - Positive immigration where employment opportunities come from the services sector (tourism, agro-tourism) - Beautiful, diversified landscape of the region can meet the opportunity of increasing demand for agro-tourism - Increasing demand for high quality (traditional products, organic, PGO, PGI, SGP) and processed products	THREATS - Lack of available labour (skilled and unskilled) due to emigration - Unwillingness of potential successors to take over farms – preference for off-farm jobs - Farm split in the next generation

A1.9 Spain

The Spanish case study covers two specializations and regions: the extensive sheep farming in Huesca and the extensive beef farming in Sierra de Guarradama (Comunidad de Madrid). Huesca is located in the Northeast Spain. It is a low density population region (324 inhabitants/Km2) and the income per capita stands at 25,400 €/cap (2010). There are several national parks in the region with a diverse natural environment. The area is under depopulation and follows a trend of farm reductions and aging farmers. The number of farms has decreased from 2.902 (1995) to 1.221 farms in Huesca (2015) and the number of ewes from 811.590 (1995) to 491.621 (2015) ewes. The mixed farming –sheep and rainfed crops- has been the most relevant agricultural specialization in the region. The extensive sheep farming system in Huesca comprises mainly medium-size extensive or semi-extensive farms (300-800 ewes); in most of the cases, farms are diversified in other less relevant productions such as almonds, olive trees, cereal crops and, in a few cases, vineyard. Due to the economic pressures of the last decades, some phenomena of intensification and changes of production have taken place. It is worth highlighting the adaptation of the production from extensive to intensive management and the numberless cases of transformation from extensive sheep to intensive pig farming followed by a large number of farmers. Intensification and implementation of more productive agricultural practices (such as irrigation) are more likely to occur in the southern part of the region, where environmental and geographical conditions make it easier; as opposed to the northern area of Huesca, which seems to be more disadvantaged and apparently poorer of agricultural opportunities due to the mountainous area.

The beef extensive farming in the Sierra de Guadarrama (Comunidad de Madrid) is located in a mountain range close to Spain's capital city (Madrid). The region has a high density population

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(820 inhabitants/Km2) and the income per capita stands at 33,800 €/cap (2017). There is a natural park close to the CS region. The number of farms has decreased from 1.100 (1990) to 850 farms. In 2016 there are 36,367 suckler cows in the Comunidad de Madrid. In comparison to the Huesca region, one of the main challenges of this region is overpopulation. Madrid capital city continues to grow and rural villages are becoming areas where urban citizens (dedicated to non-agricultural activities) live, displacing agricultural activities to the highest areas in the mountains. Land access competence increases and coexistence problems between the livestock, citizens, and tourists regarding (odour, attack) are problems highlighted by the farmers in the region.

Nevertheless, shocks, risks, pressures, and in general, challenges are approximately the same. Economic causes seem predominant in influencing the systems development; significant market parameters include stable prices, increasing costs, higher competition and a drastic reduction in consumption of meat. Intense labour dedication and the non-availability of skilled labour are challenges also highlighted by the farmers in the two regions. Environmental factors are impacting the system, such as more frequent droughts and conflicts with wild fauna management. Even policies have impacted the system's development, especially changes in the first pillar of CAP: decoupling of payments, without any specific payments that support the extensive farming and ameliorate its difficulties, as well as distortions in payments assignments.

The analysis focuses on extensive sheep farming in Huesca. 12 out of 14 interviews have been performed in Huesca. Respondents 7 (G19) and 8 (G20) are the farmers interviewed in the Sierra de Guadarrama.

A1.10 Sweden

The case study region of Sweden comprises five NUTS-2 regions[1] as follows: SE11 - Stockholm, SE12 - Östra Mellansverige, SE21 - Småland med öarna, SE22 - Sydsverige, and SE23 - Västsverige. The total area is 129 000 square kilometres out of which 17% is agricultural land. At country level agricultural land occupies 6,5%.

Southern Sweden is recognised for its agricultural activity. While the region occupies 1/3 of the country total area, in 2016, 85% of the utilised agricultural area, and 75% of the agricultural holdings registered in Sweden were situated in this region; employing 80% (in 2013) of the regular labour engaged in agriculture. The contribution to the gross agricultural output was 88%. In 2017 the gross output of agriculture in Southern Sweden was 9.1 billion euros, out of which crop and livestock output contributed with 4.5 and 4.6 billion euros respectively. Although the landscape and the soil quality are heterogeneous, the region is highly recognised for its fertile plain districts especially in the NUTS-2 SE12, SE22 and SE23 with dominating cereal production (45% in 2018).

[1] Sweden is divided in 8 NUTS-2 regions

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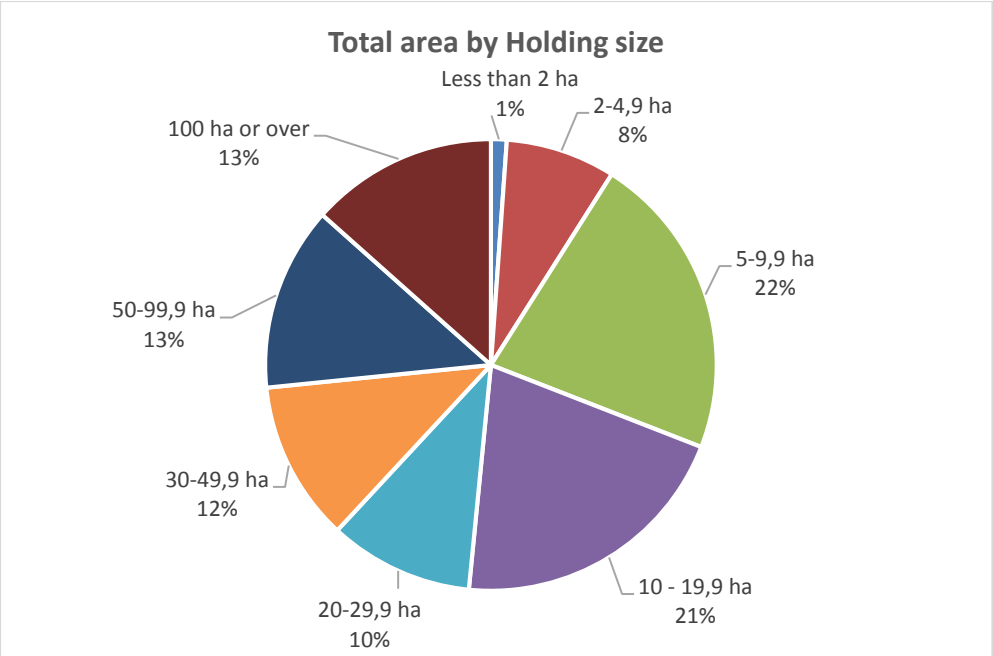

Figure 0.3. Total area by holding size (ha) in 2013, case study regional level (Eurostat data)

Private person/family farms are most common, owning/managing about 90% and 85% of the total agricultural land respectively. Corporate farms own/manage only about 5% of the total agricultural land. The average farm size in 2016 was 53 ha. Compared with Southern Sweden, farms in the remaining parts of Sweden as a whole were significantly smaller, with an average holding size of 28ha. The average farm size at country level was 41ha. Total area by holding size is presented in figure 1.

The Swedish case study of high value egg and broiler production consists of two separate sectors. The production chains of the egg and broiler production are separate and include different actors. The high value broiler production in Sweden is dominated by a handful of large chicken production companies that each contract a number of farmers, often on long term contracts. The farmers thus deliver all their chicken to the same chicken production company, through the same butchery, and are supplied by the designated suppliers of chicks. The larger scale egg producing companies also contract egg farmers that deliver to designated packing companies. While egg contracts can also be long term, the farmers gave the impression that this sector is more flexible with more actors, than is the broiler sector. The Swedish Board of Agriculture divides egg producers into size categories where the large size farmers are those with 4999[2] hens or more. All the egg producers in our study fit into this larger category, but one who were suggested to us by the gatekeeper, and had around 4000 laying hens. According to the branch organisation[3] for broiler chicken, large scale broiler farmers generally receive seven batches of chicks at 85000

[2] See Agricultural Statistics 2018, Swedish Board of Agriculture
[3] See Svensk Fågel https://svenskfagel.se/produktionskedjan/

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individuals each. The size of the broiler farms in our study varied, but are all high value producers and deliver to one of the larger, industrial, chicken production companies.

A1.11 UK

The case study of the United Kingdom (UK) consists of arable farming in the East of England. Agriculture is a major industry in the region, with the value of the output from farming in 2016 being £3.4 billion (DEFRA, 2016). The East of England is known as the UK's 'breadbasket' and is responsible for one third of the country's cereal production, as the climate and soils are well suited to growing cereals and other combinable crops. About half (54%) the agricultural land in the East of England is used for growing cereal crops, such as wheat and barley, for both human and animal consumption (DEFRA, 2016), with a further 29% classed as general cropping. Wheat is milled to produce flour, while barley is mainly grown for brewing beer. Sugar beet is grown in rotation with cereals with the area producing more than two thirds of England's sugar beet crop. Other crops such as carrots, potatoes, oilseed rape, fruit, salad crops and pulses are also grown. The region is also important for pig and poultry farms.

More than 40,000 people work directly in the farming sector in the region (DEFRA, 2016), plus indirect employment both upstream and downstream of the farm. The average farm size in the East of England is 116 ha (in 2016), compared to the national average of 85 ha (DEFRA, 2016). In the last ten years the size of farms grew considerably as the number of farming businesses decreased by more than 40% while the farmland surface area remained the same. Average farm business incomes in 2016/17 were £45,900 for cereals and £63,000 for general cropping (DEFRA, 2016).

In Deliverable 3.1 - Bijttebier et al. (2018) of the SURE Farm project three main farm types have been identified:

- TFT1: Cereals – tend to be larger farm size (in terms of area) than horticulture. Increasingly arable farms also may have other small-scale specializations in sheep or cows to provide manure (or they will collaborate with a neighbouring livestock/dairy farm to supply feed in return for manure). Intensive in work load through July-November and will bring in labour during this period. Diversification is likely, often in the form of renting out building for other business use and, increasingly, green energy.

- TFT2: General cropping (largely root crops, sugar beet) – tend to be larger farm size (in terms of area) than horticulture but slightly smaller than cereals. Often growing a wide range of crops and employing more labour throughout the year than cereals. Diversification is likely, often in the form of farm shops, although income from diversification likely to be lower than cereals in terms of their economic outputs.

- TFT3: Horticulture – less land area than cereals or general cropping but high economic output per hectare. Often owner-occupiers, but also tenanted. Could be smaller family farms, or larger corporate businesses. Highly specialized even within horticulture (e.g. may

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specialize in growing apples for cider; or glasshouse soft fruits), and unlikely to have other farming activities present. Diversification activities likely, such as a farm shop.

Within each of these farm types, there will be a wide range of farm sizes in terms of land area, ownership type and tenure. For example, this may range from part-time farms which are supported by off-farm income or diversified income on the farm; through to very large businesses employing lots of people producing economic outputs.

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Appendix 2: Interview guide

Objectives

1. To identify what environmental, social and economic factors (risks) farmers identify that are likely to impact them in the near or distant future.
2. To explore the coping or adapting strategies farming adopt when dealing with change (farm 'stories').
3. To identify what sources of knowledge and information farmers draw on when making on-farm decisions in the context of risk management.

Section 1: Farm characteristics and risk perceptions: This section aims to gather general information about the farm business and farm characteristics, alongside identification of the main risks that are perceived by farmers.

1. To start with, can you tell me about the farm business, such as the current main activities?
    - Specialisation
    - Farm performance
    - Size
    - Who owns the land and assets? [owner occupier, tenant, contract]
    - Management of farm [family, partnership, corporate etc.]
    - What is your role? How long in this role? Family history of farming?
    - Have you diversified into any other activities? [e.g. livery, office lets, farm shop]

2. What type of risks do you have to manage?
    - [economic – price drops, food safety, interest rates; exchange rates; environmental – weather, climate, pests; societal – consumer demand, consumer view of farming, demographic; institutional – policy etc]
    - What sort of risks are you most concerned about?
    - What are the most frequent?
    - Do you feel well equipped to deal with these risks?

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Section 2: Risk management and coping strategies: This section aims to gather farmers' 'stories' about how they experience and respond to the risks identified in Part 1, in terms of how they cope with challenges or adapt to change.

3. Can you tell me something about the history of the farm business, especially thinking about when you have had to cope with challenges or have undertaken change? [change can be in crops grown / use of technology / investment / ownership / management structure…]
    - What were the challenges being faced?
    - How did you cope with this?
    - If you undertook change in your business, why did the change take place?
    - What prompted the decision?
    - How did you implement the change? All at once or did you try it out first?
    - Who did you talk to or where did you go for information to decide what to do? [other farmers, agronomist, family etc.]
    - Did you look for new sources of information, alongside your existing network?
    - What sort of information did these sources provide you with and how did that help you to decide what to do?
    - Did you encounter any barriers to implementing the change? [policy, financial, environmental, technical, human]

4. What about now, are any major changes about to take place?
    - If so, why and how long has the farm business been in this situation?
    - What are the motivations for your decision to make a change? [e.g. changes in family situation?]
    - Have you considered other possibilities? Why didn't you choose one of those?
    - Who are you talking to or where are you learning about the best way to implement the change? [Why do you talk to/go to these sources?]

Section 3: Networks of influence maps: This part of the interview aims to identify the networks of influence that inform farmers' decision-making.

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<u>Note to interviewer</u>: Ask the respondent to write down on Post-It notes all the sources of information that are influential in their farm decision-making on a day-to-day basis (these can be both positive and negative influences). Ask them to place each Post-It note on the influence map (circular grid – see Fig. 1) from those they feel have the most influence on their decisions in the centre to those with least influence towards the outside. Table 1 provides a list of possible influencers – show this to the respondent after they have completed their influence map to check if they have missed any. Record (photograph) the resulting map. As the respondent works through the exercise, ask the following questions:

5. Reflecting on the sources of information in the centre of the grid, why do you feel these have the most influence on your decision making?
6. Why do those on the outside have the least influence?
7. Which of these individuals or institutions are likely to most influence your views and beliefs? And which are likely to most influence your behaviour and actions? [positive & negative]
8. Which of these influencers do you trust most and least? How do you feel about the influencers on the outside of your network?

<u>Note to interviewer</u>: Ask the respondent to reflect back to the time they were undertaking a change on the farm. This may involve moving some influencers, removing some and adding others. If there is no clear 'change' for the respondent to reflect on, ask them whether the information sources have changed over the past 10 or 20 years. Ask why they think some sources of information have become more influential and others less. Record (photograph) this second map.

9. Are there any potential useful sources of information or networks that you don't have access to, but would like to?
10. Is there anything else you would like to add?

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Table 1: Possible influencers on farm decision-making (adapted from Oreszczyn et al. 2010)

Individual influencers	Accountant Agronomist Bank manager Business Advisors Business partner Contractors Employees Family members Farmers abroad Farm owner(s) (where applicable) Farmers' merchants Farming neighbours Contacts at research organisations Individuals from seed companies Solicitor Wife/husband/partner
Influential organisations	AHDB The Arable Group Business Associations (e.g. CLA) Buying group Defra Discussion group Environmental/landscape agencies e.g. (Natural England, Environment Agency) Environmental lobby groups working with farmers (e.g. Game conservancy, RSPB) EU Farming and Wildlife Advisory Group (FWAG) Health and Safety Executive Land agents Local council National Farmers Union (NFU) (National and local) National Institute of Agricultural Botany NGOs (Friends of the Earth, Greenpeace, etc.) Public Research institutes (e.g. Rothamsted Research, John Inness Centre, etc.) Royal Agricultural Society of England Seed companies Specialist niche cropping companies (for those growing specialist crops)

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	Supermarkets Cooperative Producers Organization Traders/wholesalers
Other	Farming press Internet Local community Media Social media
Significant historical changes	Eg. In UK: MAFF change to Defra Privatisation of ADAS

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Appendix 3: Recruitment of respondents in each case study

A3.1 Belgium

For the recruitment of respondents who were/are active in a knowledge network or learning platform, we used the network that ILVO has built up throughout the years by being involved in multiple research projects. This means that five out of 13 respondents were approached directly, not via gatekeepers. We addressed one participant personally because he is the chairman of the Belgian dairy committee (he is known because sometimes he acts as a spokesman for dairy farmers in the media). The recruitment of 'solitary' farmers was cumbersome. We included one contact in the sample - a farmer who had formally been involved in an ILVO project some years ago, but who had never attended the meetings for this project, and therefore played a very passive role. Furthermore, an invitation to participate to this study was sent to all farmers who participated the first FoPIA-SureFarm-workshop that took place on 27th of November. Two farmers responded on this e-mail and were prepared to take part in an additional individual interview for the learning capacity task. The last four farmers were gathered with the help of a gatekeeper. These four interviews also feed into SureFarm Task 4.3: Bottom-up policy analysis. The recruitment conditions for this task requested a sub-sample of four farmers, with a different personal profile that are exposed to the same regional policy regulations. These conditions were compatible with the learning capacity sample guidelines. The gatekeeper was a civil servant and a member of the local council of the municipality Voeren.

A2.2 Bulgaria

Six learning capacity interviews were conducted between June-July (August) 2018, involving three researchers (one of the researchers has been part of the team at that time conducting the interviews but she did not participate in the summary and analyses; the second is a junior researcher who left that position after December 2018) and next three interviews were conducted in December 2018 by one researcher. Participants' selection and recruitment was done mainly in cooperation of regional offices of Ministry of Agriculture, Food and Forestry (in particular Regional Directorate "Agriculture" in every visited district). For the second round of interviews the team has been supported by the regional offices of National Agricultural Advisory Services and personal contacts from team's members (experts, who are working in the agriculture sector as consultants and trade representatives). All the appropriate respondents were identified and preliminarily contacted by the experts from these offices. The mediators had the key role in arranging the interviews. In regard to the recruitment procedure it is not realistic to expect any answer without a mediator, even if it is a representative of an institution or of a private company. Usually, farmers do not answer to calls and e-mails by unknown people. However, due to the approach we undertook, we managed to meet all contacted farmers and we were greeted well. Interviews ranged from 45 minutes to 1 hour 33 minutes.

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A2.3 France

In October and November 2018, we asked our local partners (agricultural chambers, producers' organisation etc.) to send us some farmers' details, in order to build a list of farmers likely to answer a survey about risk management. We used this list for these qualitative interviews but also for the quantitative survey. We contacted all the farmers on this list, whether for the qualitative or the quantitative.

From November 2018 to February 2019, we conducted 8 physical interviews: we did a first round of 5 interviews in December, followed by a second round in January-February (2 interviews). This second round happened to take place during the calving period, consequently farmers were almost not available due to the activity peak, which explains this lower number of interviews.

Interviews were conducted by an engineer of the French livestock Institute specifically trained to conduct semi directive interviews (Elodie Dolléans) and they were analyzed by her and her colleague Delphine Neumeister. Both work for the department "farmworks and society", which has developed an expertise in qualitative surveys.

A2.4 Germany

Twelve learning capacity interviews were conducted between June and December 2018, which involved four researchers undertaking the interviews. Interviews 1 – 5 were conducted jointly by Florian Heinrich and Konstantin Klein, interview 6 was done by Konstantin Klein and Christine Pitson, interview 7 by Konstantin Klein and Hendrik Daskiewicz, and interviews 8 – 12 completed solely by Hendrik Daskiewicz.

Personal connections of Franziska Appel, Florian Heinrich, and Konstantin Klein secured four of the interviews. There was an attempt to snowball, but respondents and potential gatekeepers were reluctant to make direct contact with other farmers. Therefore the other eight interviews were secured by google searches of farms in the region which fit the farm typology, emailing the farms, and then following up with phone calls. Interviews one and three fall outside the case study, as they are not corporate; but otherwise fit into the large-scale arable category.

A2.5 Italy

We performed 12 interviews, within the period June 2018 – February 2019. Three researchers and one master student were involved in the task. We started interviewing one young farmer, who showed a very positive attitude towards the Project and its objectives during a previous interview performed. A total of seven interviewees were involved already in different project-related interviews, three in the demographic and four in the biographical interviews, respectively. They were chosen based on their story, involvement in the farm management, and farm's characteristics.

The snowball procedure was applied to recruit the remaining respondents, trying to build up a heterogeneous sample of farmers (e.g., innovative young farmers, retired farmers, organic

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producers, large farmers, diversified farms). All respondents were contacted directly by phone, and all those we approached were interviewed successfully. Interviews took place at the University of Tuscia, whereas two interview were performed at the respondent's farm. Interviews ranged from 45 minutes to 1 hour and a half, approximately.

A2.6 Netherlands

All interviews were conducted by Thomas Slijper. We conducted 5 learning capacity interviews in June-July 2018. Contacts with LTO (Dutch Farmers Union) resulted in no participants. Three other gatekeepers were contacted to secure participant recruitment. NAJK Oldambt (Dutch Young Farmers Organisation), Innovatie Veenkoloniën (local agricultural innovation fund), and Veldleeuwerikgroep (sustainability study club) were contacted and provided us with a list of email addresses. Approximately 30 farmers have been contacted via email, followed up by phone calls. We conducted 5 learning capacity interviews in November-December 2018. VeKaBo (Vereniging voor Kampeer Boeren), the association of farmers with a Bed and Breakfast or camping provided us with contact details of 10 arable farmers (including some farmers without any recreational facilities on their farm). These farmers were contacted by e-mail, followed up by phone calls. This yielded one respondent. The other farmers were recruited using Twitter (sending them a personal message) or farmers' personal websites (e-mail, followed up by phone calls). It should be noted that there was a drought in the Netherlands in summer 2018. Some of the interviews were conducted in May/June (before the drought), with others undertaken in November/December (after the drought). This may have influenced farmers' responses.

A2.7 Poland

Nine learning capacity interviews were conducted within the period 8 May - 14 November 2018. All interviews were conducted by one researcher. In order to identify appropriate respondents the gatekeeper method was applied. For Poland, the gatekeeper was the president of the National Union of Groups of Fruit and Vegetables, who recommended to contact specific producers' groups, among others: "Kalgrup Ltd – A group of fruit and vegetable producers" and "SAD-POL - A group of fruit producers". After telephone and personal interviews with representatives of producers' groups, the list over 50 potential respondents was drawn up. Only responders who agreed to interview in a given period of time were chosen. Interviews were conducted at farms and ranged from 29 minutes to 1 hour 27 minutes.

A2.8 Romania

In the Romanian case study 14 learning interviews were conducted in 2 rounds. The first round included 8 interviews conducted in June and July 2018, and the second round included 6 interviews conducted in December 2018 and January 2019 by 6 researchers from Iași (the largest municipality in the Nord-Est region in Romania). The researchers have been selected to conduct the interviews due to their extended knowledge of the region and previous collaboration with many farmers in the region.

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The selection was based on the farm size and profile (small family farm – mixed activities), entrepreneurship abilities and demographic characteristics (young new entrant, active farmer, low active – retiring farmer, potential successor). For several interviews the local authorities (the village hall) and local consultants were contacted, they were presented the project, and asked to provide a list of potential respondents.

The initial list included 15 possible respondents. The farmers were contacted by phone. In some cases, a preliminary meeting (face to face) was necessary in order to present them the project, their future contribution, and obtain (or not) their agreement for interviews. At the same time, agreements were made upon the date, time and location of the interviews. In mid-July, one potential respondent opted out. Two respondents undertook both learning and demographic interviews.

A2.9 Spain

Fourteen participants have taken part in 13 interviews. In one case, an interview has been conducted jointly with the farmer and his son. We approached the recruitment through the support of our 'gatekeepers'; the Regional Agricultural Delegation of Huesca and Comunidad de Madrid. We presented the objective of the interviews to our gatekeepers, regarding the exploration of farmers' learning and knowledge networks, and the selection criteria in terms of age, gender and involvement/non-involvement in existing knowledge networks or learning platforms. Based on our requests, the agricultural delegations provided us with a list of appropriate and congruent respondents.

The UPM research team selected the participants from the list to ensure as much diversity as possible and communicated their selection to the gatekeepers. They made the first contact with the famers in order to verify their willingness to participate. Once participants consented, the research team contacted them directly by telephone, explaining the research and arranging all of the dates.

Interviews have been conducted two times by three interviewers (a researcher, a PhD student and a master student). The first 8 interviews were conducted between the 5th and 20th of June 2018, whereas the last 6 interviews were conducted between the 23th and the 24th of October 2018. In most of the cases, the researchers conducted the interviews in the farmer's house/farm, while in three cases participants were interviewed in the Provincial Agricultural Department or in the Agricultural Association office. Interviews ranged from 50 minutes to 1 hour 30 minutes. Informed consent forms have been signed in every interview.

A2.10 Sweden

A total of six learning capacity interviews were conducted during July and August 2018, involving two researchers. The selected informants were also part of the biographical narrative task and each farm visit started with completing that interview, followed by the learning capacity narrative and mapping exercise. The respondents were chosen mainly based on the guidelines for the biographical narratives, with the focus of covering early, mid and late stage farmers. We made

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sure that at least one informant of each stage was included, as well as both men and women. One of the informants was recruited using a gatekeeper at one of the packing companies, others were selected based on information available at the official websites of the large processing companies. Invitations were sent via letters and follow up phone calls were made that confirmed four out of six learning capacity interviews. Another two respondents were booked at a later stage, but also these followed the structure of the previous interviews. The learning capacity narratives and mapping all lasted about 1 hour ± 10 minutes.

In addition, a second round of interviews were incorporated into the learning capacity task. These consisted of 6 interviews from the demographic analysis and were chosen purposively to cover a good range of respondents in terms of age, gender, stage of farming and farming system (egg or broiler chicken).

Some of the information asked for in the interview guide were revealed in the informal chats before the formal interview started. In these cases we did not, out of courtesy, ask for the information again, but noted it down to include it in the analysis. This means that the importance of certain topics covered in the discussion below are not always reflected in the code tree table. For the six first interviews conducted, a narrative interview was conducted before the learning capacity interview. We did not ask again in the learning capacity interviews about information that had already been given to us in the narrative interviews. However, this information was incorporated into the analysis and the discussion part of this report.

A2.11 UK

Eighteen interviews were conducted with farmers in the UK case study between May-July 2018. Interviews were conducted by four researchers: Julie Urquhart [7], Rob Berry [6], Damian Maye [3] and Paul Courtney [2]. Six respondents were recruited via a gatekeeper, the AHDB knowledge exchange manager for the region. In addition, a mailshot sent to 100 farmers secured a further 11 respondents (contact details were drawn from an online publicly available database of farms), and 1 was recruited via a Twitter campaign. All interviews were conducted face to face. Interviews ranged from 35 minutes to 1 hr 44 minutes. Recruitment was challenging as the period of data collection was at the beginning of the growing season for arable farmers.

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Appendix 4: Common codebook

Level 1	Level 2	Level 3 (Axial codes) - examples	Level 4 (Open codes) - examples	Description
Risk & Challenges				Sub-nodes include the risks identified in Q2 and the challenges identified in Q3
	Environmental		Environmental impacts of farming; Pests and diseases; Pollution; Soil health; Weather	Sub-nodes include environmental risks and challenges identified, such as extreme weather events, pests and diseases, soil health etc.
	Economic		Availability of funding; Cash flow; Exchange rates; High level of debt; Investment in machinery; Consumer preferences; Volatility in grain prices; Changes in input availability; Changes upstream that have a direct impact on farm	Sub-nodes include financial risks such as cash flow, debt, cost of machinery, business profitability, exchange rates etc. and market risks such as volatiliy in grain prices, influence of consumer/customer preferences etc.
	Institutional		CAP reform; National policy; Environmental policy; Plant protection product policy; Bureaucracy; Planning permission; GM regulations	Sub-nodes relate to institutional challenges that impact the farm either directly or indirectly, such as policy, regulation, bureaucracy

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	Technological		Keeping up with new technology; Too much reliance on new technology	Sub-nodes include reference to the difficulty of keeping up with new technology, over-reliance on technology etc.
	Labour		Availability of labour; Increased labour costs; Intensive labour requirement for dairy; Older staff learning about new technology; Retirement of longterm employees	Sub-nodes that refer to labour-related risks, such as availability of labour, ageing workforce, labour costs etc.
	Organisational structure of farm		Land prices; Tenure; Risk of being too small	Sub-nodes that refer to the organisational structure of the farm, including tenure, land price, security in land ownership, farm size etc.
	Succession		Willingness (or not) of incumbent farmer to hand over decision-making responsibility to incoming farmer; Inheritance tax; Multiple inheritors; Planning (or not) for succession; Uncertainty about successor	Sub-nodes that relate to issues around succession, such as preferences of successors, certainty or uncertainty about succession, issues around handling management responsibility from incumbent to incoming farmer, inheritance issues etc.

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	Personal		Dealing with stress; Isolation	Sub-nodes that relate to personal issues such as illness, mental health, loss of family member, family relationships etc.
	Risk of the unknown			References to the uncertainties associated with farming in the future, and unknown risks that cannot be prepared for.
Triggers of change				Sub-nodes include factors mentioned by respondents that triggered a change in their behaviour or beliefs, such as policy changes, health issues, personal interests etc.
	Environmental		Increase in pests and diseases; Extreme weather	Sub-nodes include environmental factors that triggered a change, such as extreme weather, climate change, pests and diseases etc.
	Economic		Drop in grain prices; Increased input prices; Interest rates; Exchange rates; High level of debt	Sub-nodes relate to economic triggers of change such as drop in commodity prices, interest rates, exchange rates, increased input prices.

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	Institutional		CAP reform; Glyphosate regulation; Neonics regulation.	Sub-nodes include institutional factors that trigger a change such as CAP reform, Brexit, new regulations etc.
	Technological		Availability of new technology; Cost of machinery	Sub-nodes that relate to technological triggers for change such as cost of machinery, availability of new technology
	Labour		Availability of labour; Increased labour costs; Intensive labour requirement for dairy; Retirement of longterm employees	Sub-nodes include factors associated with labour that trigger change such as access (or not) to labour, cost of labour, age of staff etc.
	Organisational structure of farm		Land prices; Tenure change; Farm size	Sub-nodes that refer to structural triggers such as changes in land prices, tenure arrangements or farm size
	Succession		Retirement of incumbant farmer; Incoming farmer having new ideas; Inheritance tax; Multiple inheritors	Sub-nodes that include factors related to succession that trigger change such as retirement of incumbant farmer, incoming farmer having different ideas, inhertance issues etc.

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	Personal		Death of family member; Illness; Mental health issues; Personal belief in stewardship of the land; Lifestyle choice; Personal interest	Sub-nodes that relate to personal factors that prompted a change, such as illness, death, health issues, family relationships, personal beliefs etc.
Risk management strategies				Sub-nodes include strategies for risk management, such as cooperation, diversification, debt reduction, spreading risk etc.
	Ensuring a stable financial basis	Reducing debt enables farms to be more resilient to economic risks	Maintaining savings for hard times; Reducing debt; Not taking on further/any loans; agricultural insurance; reducing costs of production; Subsidies or grants	Sub-nodes relating to how farmer manages finances to be better able to deal with economic risks.
	Investing in technology to control environmental risks	Technology as a useful tool for mitigating the impacts of environmental hazards; use of plant protection products	Irrigation; hail nets; plant protection products	Sub-nodes that refer to investments in technology (or not) as environmental risk mangement strategies

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	Flexibility	Ensuring flexibility in how the business is organised provides buffer capacity; Using less inputs saves money and reduces the impact of fluctuating input price	Renting land instead of buying; Temporary labour contracts instead of permanent; Flexibility in timing of production to deal with seasonality; Adjusting agricultural practices;	Sub-nodes that refer to strategies that demonstrate flexibility to adjust the business in the face of shocks or stresses
	Cooperation	Sharing costs with others reduces financial commitments	Cost sharing; Equipment sharing; Member of cooperatives, PO or credit union; Peer to peer learning; Partnerships	Sub-nodes that refer to cooperating with others as a risk mangement strategy
	Spreading risk	Having off-farm income increases the ability of the farm to withstand economic shocks; Diversification of income streams prvoides stability for uncertainty in the grain market	Mixed livestock & crop farming; combining several crops or animals; non-agricultural diversification such as agri-tourism, on-farm sales, renewable energy, office lets, public farm visits; Future selling part of production; Having an off-farm job; Developig new markets	Sub-nodes that refer to spreading risk as a risk management strategy

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	Intensification / extensification	Intensification improves farm efficiency	Intensification; extensification	Sub-nodes that refer to intensification or extensification as a risk management strategy
	Succession planning	Having a succession plan reduces financial risks during farm transition	Retirement planning; Making provision for non-farming inheritors	Sub-nodes that relate to succession planning as a risk management strategy
Learning processes/strategies				
	Experimentation	Experimenting with new things on the farm gives confidence to adapt farming activities	Experimentation and trying out new things; implementing change a little at a time	Sub-nodes relating to experimentation or trying out new things on the farm
	Being open to new ideas	Being open to new ideas fosters learning	Engagement with new technology; changing attitude towards farming; seeking out new ideas	Sub-nodes that demonstrate an openness to new ideas and ways of thinking

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	Learning from others	Involvement in a supportive social network fosters learning	Farmer discussion groups provide a forum for sharing ideas and experiences; Trusted farming friends as valued advisers; Social media as an important source of information; Family support is important when considering change	Sub-nodes that relate to learning from others
	Learning new skills	Learning how to use new technology provides confidence adapt farming activities	Going on training courses; Learning how to use new technology; Learning about alterative ways of farming	Sub-nodes that relate to learning new skills
	Seeking out information	The ability to seek out information is important for learning how to adapt	Internet searches; Researching new ideas	Sub-nodes that refer to seeking out information and knowledge
	Ability to be flexible	Being locked into a way of operating restrains ability to learn about different ways of working	Locked into a way of operating	Sub-nodes that refer to having a flexible approach enables learning

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	Reflexivity	Learning from one's own experiences enable farmers to respond to challenges	Reflecting on how to do things better; learning from past mistakes/successes	Sub-nodes that refer to the ability to reflect and assess what works well and what doesn't
Influencers on learning				Sub-nodes include cognitive & affective factors, external influences and networks of influence.
	Cognitive & affective factors	Approach to risk-taking influences willingness to try out new ideas	Attitudes; Attitudes to risk; Beliefs; Trust; Self-identity; Values	Sub-nodes include farmer attitudes, beliefs, perceptions, subjective norms, values, self-identity, etc that may influence decision-making and learning
	External influences	Policy sets the boundaries for decision-making possibilities; economic drivers of learning	Access to technology; Regulatory restrictions; Policy change; Family crisis; Environmental limits; levels of debt	Sub-nodes include external factors that may influence decision-making, such as policy, institional and regulatory structures, access to technology, human & financial capital, health or family crisis
	Networks of influence	Influencers who are more trusted are most likely to	Family; advisers; farming neighbours; social media; government agencies etc.	Influencers on decision making from the influence map exercise

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		impact on decision-making		
Learning outcomes				Sub-nodes that identify learning outcomes such as change in values/beliefs or change in behaviour, and the impacts on resilience
	Change in beliefs/values	Learning leading to increased environmental awareness	Increased environmental awareness changes attitude towards farmer role as environmental steward; Learning about conservation agricultural leading to improved knowledge about soil health; Talking to no till farmers influences understanding of soil health	Sub-nodes that relate to how learning has resulted in a change in beliefs, attitudes or values
	Change in behaviour	Learning can lead to a change in behaviour	Improved knowledge about soil health leading to a transition to no till; Observing other farmers leading to changed practices	Sub-nodes that relate to how learning has resulted in a change in behaviour

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	Impacts on resilience		Learning than enhances robustness, adaptability and transformability	Sub-codes that identify how learning outcomes may translate into enhanced system resilience through real-world changes in behaviour or values

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Appendix 5: Belgium Country Report

A5.1 Who/what are the most important influencers on farmer decision-making, and why?

Based the number of sources (respondents mentioning certain topics), as showed in table 1, we can derive that the most occurring factors of influence on processes of learning and decision making for the Flemish interview sample, were: farmers' own knowledge, experiences, personal interests, reflexivity, attitudes, beliefs and trust; veterinarian; family members; regulatory restrictions; accountants; bank managers; advisers and consultants; land owners; (farming) neighbours or (farming) friends; local community; price volatility of and low output prices; levels of debt; cooperative structure and working; concerns about famers' family well-being; CAP, regional and national policies (especially manure and environmental policy); land market system and uncertainty of land availability.

Feed sellers, bank managers and other suppliers are the least trusted by the respondents, but their degree of influence varies according to the specific situation. Agricultural magazines, farming press and the internet, as well as specific social media channels (e.g. dairy farmers' facebook groups) are sources of information that are consulted on a regular base by most of our respondents. The veterinarian is usually the first person they call when in doubt about the health condition of the cows.

It was striking that all respondents talked about one specific person they trust and on which they invoke for daily on-farm decisions. This 'first point of contact' could be a family member for some respondents, or a specific adviser, the veterinarian, a consultant or an accountant for other respondents. The common feature about this 'first point of contact' was not the type of the relationship, but the degree on which the respondents rely on this person and the fact that they are in contact on a regular base. In all cases, the trust relation was based on recurring contact moments (mostly frequent farm visits by the person) and the fact that the respondent is convinced about the independency of this person (e.g. the conviction that this person is not someone who is striving to sell something to the farmer, but who is in an authentic way advising the farmer on why to do things in certain ways or why to (not) make certain decisions. It is mostly someone who frequently physically visits the farm and with whom the respondents can also talk about private stuff. We therefore argue that the recurrent meetings shape some sort of connection between the respondent and the 'first point of contact', which induces strong feelings of trust, which makes the respondent take the opinion of this person into consideration when thinking of an important decision. However, in some cases, the respondents name other key factors when they start talking about a major change they have implemented or they even state that this 'first point of contact' was a less influencing source for that specific decision, while he/she is the main source of influence in daily decision making.

LCI_4: *"**And why is it that your veterinarian is positioned central on the grid?** He is the first point of contact for problems with the cows, he is the first person you call. He is also the person who comes most frequently here and to whom you tell about your private life. You build a bond with him, it*

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used to be the bank manager but now he is not coming anymore to visit the farm, that's the difference. Nowadays, he only comes if we need a loan."

Generally, it is remarkable that policy mainly has a restrictive or obstructing character. The most occurring negative factors of influence were national, regional, European, manure and environmental legislation. Only in some cases, very specific regulations enabled very specific on-farm changes. The degree of influence varied from making the farmer's life harder by tedious administrator obligations to literally obstructing the farmer to implement a specific change. For example, some specific national environmental regulations can literally prevent the farmer to expand his farm because of its geographic position and thus influencing the farmer's decision making in a very direct and determinant way; while other environmental policies are another factor that, on top of other more important factors, shape the final decision of the farmer. Likewise, high land prices and uncertainty about future land use as a result of the Belgian land market system is a topic brought up by most of the respondents, but it situates more in the outer sphere of influence. It seems like farmers are aware of this risk, but this factor only has a direct impact in very specific situations. For both topics (policy and land), it seems like the farmers are frustrated because they feel like policy makers can change the situation, but they are making the wrong decisions in the farmer's eyes, but the farmer himself has a low amount of control on this.

Furthermore, it seems like the positioning of parents and children relates to the phase of the succession cycle the respondent is in. We noticed that younger farmers tend to put family members further on the grid as opposed to mid- and late-career farmers; who tend to immediately name the close family members after the exercise was explained. Also, the presence of a potential successor (or not) influences the farmer's decision making.

LCI_12: *"I have to note my son and my wife first. They have the most influence on it. And then the policy on the second circle. No, I'm going to put it on the third. Because the cooperative has a lot of influence, so it comes second. If you would have asked me this question ten years ago, it would be totally different* [replacing the cards while talking, then putting them back]*, then I would have positioned it the other way around.* ***That is the next question, you are too fast (laughter).*** *But that's because, I am always thinking a lot about it, that's why, it is not a cliché I am telling you. It is because of all the experience that I have built up. But how come that 10 years ago, your wife and son and even yourself would be further compared to the cooperative and the policy? Because we have been through so much together. Every year, a new regulation came. Then the manure, then we need to do this and that. (…) And every time there came a new policy that was again limiting what you may do, it was really an obstruction. It felt like an obstacle to us. Now that we are organic, we experience less such problems. (…) But the policy stays limiting for me. It are now more adminstrational problems that I find tedious. But not really the legislation anymore."*

Season and weather (forecast) are not named by all farmers, but if they do include it on the map, they place it close to the centre. This can be associated with the importance of seasonality on the production of forage crops.

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A5.2 Do these influencers change over time in relation to different decisions/risk management?

First of all, we want to emphasize the case specificity that is of key importance while analysing the results from the influence mapping exercise. For some respondents, profound rearrangements were made on the grid, while other respondents just added or removed one (or a couple of) cards. This is somehow linked to the nature of change they talked about. Some farmers talked about their conversion to organic production, which has a high impact on the surrounding influencing network. Other farmers changed more gradually, and reflected on how their network of influence changed over the years. Nevertheless, we try to describe some patterns that were observed below.

When the respondent chose to consider a key turning point or major on-farm change that featured the decision of whether or not to make a significant investment and/or taking up a loan, actors with specific advisory functions appeared in the map or moved towards the centre of the map; among which bank managers (they decide whether or not the farmer gets a loan, based on the business profile), business advisers, accountants and other specific consultants (e.g. a researcher specialised in how farm equipment can improve animal health and well-being).

As discussed in the previous section, the specific trust person can change over the years, especially when implementing change on the farm. The change in predominant trust person can occur in a rather abrupt way (e.g. LCI_12 who met this inspiring researcher who played a key role in the transition towards organic farming and with whom he still has close contact now) or can simply be the effect of a slow shift in number of meetings. Various factors can induce more frequent meetings with a new person and diminishing meetings with the former trusted contact person. Likewise, such key changes in the farmer's network can have multiple causes, varying from quarrels, over changing circumstances, over changing attitudes and beliefs of the respondent, to loss of trust due to specific events the farmer came across.

When the decision is about scale enlargement or diversification of farming activities, the local community and/or non-farming neighbours appear in the decision map. It is thereby clear that farmers take public opinion into account when changing the core functions and/or changing the scale of their farm. More specifically, the support (or disapproval) of the local community appears to play an important role in farmer's decision making, especially when the business decision impacts the nearby residents in one way or another (e.g. by change in the landscape view, by frequency of transport by tractors, etc.). Similarly, when farmers consider buying (more) land, these stakeholders move into the grid because relations are playing an important role in farmer-to-farmer or farmer-to-landowner agreements. These relations are often a result of years of engagement of the farmer in the local community life.

Some respondents also named own knowledge and experience they have built up through the years, as well as the ability to be critical and reflect on your own behaviour, as an important factor while considering/implementing change on the farm. Older respondents also seem to be more at

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ease when talking about risk management, as if they are more confident that they will be able to manage a solution because of years of experience.

As opposed to what seems intuitively evident, not all farmers are actively searching for other information sources (e.g. specific literature/internet research) when considering change. It seems like some decisions are the result of changing attitudes/beliefs that slowly develop over time. In some cases, even unexpected meetings or unanticipated events could have triggered the change.

Furthermore, farming's portrayal in the media and/or concerns about public opinion and consumer preferences was named by some respondents as a factor that recently gained in importance. This illustrates that the results of the learning capacity interviews are also related to timing.

Drawing from the influence mapping exercise, we can conclude that relations with influencers do change over time and that both the relations itself, as well as the way they change, are very case-specific and thus very complex to describe in one generally applicable way.

A5.3 How do farmers' attitudes and beliefs influence their decision-making?

Attitude and beliefs towards scale enlargement and intensification: several of the respondents share the belief that scale enlargement and intensification are the only strategies to deal with lower margins. This belief has been institutionally supported for many years. Some farmers indicate that their decision to farm enlargement is driven by this belief. They see that many other farms are getting bigger and bigger, which convinces them this is the way forward.

LCI_13: "Nowadays, with 100 cows, you can't do anything"

Other respondents, however, do know examples where these large farms with new stables do have financial problems or where very high labour pressure prevents a good quality of life. These examples stimulate farmers to reflect on their own situation, on long standing convictions, or even to question current way of dairy farming in general. Some farmers just cannot longer identify themselves with their current way of producing. They are convinced that current way of dairy farming in Flanders is not sustainable. These farmers seem to be more open to new practices or strategies to do things differently. In their search, they are open to strategies and innovations that are not obvious and frequently applied by other farmers. They like to experiment with new things. One of the respondents said that he went to a meeting to learn about organic farming, but he didn't tell his father because he knew he would not understand and approve.

Some other respondents do acknowledge that these low margins and low milk prices, are not providing a good income (especially in relation to the amount of work), but they see no other way than accepting this situation.

LCI_8: "We as a farmer, we undergo it, and we make the best of it"

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These farmers are less proactive. They rather adapt their practices when new regulations prevent them from doing business as usual. As manure legislation is becoming more stringent year after year (as water quality is not improving enough), they wait (a little anxious and sceptical) until new regulation is there and then adapt. While other farmers are more proactive and try to anticipate on forthcoming regulations.

LCI_12: "So when 2015 came, I knew we were going to lose, so in 2011 I decided to converse to organic production"

One of the respondents has a lot of financial issues, with no clear idea how to deal with them. His motivation as a farmer was really low, just as job satisfaction. This farmer also had lost his interest to join farmers' networks, to read agricultural magazines and to learn in general. Another older farmer doesn't have to pay off any loan anymore, he didn't plan any major changes for the future. He just wanted to continue as it is. This might also impact his approach to learning and acquiring new knowledge.

Another factor that might impact learning is trust. Sometimes, farmers have a lack of trust in some people, especially advisors with a commercial function. They indicate to give less attention to information and knowledge of these people. One farmer indicates that this lack of trust in feed advisors, stimulated him to learn more on composition of rations, so he can trust on his own knowledge and capacities. Gaining trust in people might be accompanied with building a personal relationship with that person. One farmer indicates to rely on the opinion of the veterinarian, as he also feels connected with the veterinarian. He also shares and talks about his private life with the veterinarian.

Sometimes, farmers main motivation to join farmers' networks is to have social contact. Learning might be a secondary consequence, a kind of side effect, of joining this network. Some farmers like to experiment with unknown innovative practices, whereas others are more reluctant. One of the farmers associates experimentation and trying something new with making mistakes. Making mistakes, costs money, so one should continue doing in what he's good at.

A5.4 What external (to the farm) factors influence decision-making, and how?

Bank, financial institutions: decisions concerning investments are largely dependent on financial institutions. In the past, farmers could get a loan much easier. But since the bank crisis, the banks dare to refuse once they are convinced that the farmer will have difficulties to pay off his debts.

LCI_5: "The bank will come over to see what we want, what we can and may do. If the bank does not go along with our plans to invest, it will soon be over. Banks have a lot of decision power."

Economic conditions and especially volatility of milk prices: In periods with low milk prices farmers start thinking about how they can respond to this by adaptation of current practices. One respondent wanted to learn more on organic production and went to a meeting when there was a severe drop of the milk price. Other farmers are taking stock markets into account to decide when to purchase feed for the cows.

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Biophysical conditions of the region: biophysical conditions might impact decision making of farmers. Depending on soil type, certain crops are better or less suitable. For example in the Polders, mixed farms dominate the region, whereas in Antwerp specialised dairy farms are the domination farm type.

Land availability: insecurity on long term availability of land or potential opportunities to buy land in the neighbourhood, might also have an impact on farmers' decision making.

Public opinion and media: some farmers do indicate that public opinion has an impact on farm development.

LCI_5: "I can decide to keep the cows inside, but I feel that it is becoming more and more important to allow grazing."

Policy: new regulations might require or stimulate adaptation of farm practices (eg greening of the CAP results in adjusting crop rotation). After abolishment of quota, many farms have taken the step to scale enlargement. Upcoming new regulations/legislation also stimulates discussion within farmers networks. 'Are they in favour of the new regulation or rather against it? How will they cope with these new regulations?' Although policy might stimulate (obligate) farmers to change business as usual, farmers also perceive some regulations as impeding farm development. Some respondents want to respond to some challenges by adjusting practices, but do not feel supported by policy and regulations. A farmer states that very stringent regulations discourage the farmer to produce fresh milk or to invest in production of fresh milk, or on farm selling of dairy products. This farmer reproaches government to only stimulate the strategy of intensification and scale enlargement. CAP premiums are perceived as a false gift, as more and more conditions are needed in order to receive premiums.

A5.5 What are the key risks in your case study farming system, as identified by farmers?

Farmers didn't really give a clear definition of risk. Several respondents however, are less concerned about challenges of which they are convinced they cannot change them. They have no impact on these challenges, cannot control them, and nobody is responsible. This might explain why environmental challenges are viewed as far less constrictive compared to institutional and economic by the farmers of our sample. An example is 'extreme weather events'. Farmers do acknowledge this as a challenge, but less worry about it. Challenges that are linked to human activity (price volatility, consumer demand, policies), on the other hand, are more often source of frustration. Evolution of these challenges is often a big question mark, which makes it difficult to cope with them.

*"**So these are things that occur on a less frequent base, but, still, they are risks?*** LCI_2: *Yes, but you have no control at all on it. It crosses your path and you need to solve it.* ***So you are experiencing them differently?*** *Yes, that's the risk with nature. If there is a flood, then there is a flood, you now sometimes it happens an nobody can do anything about it, it's just the way it is. But the other types of risks, someone is in the ability to do something about it and that's why it frustrates me, because*

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the way it goes is not fair and not nice. ***So you can better cope with risks that nobody has control on?*** *Yes, I find them less tedious. You could say it is the challenge of a farmer to work with nature, that is part of the job."*

Changing European and Regional policies (11) . If farmers receive less subsidies, this might be a problem, especially for young farmers who often have a lot of debts.

LCI_4: *"A large part of debts is paid with subsidies from Europe".*

There is upcoming a more stringent manure legislation in Flanders as water quality in the region is still suboptimal. Farmers are concerned this might increase manure surplus in the region, making it more difficult to get rid of manure (increase of costs). Another respondent states that part of their land is recently named cultural heritage. It is still unclear what exact impacts this has for their farm activities, crops they can grow on that land, financial support they will get for the environmental efforts they offer. Different regulations are not always complementary. Also the complexity of legislation is perceived as a risk.

Volatility of milk price and milk crises (9) makes it difficult to pay debts, especially for young farmers. Dairy farmers in other countries have lower costs of production, making it hard for Belgian farmers to be competitive. This is a source of frustration for the farmer.

Input availability:

1. Feed (2): low access to organic feed, roughage of good quality is often hard to find (especially in years with bad weather conditions)

2. Labour availability and labour pressure (7): dairy farming is perceived as labour intensive, which might result in high labour pressure and make it hard to maintain a good life-work balance. It's not easy to find external labour force to help farmers on a structural basis. Temporary work force is available through specific organisations but the quality of these workers is perceived as unpredictable. Farmers indicate that they need to spend more and more time on administration and paper work. Different institutions should unite to make it more doable for the farmers. Recently, these working conditions are increasing the gap between farming and non-farming people and consequently also reducing the population of successors

3. Land availability (8): Competition for land – high land prices + low availability of land makes it difficult to acquire additional land. As land prices are very high, it is often too expensive to buy as a farmer. But if the land is rented, the owner of the land might change or he might decide to sell the land, which makes farmer insecure about land availability. Uncertainty about land availability has major implications on farmer's chances to develop his farm.

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4. Increasing and volatile input prices (3): These increasing input prices result in low margins.

High investments and capital intensive farms (7): Farmers often perceive an institutional pressure towards scale enlargement. Over the years, dairy farms in Flanders have become more and more capital intensive, which makes it difficult for a young farmer to take over the farm, especially when there are more children. Making high investments might result in an enormous financial burden due to high level of debts.

Changing societal demand (6): this results in changing consumer preferences, like more attention for animal welfare, climate change, environmental issues. This is also associated with farming's portrayal in the media. Some of them fear and believe they always end up being the 'bad guy' in the media. This might have a major emotional impact on farmers. One respondent states that he sometimes feels like he should be ashamed to be a farmer. These shifting consumer preferences might also be reflected in demands from buyers. Some respondents are convinced that demands from society are threatening farmers' profitability because they are more and more obliged by law or by purchasers to take these demands into account. But they feel these demands are not always compatible with modern farming practices.

Uncertainty on milk sales (5): Especially after removal of the quotum, milk production has increased over the last years. Overproduction of milk and increasing requirements from the buyer is a source of insecurity for some of the respondents. One respondent received recently a letter from the dairy processor (Friesland Campina). They will no longer purchase the milk, if the farmer doesn't meet specific obligations (e.g. 100% grazing). The producer organization has not enough power to negotiate this. Although most milk in Flanders is sold to a cooperation, farmers do fear that the cooperation will introduce increasing regulations on production techniques.

Succession (5): low succession rate in the region – multiple inheritors – more than one generation working together

Monopolization of feed suppliers and co-operatives (4). Power imbalance in the food chain and low bargaining position of farmers. Even farmers, in a cooperative structure, state that, in the end, they have nothing to say at all.

Extreme weather conditions (4): extreme weather might impact yield of maize and grassland, as main forage crops. One farmer states that he has not enough roughage this year due to extreme drought. Therefore, he needed to sell some of his cows.

Own health and well-being (4): Health problems might have a devastating impact both on the farm and on the family. LCI_3: *"What if something would happen to me?"*

Making the wrong investments (2): If farmers do large investments, they often repay the bank for many years (up to 20 years). They perceive these investments as: 'there is no way back'. These decisions have a long-term impact, and make the farmers sometimes doubt whether their decision of today will turn out to be the best decision in let's say 10 or 20 years.

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Animal diseases (1): one of the respondents buys young stock instead of breeding them on the farm, which increases risk on bringing in diseases.

Family farms (1): Farms are mainly depending on family labour. Arguments, disputes in the family (especially when multiple generations are involved), might have an impact on farm functioning.

Accidents (1): fire

A5.6 What learning strategies do farmers adopt for managing risk and adapting to change?

Agricultural education is a first approach to acquire farmer's skills and knowledge. Some of the farmers talk about their agricultural education. One respondent indicates not to have followed an agricultural education before taking over the farm from his parents. These first years as a farmer, he went to many initiatives to acquire agricultural skills. Another farmer states that agricultural education is not preparing future farmers for the real world:

LCI_2: *"That is the resilience they are currently missing in agricultural education, in the schools for agricultural studies. The bank manager tells you what you can do, the feed supplier calculates what you need to feed to your cows, consultancy companies come to tell you which bulls are best to use for insemination, (…). For all matters, there is at least someone who comes you to dictate what you should do, what's best for your farm. But in the end, you still need to do it yourself. It is not because everyone comes to your farm telling you what to do and why you need to buy stuff in order to survive. (…). But if you make sure that you don't have too much worries because you know you are able to take your own decisions, but that's something they don't teach you in farming school."*

In the fragment above, the respondent talks about how you can surround yourself by many advisors, so that in the end, you are not deciding yourself, but they will decide for you. But this respondent indicates he wants to make his own decisions, he wants to be independent. This is more or less told by other farmers. But this is often a process in which you are growing as a farmer to become more mature. To know when you should seek some expertise and which decisions you can take by yourself, is a learning process on itself.

A second important factor for improving farmer's skills and knowledge acquisition, is peer-to-peer learning, which is often mentioned by our respondents as a learning strategy. This type of learning can occur through farm visits, experimental fields, events organised by research centres or meetings organized by governmental institutions. Such organized info sessions can also enable farmers to prepare and inform then on future changes in the farming system. Some farmers learn from farmers in their neighbourhood, while several respondents also learn from farmers abroad to really come with innovative ideas.

LCI_12: *"Look, you don't need to re-invent the wheel. If you say: I want to make the best cheese of the region, then you need to look where the best cheese is currently made. And that's in France and in Swiss, that's a fact. How do these people make the best cheese? Using grass and hay. So what do we need to do in order to make tasty cheese? Grass and hay."*

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The fragment below is illustrating that social learning by participation in various discussion groups is perceived by farmers as a very efficient learning strategy:

LCI_12: *"Thus, when I went to a small cooperative, that had a totally different philosophy, for me it was a super challenge. I decided to immediately join the board of this cooperative. Because I had so many ideas to make it big. And I have built up a lot of experience and when I went to manifestations, a lot of farmers said 'you are wasting your time, do something else you fool. I did not waste my time at all. I am convinced that I have learned a lot and a lot of decisions thanks to those manifestations. If you are only working all the time and only listening to national farmer's organisations and what sellers come to tell you on your farm. Because you have no time, then you end up in some kind of state like everything they say is the only truth so one should only do it their way."*

Respondents who are members of a farmer's network declare that it is nice to try something out together. They often start with an innovative practice with more than one farmer. This way, they exchange experiences when trying out, to learn from each other's experiences. They exchange their main individual challenges and how they like to approach them on their own farm. By creating a group feeling (feeling connected, relatedness) they can push each other to hold on; like the network is creating support.

A next learning strategy that was observed in our sample, is experiential learning: some of the respondents indicate that they used to go much more to information events. But over the years, by doing it every day, they can trust on their own experience. To experiment, you need to have some space to enable experimentation. One respondent indicates that experimentation and trying out new things involves a major risk to make mistakes. Mistakes that might cost you something. Several other respondents enjoy to experiment, this experimentation contributes to job satisfaction. One of them always has a small financial buffer that he might use if some experiment costs him some money. He needs this to allow him this room to experiment. This farmer also looks for funds, subsidies that support initiatives for innovation and thus relies on specific governmental regulations. Likewise, other respondents give examples of failure and indicate indeed how hard it is to recover. One has bought a milking robot, but it didn't work for his farm. This didn't change his idea about experimentation. He is still is open to trying out new things. Another respondent converted to organic production, but he didn't find a buyer to pay the organic milk price. Eventually, he was forced to stop organic production. Experiential learning is built up slowly over the years, by experimentation among other things. It increases the farmer's independence, autonomy and ability to learn from past mistakes or successes. This enhances farmer's reflective behaviour.

Another crucial factor for managing change, is openness to new ideas. Some farmers are really driven to continuously improve their practice. One farmer has many visitors on his farm and their criticism or remarks does he use as an opportunity to change. Innovations and alternative practices are always considered as an alternative by this farmer. This factor is also linked to some key moments in the farming career. When a child wants to join the farm, farmers often have to

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think how they will provide an additional income. At this time, several respondents indicate this makes them think of how they will organize farm development; while some others, more at the end of their career, indicate they want to continue as it is. They don't plan any changes.

LCI_10: "At the time he left school, I thought, what are we going to do? Will we enlarge, or what will we do?"

Sometimes farmers are very used to a particular way of farming (eg. management of the animals, fertilization, weed management). They find it very difficult to switch this.

Relating to this level of openness, change in underlying values or attitudes is another factor that triggers change. One of the respondents indicate that some beliefs and attitudes towards farming practices is already learned at school.

LCI_12: "When you are growing beets, they told me you need to spray this and that. They never said: you can spray."

A5.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

Drawing on the interview and influence map data, we already discussed the appearance of a specific adviser or researcher for respondents who converted their farming practices into an alternative way of farming (e.g. organic farming). This illustrates that double-loop learning involves searching for new information by invoking on people that are viewed as experts or that have specific skills/competences that allow them to conduce the respondent in his/her learning process.

Time allocated for attending discussion groups, conferences or other events that involve information exchange appeared to be an important factor influencing both single-, double- and triple-loop learning. Intuitively, one could derive that dairy farmers that are experiencing very high work load and/or are very dependent on own- and family labour, would have no more time left to engage in such social learning behaviour. But from our sample, it seems like this is not the main determinant factor. Rather the respondent's character, interests, mental capital, motivation, entrepreneurial spirit and ability to manage a various job package is mirroring his social behaviour.

At the same time, other farmers, farming neighbours and/or farmer-colleagues tend to move closer or further on the grid, which was explained by the respondents as other farmers having a positive or negative impact on the final decision. This indicates that – depending on the respondent and the specific situation – farmers are likely to assess other farmers by observing them, asking them for their opinion, or having conversations in which they exchange knowledge. The way in which respondents are influenced by other farmers, mainly depends on their own character, social engagement, values and beliefs. Some respondents just observed other farmer's behaviour, reflect on it and draw conclusions from it, other respondents actively search for other farmer's opinions or experiences. For example, LCI_13 didn't include one of these 'other farmers' card in his map, but he talked about a neighbouring farmer who diversified with on-farm

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processing of ice-cream, noticing that his business was flourishing but immediately stating that you cannot compare it with his own situation, that he would never think of considering such an option.

In addition, some respondents even explicitly emphasized the importance of farmers getting in contact with non-farming people. LCI_11 declares in this context that he sees other farmers being convinced that they are the only hard working people on earth. With farmers becoming a smaller part of the total population, it is crucial that they are not feeling abandoned by society. We can conclude that it is important to enable farmers to get out of their bubble of isolation and connect with the local community. If we combine this knowledge with the observation that farmers' distrust in institutional support organisms is growing, we suggest that settings which enhance social learning, like on-farm demonstrations, should enable farmers to (a) learn from each other and (b) reflect on their own behaviour; the two strategies that were most observed (codes: '(Dis)ability to be flexible'; 'Being open to new ideas and eagerness to learn'; 'Learning from others'; 'Reflexivity') and appeared to be most effective in our sample.

In any case, it is clear that respondent's openness to alternatives and innovation play a key role in the learning strategies that farmers adopt. Respondents that showed to have the ability to put themselves in another one's perspective, seemed to be more likely to show symptoms of double- or triple-loop learning. For example, LCI_8 extensively analysed the issue of negative farming's portrayal in the media and changing consumer preferences and discussed the role of the farming community to counteract this tendency. Furthermore, respondents who showed to have a clear vision on the wider farming system (and how different factors of influence are intermingling in how they affect the specific farm situation) were able to better reflect on their own behaviour and assess why they made certain decisions, as opposed to respondents who constrained their story to their own situation.

A5.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

From the Flemish influence map data, it seems like farmers should get in contact with key persons with knowledge about specific topics in order to enable single-, double-, or triple-loop learning, and consequently implement strategies that relate to robustness, adaptability and transformability.

We want to emphasize the importance of farmers' attitudes to risk of particular challenges. For some of the challenges farmers are confronted with, part of the respondents make statements like *"I have to undergo it, it is beyond my power to do something about it."* This feeling of (dis)control is of course depending on the type of challenge. Respondents who are strongly convinced about their disability to cope with such challenges, tend to show coping strategies that relate to robustness. For example, to cope with price volatility, these type of respondents try to build up a buffer when prices are higher to compensate for the times when prices are really low. Likewise, when new legislation is upcoming, these farmers complain about it, but are obligated to adjust their practices to meet legislation and new regulations. Or if it is in their power, they will

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try to circumvent new regulations. In contrast, other respondents of our sample had a different attitude to these particular challenges. They do not accept them and try to seek for solutions to respond to it in an appropriate way. First, for the problem of price volatility, these farmers converted to organic production as they were promised to get a more stable milk price by doing this. Or they considered on-farm selling, or diversification towards e.g. meat production. Second, for coping with frequently changing legislation, let's take the example of LCI_12: he declares that by converting to organic, he no longer has to adapt every time to new regulations. Although he finds that there is a need for more specific legislation for organic farming, he explains that legislation is at least no longer directing him and this feeling of independency is clearly enabling him to continue his farming career. However, it needs to be noted that this attitude is the result of maturity, of years of experience. This is what LCI_12 says: *"In the beginning I listened to the advisors, to 'Boerenbond', as I was convinced they knew what was good for me. Now, nobody is coming on my farm anymore. I make my own decisions, I follow my own way."*

The latter relates to the observation that reflexivity is important for considering change. In what follows, some factors that stimulated reflection by our respondents are discussed. First of all, 'Being open to new ideas' was an important characteristic of farmers to induce reflection. We observed that farmers that were not only surrounded by like-minded people were more likely to start reflecting on how to do things differently. With other-minded people, we mean both other farmers as well as consumers and/or citizens. The respondent also needs to be able to make links between possible new strategies and the wide challenges they are confronted with. For example, LCI_12 saw something on the internet about 'foster cows' and is now trying it out with some of his own cows; in order to be able to, on a long-term base, answer to society's increasing concern about animal well-being. Additionally, the respondent needed to have some level of 'open-mindedness' in order to start considering alternative ways of farming.

Furthermore, farmers who are actively trying to know more about a potential change, are more likely to eventually implement the change. Joining discussion groups and farmers networks appeared to stimulate peer to peer learning. Such meetings allow farmers with different backgrounds to discuss and exchange knowledge (eventually in a practical, hands-on way). This can be achieved by, for example, going abroad: several of our respondents (including LCI_12, LCI_7 and LCI_2) have acquired new insights by visiting farmers in other countries. As these farmers often have practices that are very much different from their own, this stimulates reflection. This also stimulates having a systemic view on farm functioning and realizing that a profound change in the system is not impossible, but that the overall context should be considered.

Finally, it seems like family support (can be financial, can be mental support) is a very important enabling factor when a farmer is considering change. This is a rather obvious conclusion on Flemish farms, where family farming dominates the farming landscape.

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Appendix 6: Bulgaria Country Report

A6.1 Who/what are the most important influencers on farmer decision-making, and why?

The influential network consists of different actors in different position in regard to the value chain. For each farmer it depends also from the farmers' story. But the actors that are always mentioned are the family, friends, workers and representatives of the companies selling inputs, seeds and machineries, NGOs, namely:

1) family – usually father with whom the business has been started and sons and daughters when the farmer plan future succession of the farming business, wife/husband (even if there is no formal marriage, the partner, who is also a farmer is the main influencer). Most of the businesses are run by the family and all the decision are consulted within the family.

2) friends, who are working (sometimes not when we talk about moral support) in the agriculture sector – actually they are farmers but the farmer we interviewed are in closer personal relationships with them compared to the other farmers in the region.

3) agronomist and other workers with specific knowledge about different elements of the production process and machineries; the team of the managers in the companies where there are different branches developed.

4) agriculture consultants but also feedback from clients, novelties introduced on different events ("*The innovations come to us through the companies, big traders*.") as well as the opinions of the association members (Association of the agricultural producers in Bulgaria) and colleagues.

5) NGOs are important, mainly in negotiation in policy and administrative procedures – there is a system of NGOs protecting farmers' interest but in general, participating in policy consultations.

It is important the collaboration with research and educational institution because in case of labour scarcity this relationship is crucial. The specialised schools and universities are the ones which could enrol (increase the interest in agriculture) and motivate young people to continue their carrier in the sector. The relationship is important because innovations usually are inventions of the researchers and they need practical experimentation. These is the way synergies could be achieved. Unfortunately, it does not happen still in Bulgaria and therefore these influencers (universities, research institutes) are rated very rarely and on the most external circles of the network of influence.

"We have contacts with research institutions and universities but only because I have personal relationships with the lecturers and researchers from these institutions… My opinion is that research institutions in Bulgaria are behind the practice due to the way of their financing"

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Financial and insurance companies are not also mentioned often neither ranked as important influencers. Partially, the good collaboration with bank during the years is part of the influential network for two of the farmers identified. Good collaboration with bank institutions but some changes into bank requirements and rules would prevent future interactions.

Farmers use many sources of information but the most cited once are internet (specialised webs), trainings organized by the agribusiness companies and seminars organized by the NGOs in the sector.

A6.2 Do these influencers change over time in relation to different decisions/risk management?

Usually, farmers in grain production sector rarely passed through the transition period. Because the region is suitable and specialized in crop production, this is their main activity during the farm development and growth. Farmers are emotionally bounded to their businesses and they are keen to talk about their pathway, especially talking about their successful decisions. It is about the feeling to be appreciated and to be successful within the society. Currently, farmers are confident with their knowledge on technologies and requirements, but they still continue to trust mainly to the family members, friends and colleagues as well as representatives of the trade companies. And on the first place, every one of them talk about the family and its influence not only during their business development but as general attitudes and education.

Thus, within the family there is a change of the influencers – at the beginning the father and the wife/husband of the farmer is the most influential. Despite most of them continue to actively participate in the decision-making (except of case of death) the children of the farmers have grown and now they not only participate in the decision-making but also there are signs of start of the generational change. This has not been considered by the farmers' community up to that moment. Now most of them (reaching age of pension; most of the farmers we interviewed are at the ages of 50 and over) start to think about that issue. All of them have children and somehow they have planned the future succession through offering them trainings and education, involving children in the decision making from early ages, practical training at the farm etc. Farmers' willingness is for continuation and they know that it will happen for those who successfully involved their children in the business. Very few of them did not succeed (or have daughters who are not interested in farming or prefer to be engaged in the administrative not in the production part of the business) which prevent most of the decisions about expansion and changes in specialization of the farm.

The sources of information have been changed, mainly due to development of the ICT and the social medias. 5-10 years ago the main source of information are seminars and fairs and exhibitions. Nowadays their importance is lowered in contrast to the online resources and social media publications. Even for market information the situation is much better and farmers have better access to international stock exchanges and could follow the international (regional) trends as well as to use different analysis about future expectation about market developments for

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grains. In this regard the better access to the market changed farmers decision-making process. Many of them pointed out that the main driver of changing production structure is the market.

A6.3 How do farmers' attitudes and beliefs influence their decision-making?

During the year farmers grow and become more confident. They are keen to present themselves as a sussesfull businessmen and businesswomen. Currently, the main change in their values and beliefs is related to natural resources preservation as a consequence of negative impact of climate changes. There is clear understanding that the monoculture is decreasing the humus content and destroys the soil structure. There is also a limit of inputs increase. Moreover, the land short-term rent/lease contracts limit farmers' investments in enrichment of soil fertility.

Next important issue is farmers believe that more investments in the education are needed as well as more collaborations with the educational institutions. All of them appreciate the importance of science and new inventions but also all of them share that current status of the relationships between agricultural universities-research institutes-farmers are very weak. The main change here is the openness and efforts which farmers put to cooperate with agricultural schools and universities offering trainings and scholarships for students. Another important issue is the fact mentioned by the interviewees: universities/research institutes are behind of the last developments in the sector and farmers have the confidence that they implement more innovative technologies/varieties/machineries compared to the once taught and presented in the education and science institutions.

Climate change is a challenge and the farmers see it as a precondition they should take care, year by year the risks are different – drought, rains etc. Therefore, they invest in new technologies and varieties, including no-till, strep till, irrigation. Adaptation is happening in regard to the technologies applied and grain varieties. But at the moment they choose only crops which could be planted and cultivated with the machinery they are equipped at the moment (suitable for grains and oleaginous). Despite of that, we can say that the farmers change their attitude to the novelties. The innovations are triggered also in combating climate changes and looking for opportunities to preserve and enhance productivity of natural resources, namely land.

Another important change in farmers' decision making is the acceptance and the reasons behind new technologies (e.g. precision farming, GPS control etc.) implementation. These novelties are highly appreciated and farmers realise that the increase of their efficiency (decrease in production costs) is the only way to keep and advance in international competitiveness.

Even if the farmer has not taken any crucial change into their activities, all of them state that the production influence negatively environment. It is result also of changes in community perception about the role and importance of the farm. Inevitably, farmers do change their beliefs and the change is inevitably visible in this respect - their perceptions of tensions between society and natural resources use is changed, they start to appreciate more of both nature and society awareness.

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It is valid also for changing valuation of the common actions and the need of cooperation to stand their ground as grain producers' community. But at the moment of the interviews there are still no real actions undertaken in this regard. Only the formal participation in farmers' associations but not cooperation for common production, marketing etc. works.

A6.4 What external (to the farm) factors influence decision-making, and how?

The external factors are important as far as the environment is crucial for decision making in long term period. In order to be sustainable in their developments farmer would like to have more stable institutional framework including legislation and its implementation. Sometimes farmers do not take any kind of transformation just because there is no long-term national strategy which outlines sustainable future vision for development of the sector. This perception is result also of the planning cycle of the EU policies (in particular CAP) and the changes following the planning cycle – every 7 years. But more stressful is the time of discussion of the future policy which stop farmers to undertake long-term changes because they are afraid that changes could compromise final results. The main change in this regard is the willingness and awareness about the need for cooperation between farmers – formally to protect their common interests in regard to the national policy decisions.

The CAP implementation fostered changes in both farm structures and institution functioning. The CAP implementation (especially SAPS) stimulated many farmers to enlarge their size and activities. But the lack of long-term and secure access to the land (due to the complicated land relationships and privatization) is the main issue in regard to the farm structure – approx. 50% and over of farmed land is rented/leased and due to the short-term contracts investments in perennials are limited. It substantially affects farmers decision-making and they stated that they are forced to continue monoculture farming. Consequently, the land management (increase of soil fertility) is limited to preservation of the soil and very rarely investments in soil fertility increase.

Another important factor which is in the initiation of the entrepreneurship in agriculture (and in general in Bulgaria) is the restructuring of the old cooperatives and privatization of their assets. Thus, everyone has inherited some pieces of those assets. Each one of the farmers interviewed namely has inherited from their parents/grandparents more or less pieces of land (e.g. 10 to 30-50 ha). And it is the starting point for business development. At that point their decisions have been influenced by the memories shared by their parents/grandparents about the time before communism and each one of the farmer shared stories about his families. But also during the communist time everyone who wanted farmed small parcels (0,01-0,05 ha) for own consumption production and many of them have their education in agriculture. The influences of those factors is minimized at that moment and the decision-making is less emotional, it is more practical and profitability oriented.

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A6.5 What are the key risks in your case study farming system, as identified by farmers?

Risk is every situation or step that farmers undertake which include uncertainty in regard to the final result of their activity. Farmers usually talk about challenges and changes in the environment (does not matter if it is related to the economic, social or environmental factors) which changes lead to negative consequences for them and lead to lower profitability/effectiveness of their activity (lead to negative impact on the production capacity of the farm). The main risks identified by the farmers are following:

- Economic risks - the main economic challenges differ in the different stages of farm development: at the beginning all of them were challenged to ensure capital investing in the farm assets. Before year of 2000 (not to forget that 1996-97 the collapse of economy impeded the overall development) bank sector has no experience with agricultural credits and the requirements are high. Thus, farmers were forces to use the support of their families and friends as well as to build good relationships with bank institutions. Nowadays, most of them are large enough (SAPS is used a source of capital accumulation) and have long stories which makes things easier; there are opportunities to finance their investments also through projects under the RDP.

- Production risks: The needs to maintain a huge machinery stock, respectively to invest in is in the base of farm development. Farmers mostly invest in high technological machinery to ensure proper and timely activities. Each one of them maintain machineries at 1,5 up to 2 times more productive compared to the farm size in order to prevent proper technological process when the weather conditions decreased the possible working days. From the other side farmers should take into consideration not only the limited production capacity of the natural resources (soil fertility) but also the interaction with neighbour farmers during the production process because it is related to the biological organisms and for some process in the nature there are no borders. This risk is increased by non-regular control inspection on the seeds; aggressive distribution of western selection of seeds to Bulgarian market and lack of capacity to develop and produce national varieties which in general are more resilient despite the lower yields.

Main challenge identified and related to introduction of new technologies and new varieties is the adaptation to the local conditions. Many of the offered new decisions are launched by international companies and need to be tested and adapted to the specificities in the region. In regard to the production farmers identified the higher competitiveness in international environment as important challenge they should consider. Last but not least the short-term access to the land (as production factor) defined by the historically developed land management relationships influences negatively their long-term production plans, including crop-rotation, soil fertility preservation etc.

- Environmental risks: environmental risks are associated mainly with natural resources (land fertility) preservation; bad weather conditions and the need to prevent and preserve natural resources to secure future profitability of agricultural activities; climate changes and pests' and diseases' control.

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- Climate change: rains/droughts are happening in crucial moments for the production process; diseases following the bad weather conditions.

- Labour force risks: It is recognized as the second most important risk after the climate changes. It is crucial and farmers struggle to ensure workers for timely operations. The problem is both related to the quantity and quality of the labour. The main risks are identified with the very low level of available qualified employees/workers in agriculture sector as a consequence of many factors: rural depopulation and overall adverse living conditions – low level of main infrastructure and services etc., economic crises after the transition of economy, perception about the prestige, etc. Another risk is the difficulty to find and engage young qualified/skilled workers and specialists having in mind the lack and broken relationship between research and educational institution and the business structures in agriculture. As general it is consequence of the rural areas population general developments but also due to the image of the work in agriculture.

- Market risks and risk with competitiveness of the grain production: currently, farmers see the riskiest issue is the grain market including price volatility (the need of knowledge and experience with international markets as well as the common understanding about how those markets functioning) and different political trends (all of them mention Russian embargo and more general to say political risk which has nothing with the market but with the global conflicts between countries and blocks). Farmers cannot control the grain prices (commodity/stock market), they just follow the world/regional trends. Another market is risk is related with the production factors markets, especially the development of the land market (up to 10 times increase of the level of rents/lease/prices for last 5-10 years).

-Financial risks: non regular revenues due to the seasonal character of the production and proper planning and management of cash flows is the main economic risk identified by the farmers and the need to ensure the cash flow having in mind the seasonality in grain production. Most of them manage the cash flow through different market strategies.

- Institutional risks. The institutional challenges and risks are mentioned by all farmers and could be generalised as: a lack of long-term stable decisions (very often changes in law and rules); lack of national strategy in agriculture and subordinated implementation of the CAP according to national priorities and specificities as well as long-term concept for policy implementation; low level of cooperation with colleagues; low level of trust both in institutions (low administrative capacity) and policy makers; bureaucracy and administrative hindrances; lack of coordination between different institutions; CAP and subsidies in the why they are implemented (SAPS) is not good for the future development of the agriculture; CAP greening. Farmers agree on the need of changes towards more environmental friendly practices and therefore argue that the CAP greening should be implemented in different way due to the negative consequences now – increased level of diseases and need to use chemical inputs. The next challenge related to the functioning of institutions is the land market developments and very high level of land prices (including rents/leases) resulted from the complicated land relationships and their regulation by the law.

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A6.6 What learning strategies do farmers adopt for managing risk and adapting to change?

Farmers apply different strategies. Main strategies are related to the optimisation of production costs and securing proper assets for farmer to decrease external dependencies.

In this regard the experimentation is mentioned by each one of the farmers. They are keen to experiment with new technologies and new varieties of crops but also they are forced to do it mainly due to the climate changes and need of optimization of the production costs to increase their competitiveness. Also, all of them have different experiments in seeds tests and actions for seeds adaptation to local conditions because the main seeds on the market are not Bulgarian selection.

Another strategy seen as part of the climate changes overcoming is the diversification. But it is understood not only as different varieties of crops and/or mixed farming but also territorial allocation of the farmed plots. It is as an advantage because there are two different soils and meteorological conditions if plots are in two different places. Thus, if there is a problem on the one field, the other one can compensate. In general, scattered plots increase farmers' expenses for production and maintenance of those field and they did many actions to re-group the plots. Now, they even look for this diversity.

During the experimentations famers always show interest in novelties but not all of them are open to new ideas. But it is part of their strategies for long-term development of the farm because they should be able to recognize what is the future.

Very often farmers learn from others. And not only through the possibilities they have to travel and/or meet colleagues to exchange experience and learn new and useful information but also to trust in some innovation. Farmers really appreciate all possibilities they have to travel and/or meet colleagues to exchange experience and learn new and useful information. Therefore, each one of them participate in different fairs (also international once), exhibitions and trainings organized by the agribusiness companies offering inputs, seeds and machineries. This strategy is related to the previous one because some of them say that prefer to wait and see if some novelty is worthy to be implemented having in mind the results of the others who risked to try first.

Farmers are very experienced in seeking out information and show ability to use many and different sources of information. But the internet (specialised webs), trainings organized by the agribusiness companies and seminars organized by the NGOs in the sector are the three sources pointed out by each one of them.

The next strategy farmers apply is reflexivity because based on their experience farmers demonstrate ability to be open-minded to different viewpoints and to be self-critical. They very much appreciate the expertise of their workers (agronomists, machineries specialists, etc.). Farmers realize that business of such size could be managed properly by a team.

Following the results from the interviews it is important to mention that opposite to overall developments, farmers in general are not keen to talk about insurances and they do not consider

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it as a possible risk management strategy. They still do not feel that it is a good opportunity to minimize the risks but only having in mind the bad experience with insurance companies.

A6.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

The CS shows that in the learning process farmers changed their behaviour. It is a bilateral process because farmers changed their behaviour but also succeed to change it according to the changing circumstances and environment (because the more changeable are the conditions under which farmers operate). And the changes are valid both for their certain actions and also for their skills and knowledge – it is observed deepening of knowledge about the economic processes and the logic of investments. And it is important because in Bulgaria farmers should develop/learn to act in market economy as entrepreneurs and it is linked with changes in their behaviour too.

Enabling factors for farmers learning strategies adoption is long-term experience they gained during the years in one and the same business as well as the resources available for them. Each one of them demonstrates a good managerial skills and ability to predict and ability to understand the future trends having in mind the development line of the farm business. Another enabling factor is that the adaptations they undertook as a result of learning process do not require additional investments in machineries, equipment and training of workers.

Lack of incentives (policy stimulus) as well as the restricted ownership on the land prevent/constrain farmers to undertake even more radical changes and adaptations. The insecurity about the size of land they could rent/lease next year as well as the possibility of territorial changes of the fields are mentioned by all of the farmers for the reasons why they do not undertake changes which require long-term period of implementation. Another important constrain is the broken relationship between research/education/business, actually the knowledge generated part of that system (universities, schools, research institutes) is developing at slower pace than the business. Even no one mentioned a very important part of the transfer of knowledge to the practice, namely the extension services. Actually, the functions of both of them taken away by international companies and their representatives.

Following the definitions of single- (associated with incremental innovation towards further growth) and double-loop (involves more radical innovation and adaption in response to crises in the system) learning in conceptual framework for learning capacity task in the cases discussed here we can identify both.

One of the most visible adaptations farmers undertake is related to the production practices and applied technologies. All of them are forced to think about their actions following the climate change conditions and the need to stay profitable and competitive on the international markets. All of them operate in the framework of optimization of the production costs and increasing effectiveness of resources usage. Thus, each one of them analysed the process and start to think about the results asking yourself what is going on with the production system and what are the new modes of operation. Consequently, the learning process of experiments, learning by others,

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looking for information and openness to new ideas lead to better decision-making and farm management. In this process farmers show awareness to the system boundaries and took their responsibility implementing new technologies which preserve soil fertility (even increase it) and lead to decrease of the production costs.

A6.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

In general, the farms demonstrate adaptability. Farmers were able during the years to adjust their on-farm production from a conventional to innovative technologies either it is related to the production technology and/or technical innovation. Crop production is the most intensive one in Bulgaria and only the innovations could bring different dimension of intensification. Farmers prefer more environmental friendly production methods in order to be sustainable in long term. It is interesting that in most of the cases they think about long-term decisions for their owned land occupation. It is kind of combination of resilience attitude (own land give them security to continue running farm) but also needs of adaptation to meet future challenges and to continue the business.

Each one of them enlarged farm size during the years, mostly gradually but each one of them recognizes the need to adapt their decision making process to manage and to be able to continue and adjust the production structure according to the new realities. Some of them also undertook diversifications in several directions and each one of them required actions to adapt the farm structure, management activities etc. The diversifications include starting seeds production (experimenting and ensuring adaptation of the varieties to local conditions), to other businesses (subsidiary companies), trade companies, machinery services etc.

Two of the farms have overcome a transformation – from mix to production structure dominated by crops and from diversified businesses in mill to grain production and sheep breeding.

At this moment two of the farms operate in robustness mode and continue the activities for longer period. Both of the two owners declared that they do not have future plans for more changes under the circumstances as they are.

The main challenge to the ongoing resilience of the farm businesses together with climate changes are the fragmented land ownership (lack of legal acts which secure longer contracts), lack of skilled workers and sustainable and contiguous policy.

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Appendix 7: France Country Report

A7.1 Who/what are the most important influencers on farmer decision-making, and why?

The people and organizations most often mentioned by farmers in the influence circle:

- Agricultural cooperatives
- Former farmers
- Accountants
- Family members
- Neighbors farmers
- Internet
- Agricultural press
- The Chamber of Agriculture

People and organizations that farmers consider as the most influent in their decision-making

In general, organizations and individuals with the greatest influence on livestock producers' decisions are those with whom the farmer has an emotional bond (friendship or family) or organizations whose functioning he knows from the inside.

- Family and/or former farmers: Family members are influencers if they have been or are part of the agricultural world, which is the case for the most part. The influence of the former farmer is almost always mentioned, whether it is the parents or someone outside the farmer's family and friends circle. The only person who did not mention the family or the former owner is the farmer closest to retirement. These people are influential for the breeder because they share their experiences. They often help the farmer to have a more general view of the farm because they know its history. For some people, they still contribute to the farm's activities by helping with administrative or technical tasks.

- Other farmers that are also friends: they bring an outside perspective while bringing their experiences. They also sometimes help and can influence factors such as the hiring of an employee or the purchase of a tractor. They may be close neighbors but also farmers who are more distant geographically, met during a previous experience. They are also sometimes the result of a meeting through social networks (less influence of these actors, because of less trust between them). In all cases, it is mainly exchanges with farmers of the same age group and/or adapting the same type of agricultural system.

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- **The accountant when he is part of a private company**: farmers consult them once they have already built their project. They intervene to say if and how the project is financially viable. But breeders address these questions to their accountant only if they trust him for technical and not just economic answers. This is always the case for accountants belonging to private companies.

- **Cooperatives when the breeder maintains a relationship of trust or even friendship with the technician**: Agricultural cooperatives are always mentioned, whether their field activities are cereals or animals. But they are often placed on the middle circles of the influence map. When they are close to the centre, the breeders explain that they have confidence in the technician, sometimes even a friend. This proximity allows them to exchange ideas that sometimes lead the farmer to ask for more advice and/or follow training courses with the cooperative.

- **Farm organizations where the farmer worked before settling in**: Another phenomenon causes the same result, it is the fact that the breeder has already worked in this organization. This gives him the contacts and skills. Yet the knowledge of a company allows a better confidence that positively affects the influence.

- **Agricultural organizations in which the farmer is an active member or where a family member works:** The Chamber of Agriculture is often mentioned but not in a central position. When it is more important, it is related to the fact that one of the family members works there or that the breeder is himself active there. The fact that a breeder is active in an organization allows him to influence the training, the conferences given and even the people hired. The fact that they lead these organizations makes it all the more important from an influential point of view.

- **For some people, personal research made possible by the agricultural press, the Internet and/or training courses:** the first source of information is the agricultural press because breeders read all types of subjects on a regular basis. The Internet is more commonly used later to search for specific information. The same applies to the training that farmers choose to follow.

A7.2 Do these influencers change over time in relation to different decisions/risk management?

Generally, the organizations and individuals remain on the general map when it comes to a particular change. On the other hand, the degree of influence varies more or less according to the different categories of influencers. Indeed it can be observed that family members, former farmers, other farmers and the farm press remain important influencers. This can be explained by the fact that they are various sources of information and exchanges. However when the former farmer is not family, he may become less important over time or depending on the subjects. Agricultural organizations in which the farmer's family works, in which he has worked or in which he is involved also remain important influencers. These are organizations in which the breeder

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has confidence and will go to reinforce himself in case of doubt. They are also organizations that can be at the root of ideas for change since the farmer may have been involved in the reflection or development process of this idea as he was working for this organization.

The bank and the accountant mainly keep their position since they can intervene on any type of project provided that requires funding or investment.

The majority of organizations and individuals taking or losing influence are more specific. The movements of these influencers on the map are explained by their specificity: they will not be able to act on all subjects. The following groups are concerned:

- Agricultural cooperatives
- Scientists (research institute or agronomists)
- Suppliers
- Genetic selection organizations
- Agricultural labour companies
- Conferences
- Training
- Breeders' groups (CUMA)

Depending on the different changes, there are no major differences that appear except between the modifications to the installation or shortly after and the changes that occur once the installation is completed and the farm is in a state of relative stability. Regarding the changes to the installation, we observe a support from the former owner who can then disappear and supports in financial advice more accurate than afterwards.

A7.3 How do farmers' attitudes and beliefs influence their decision-making?

A patrimonial identity and intergenerational activity: Farms are usually transmitted from father to son, which gives to the job a patrimonial scale. Incoming farmers want to respect the tradition of the farm by keeping livestock on it. Most of the time they do not even consider to abandon livestock, even if in the past years this position has evolved (with the livestock farming difficulties, more and more farmers are wondering whether they should go on or stop livestock activity). The farmers are usually passionate about their activity, they love breeding their animals. Consequently farmers look for adapted solutions in order to be able to maintain breeding activity on the farm: increase of heard size, more land, change of way of sale etc. Very often two, or three, generations work on the same farm. On the one hand this is very enriching: experience comes from the oldest, energy and new vision from the newest, which brings innovations or changes on the farm. On the

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other hand this can be conflictual, or the exact reproduction of the ancestral production system breaks any kind of change or learning on the farm.

A strong belief in collective work: Even if this tendency is decreasing, farming is a profession individual on the farm, but collective at a more global scale. All the interviewees stress the fact that collective approach are crucial and they organize their farm considering these collective options. Farmers share material thanks to the construction of material cooperatives (economic reason),they organize the sale of their products through cooperatives in order to be more powerful together than alone (organizational and economic reasons) but they also share ideas which can lead to changes on the farms (social and technical reasons). Moreover mutual assistance (in case of an accident or a temporary difficulty) is a key value in breeding environment.

A taste for alternative farming: This value does not apply to all breeders but illustrates the rising tendency towards alternative farming. The sample of farmers we had was a bit overrepresented, but three of the interviewees produce organic. The conversion could have been for economic reasons (a better price for organic meat) but also ideological (farmers want to produce in another way than before, more respectful of the environment and for health reasons). Conversion often occurred at the transmission time, showing the importance of the incoming farmer venue in the process.

Seek for independency and liberty: the farmers who have worked as employees before settling in often turn to be farmers because of the need of "being your own boss". In their whole activity they look for this independency which is reflected in their actions (search for different purchasers in order to be able to sell to the better price, market analysis to help them doing the best choices etc.). However all the farmers we interviewed feel they lost this independence (or never had it) because of the economic situation that does not allow them to make a living or to invest on the farm.

A political duty: Farmers are well represented in the countryside political life (in France, 30% of mayors are farmers): in our sample two of them have important responsibilities. This sense of duty to represent the profession and defend their activity allows them to "get out of the farm" and see other contexts, farms, experiences etc. they can bring back home. It also influences the farm structure, as political work is time consuming, hence the hire of an employee or a technical adaptation of the farm to limit the time spent on the farm.

A7.4 What external (to the farm) factors influence decision-making, and how?

Price of the meat or the weanlings: Like every other business, farmers' objective is to make a living out of his activity. On the contrary to every other business, regular farmers cannot decide the price of their products: it is the buyer who decides. Consequently meat prices or weanlings' prices are external to the farm, and when this price decreases so far that the production price is not covered, farmers have to imagine another way of selling or producing: selling on the farm, processing the meat, selling to other purchasers etc. The added value they could win through these different ways influences their decision.

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Climatic change: Climate is a change driver. Indeed farmers work closely with their environment, so when a change occurs with the latter, farmers have to adapt their practices to it. In Bourbonnais region the climate has evolved towards some very dry summers, which was before not common. It is now compulsory to change the crops selection and the pasture management in order to avoid buying feed and to save money. Farmers try to learn from these events to better adapt to the next episodes.

Access to land: if a farmer has access to land (mainly because a neighboring farm stops its activity) and if he has the money to buy it (land may be very expensive), it opens up new perspectives for him: the possibility of extending the main activity thanks to a bigger surface, the opportunity of developing a new activity besides the main one (sheep, crops etc.).

Policy and CAP supplies: most farmers are dependent on CAP supplies and therefor adapt, when possible, their production system to fit with the new regulations (development of a new production, no turning of the grasslands, density of animals, protection of Natura 2000 areas etc.). However the change of policies occurs too quickly after a reform, and as investments are usually made for a couple of decades, farmers cannot

Evolution of labor standards: incoming and more and more established farmers are now willing to live a "normal" life, which means being able to take some days off, to have some free time and leisure activities. As a consequence, farmers are likely to change their approach to work and are looking for solutions to do so: hiring an employee to spend more time with their family, reducing the production (not often), changing the production system (less herd supervision…).

Evolution of societal expectations: societal expectations are evolving: in addition to sanitary security which was the main focus after the mad cow crisis, consumers now want to consume a product that answers several environmental and welfare standards. This evolution can lead farmers to try to stick to more extensive systems or to valorize the use of pastures. Bourbonnais region already answers to some of these expectations (lots of grasslands, hedges that protect biodiversity etc.), which definitively is a strength for its agriculture.

A7.5 What are the key risks in your case study farming system, as identified by farmers?

Definition of "risk"

Globally farmers define risks as being an external event that may happen and triggers off bad consequences for the farm. They feel powerless against these events and consider them as a threat that may endanger the sustainability of the farm. Risks can be exceptional (drought, accident etc.) or usual (low prices, difficulty of transmission etc.), which illustrates that the term "risks" also stands for the difficulties that farmers currently have to cope with.

However risks can also be internal to the farm, like high level of debt, sanitary problems, labour issues etc. Although internal risks are more dependent on the farm itself, farmers are most of the time not prepared to face the risks.

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Main risks identified

Climatic risks: this risk is the most quoted by farmers, which can be explained by the fact that the region had to cope with two severe droughts in the past two years. Moreover, droughts are totally unpredictable and uncontrollable, which gives a feeling of powerlessness to the farmers. Climate change has a direct impact on productivity (less water or forage available for the animals) and operating costs (more feed to be bought to feed the animals). Climatic risks are a vector of change in the farms, who are forced to adapt regarding the increasing tendency of climatic events.

Financial risks: farmers see financial and economic risk as an "everyday fight". First of all, suckling cows' farmers suffer from a low added value production, hence a low sale price for their products. Moreover, they have to endure the market insecurity and a strong volatility of the products sale prices, but also of the inputs prices. With higher input prices and lower sale prices, farmers meet strong difficulties to make a living, and many of them wish they could live from their production. Combined with a high level of debt, farmers are not able to live decently nor invest on their farms.

Sanitary risks: Bourbonnais farms are dependent on international markets to sell their weanlings. These markets are very sensitive to sanitary crisis, and a suspicion of zoonosis can close an outlet for many months. In the past 10 years, three sanitary crisis (bluetongue disease in 2007-08 and 2015, Schmallenberg virus in 2011) endangered the resilience of farms, which explains why farmers see sanitary risks as a potential of economic losses.

Succession risks: succession is becoming more and more difficult and farmers identify this point as a major risk, not for their own job but for the global activity of meat farming. Attractivity of farming is decreasing because of many factors, among them the low income, the on-call work and the conditions of access (farms and land cost too much for young farmers).

Institutional risks: as farmers are economically dependent on supplies, they need to submit supplies applications, but it has become a tough fight for farmers who are tired and express an administrative burden. Hard administrative constraint prevent some farmers from having access to them, which often triggers off the abandon of the farm. CAP reform is a very tensed period for farmers, who hope to receive more supplies but are often disappointed. The regular changes in supplies allocation do not help farmers to adopt a long term reflexion for their production system. Lately the CAP payment (distributed thanks to the administrative regions) were postponed during many months, putting the farms in a very difficult economic situation. Last but not least, new international agreements (like Mercosur or Eastern Europe) are synonymous of a further price decrease, due to the arrival of less expensive meat on the French market.

Labour and personal risks: the departure of an employee or an associate partner may jeopardy the balance of the farm, especially when it is difficult to replace him. With the farm-size increase, a single farmer has in charge very big farms and often need to hire an employee, but farmers have trouble to find skilled and trusted staff, and to retain him on the farm. Moreover when the farmer is working alone, it may be difficult to handle with a temporary illness or injury (working with animals implies a significant risk), which is also an important risk identified.

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Societal risks: societal expectations about farming, among them the vegan movement which appears to be very influent, causes fear and misunderstanding among the farmers. They fear that their activity may disappear if people decrease their meat consumption. They wish consumers were more aware of the farmers' practices and situation to better understand them.

A7.6 What learning strategies do farmers adopt for managing risk and adapting to change?

Cooperation and learning from others: even if more and more farmers are working alone on the farm, farming is an activity that requires lots of exchanges between pairs, because of the difficult conditions of the job. Discussion is a key-element in finding solutions to challenges that farmers have to take up. Farmers can benefit from different opportunities to learn from others. Trust is a crucial point (a farmer won't develop an idea from someone he does not trust):

- Familial influence: farming is most of the time a familial activity, and plenty of farmers have a parent or a former breeder who can give a hand or advise him with his experience. Family has a strong influence on the breeder's decisions. If the former farmer still interacts with the farmer, he may have an influence power on decisions and/or possible actions.

- Farmers cooperation: Farmers have different ways of interacting: sharing a material cooperative, sharing an employee, taking part to training groups etc. These opportunities are very important for the farmers because they allow them to exchange directly and informally about techniques, problems or ideas. Especially in a strong evolving context, these exchanges feed the farmer with reflection and open-mindedness.

- External activities & social learning: farmers who are engaged in a nonagricultural activity have the opportunity to exchange with citizens that are not farmers, in particular about their perception of agriculture and their expectations regarding livestock. Observing society expectations may trigger off a change in the farmer's practices: seek for more welfare, improving the quality of the products, more care for the environment etc. Changes in consumption patterns impact directly on the farm's income and some farmers try to add value to their products regarding these social expectations.

Learning from past experiences: giving value to former experiences and learning from one's own mistakes is a key-element in the learning process.

- First experience before farming: some farmers took the opportunity to work elsewhere than on their own farm before becoming a farmer. From this experience they may bring ideas, different ways of producing, curiosity that will help them during their career.

- Past experience on the same farm: if a problem happens for the second time and if the farmer took time to analyze and understand the problem source, the farmer will be much more prepared to cope with it. For instance, productivity losses related to climate change may bring the farmer to test another pasture composition for the eventuality that the problem may pop up in the following years. Or a farmer who experimented a sanitary

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problem may try to limit the sanitary risk for the following years (animal isolation, vaccines, building disinfection protocol, etc.)

Skills and knowledge acquisition: General information sources can bring ideas to farmers: audio sources like radio and television are widespread whereas reading sources like press and internet are increasing. These information may raise questions about one's practices or provide answers to technical issues. Training, mainly collective but also self-taught, allows the farmer to learn out more about a technical subject.

Openness to new ideas: Farmer's state of mind is crucial for changing and learning. Open-mindedness is crucial for someone who wants to reconsider his own practices or test new options, among them new technologies that open new horizons to farmers: technologies to monitor animals (cameras, necklaces, echography etc.), technologies to reduce inputs (GPS, drilling, mixing machines, etc.). More generally farmers open to new ideas are eager to test new techniques and practices that initially are at an experimental stage but if successful can integrate the usual practices of the farmer (see next paragraph).

Improving existing practices through experimentation or innovations: Farmers develop an expertise about farm management during their career. They are able to capitalize on what they have observed and consequently improve their existing practices thanks to adaptation. Regarding the economic and climatic situation, farmers develop different innovations on the farm which gradually become part of the production system if they happen to be efficient. The following risk management strategies are the more frequent:

- Experimentation to enhance self-sufficiency: climatic conditions bring farmers to adapt their crop and pasture management in order to limit feed purchase. Farmers who sell crops may decide to store a part of the production to sell it later at a better price. Tests on pasture or on crop composition (more leguminous plants, or storing water plants) help the farmers to identify the most successful associations, regarding climatic change for instance.

- Adapting to the market: as prices differ from one purchaser to another and during the year, farmers may change their usual partners in order to select the ones that pay the higher price. Moreover he may change the production period in order to sell at the time when meat is most expensive (summer) than at the regular production period. The whole herd may be concerned by this choice, or only a fraction of it in order to test the option first.

- Spreading risk: due to the volatility of the market, lots of farmers decide to diversify their activity and their incomes in order to achieve economic stability. Diversifications can be agricultural (developing a second production activity like pigs or poultry) or non-agricultural (agro-tourism for instance).

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- **Adding value to productions**: farmers seek to enhance the value of their products as much as possible, even if it means changing their practices. Sale on the farm is a
- **Contractualisation**: farmers seek contracts to secure the products sale or limit the purchase of inputs. They conclude a contract with purchasers.

Radical change of production system: changing herd's feed or crops is quite frequent, but breed change is a rising practice observed in Bourbonnais, where the Charolais breed is the most represented: farmers may change the breed to look for easier calving of for a different meat conformation. Regarding economic yields, farmers can also choose to abandon a production (stop of pork or sheep production in our interviews) or to intensify (more lands, livestock or buildings).

A7.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

Adopting these strategies requires:

- An **open-minded spirit**: Most of the farmers that have implemented changes had the original idea by seeing it on another farm, or reading it somewhere, talking to technicians or to colleagues etc. This spirit may be related to the education level of the farmer (hypothesis that the more you had the chance to study, the more open-minded you get). Some farmers are too focus on everyday problems to be able to anticipate changes.
- Some **financial flexibility or supportive banks**: implementing a new solution often costs a little bit at the beginning (new material, training, etc.). Consequently either the farmer has the money to invest, or he needs to get a loan from the bank.
- A **strong willingness**: some strategies are easier to implement than others. Adversity may be strong along the way of the strategy implementation and personal motivation is a ley-element to lead it to the end.
- A **complementary sector**: some strategies cannot be developed if the local sector does not provide elementary tools or organisations. For instance, you cannot develop an on-farm sale activity if there is no slaughterhouse around, or you cannot convert to organic farming if there is no economic partner that will buy your meat with organic prices.

On the contrary, following factors breaks the adoption of these strategies:

- **Weight of traditions**: some incoming farmers arrive with energy and new ideas, but working with parents (or even grandparents) may restrain their creativity, because of the difficulty to impose new choices in a familial context where parents always had the authority.
- **Tiredness of the job**: regarding all the constraints and difficulties met, farmers may be fed up with their job and without enough energy to dedicate to the development of new strategies.

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- Insecurity of the market: farmers build their strategies regarding many factors, but the most important one is the price of the products which will determine their income. If the market is systematically instable and prices are too low, farmers may fear to develop any new strategy (as innovation always imply some risk) and may prefer sticking on with their original way of functioning.

Examples of single loop learning: increase of the on-farm feed production to reduce the costs and be more self-sufficient.

Examples of double loop learning (in project): developing an on-farm feed factory for the farm and neighbor farms, in order to produce local and qualitative feed, to improve fattening performances.

Examples of triple loop learning: conversion to organic farming in order to improve added value on the products and to better answer to social expectations.

A7.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

See part 5.6 for the different learning strategies.

Due to the climatic and economic context of the suckling cow's production, farmers are constantly looking for solutions to increase their resilience, notably through the added value of their production. The Bourbonnais livestock will have to face four major challenges in the next years and are getting more or less prepared for them:

- Economic valorization of farmers' work (and indirectly the generations' renewal): meat sector in France (not only Bourbonnais) is in a critical situation because of very low prices, consequent production prices and a decrease of meat consumption. To cope with these problems, most of the farmers are working on the robustness of the farm by trying to reduce the inputs. some farmers have developed or are developing innovative ways of producing (organic, off season, contracts etc.) or selling (direct sale, internet sale etc.) in order to increase the added value of their product. These initiatives enhance the resilience of the farms thanks to their adaptability or their transformability capacity.

- The multiplication of droughts: livestock in Bourbonnais is dependent on grasslands, as they represent the main part of feed for the animals. Farmers who have implemented drought resistant mix grasslands will increase their robustness and hence their resilience.

- The rising social expectations: Bourbonnais livestock is already well prepared to answer to social expectations, thanks to its extensive livestock breed on grasslands, which shapes a mosaic of unique landscapes, contributes to a high quality environment and creates economic vitality in a rural territory. Farmers who will be able to communicate on these sustainable characteristics (rise of adaptability) may win the adhesion of the consumers and improve their resilience.

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Appendix 8: Germany Country Report

A8.1 Who/what are the most important influencers on farmer decision-making, and why?

In the interview mapping, the farmers tended to respond saying that their own experience is what influences their decision making and other influences and sources of information had to be coaxed out. Their responses during this portion were mostly consistent with the sources of information that were mentioned in the open portion of the interviews. As seen on the maps, the majority of influences are classified into three categories: financial, policy, personal, or environmental.

Financial was referenced by the saying that the bank influences the decision making – will they get the credit or not? Will an investment be approved? As agricultural is so significant to the region, each bank in the Altmark has several bankers with agricultural backgrounds who assess and determine whether credit is to be lent, as the loans are significant amounts.

The personal category covers both the farmer's personal experiences, but also their immediate circles. Professionally this would be employees, other co-op members, or colleagues of other farms. Personally, sometimes family of friends were mentioned as an influence, but in these cases, the family and friends were also farmers.

Various German policies and regulatory bodies were listed as influential. These influence the farmers' decision making because they have no choice but to comply with new regulations even if they do not see it as the best farming method.

Then the environment affects their decision making in terms of weather on a daily and seasonal basis. Daily, the weather determines what they can and cannot do that day regarding crops and seasonally it determines the harvest, which then has a domino effect influencing other decisions which must be made down the line (e.g. bad harvest -> how to feed livestock -> exiting livestock). In the interviews, the respondents spoke more generally about weather and its effect on farming; specifically, about extreme weather events influencing their decision to look for new technology, crops, or methods to continue farming.

The data on influencers used to answer these questions came mostly from the maps and partially from the interviews, but both of which was only after they were asked directly. In the story telling, farmers spoke about their experiences as if it were just them and the regulatory bodies.

The respondents use peer to peer learning; often with colleagues on the farm in day to day situations. In more specific larger cases, they speak with other farmers and also seek outside help from consultants as well as visiting conventions or lectures. The respondents all actively read some form of agricultural news and or literature (literature being defined as more scientific). This kept them informed on events and new ideas, which would give them the opportunity to research more as well as find conventions on a new subject. The farmer's association was only ever listed as a source of information after the respondents were asked specifically about it, so it provides

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updates but is peripheral and not as trusted as the general agricultural news and literature sources.

A8.2 Do these influencers change over time in relation to different decisions/risk management?

Given the socio-political history of the Altmark, there have not been massive changes over time, because there has not been much time for change to happen. None of these farms can be older than 28 years, and that shows in the mapping scenarios. In the first 5 – 10 years the objective of the farms was was about re-organizing and creating stability. For the farmers, those days were all about big changes, but it was not just farm-related changes, but throughout society as well. The "thinking back to a situation in the past" scenarios are not more than 10 years old. At which point, information technology has not massively improved in this region. Many areas are still without reliable internet, as a consequence, the internet is not how many of the farmers in the region stay connected and informed. Rather, the "older methods" of literature, newsletters / farming newspapers, conventions, seminars are the main sources of information. Overall, there are not radical changes in influencers.

A8.3 How do farmers' attitudes and beliefs influence their decision-making?

The respondents were not particularly revealing in regard to attitudes and beliefs. The managers did not speak about themselves outside their role as manager or even much about memories.

If I were to speculate, the lack of disclosure would have to do with culture – Germans are not known to be open and warm and are also quite direct (e.g. interviewer asks a question and they respond just to what was asked), and or the fact that the respondants are not small family farms, but managers of large business operations, even the "family farms" are large farms and partnerships (imagine mom and pop shop vs director of M&S).

Two main observations:

1. The farmers are risk-averse; as is typical in Germany.
    a. They see themselves in a high-risk situation, which causes distress and leaves them feeling trapped. The situation is brought on by constantly changing regulations, which are created by people outside of agriculture and therefore nonsensical to farming and the nature of long-term investments in farming. Specifically, they are at an intersection where all farm decisions are costly and require a long-term investment. The farmers will not build a new stable if they are not confident that the stable will generate profits for the next X years. The overwhelming point emphasized by the respondents is that they are unable to plan because of the extreme regulatory changes.
    b. How this influences their decision making:

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i. The above example has been an influential factor in farms exiting livestock, as the costs of the regulations hit livestock farms harder than arable operations. However, this cannot be said to be the sole reason to exit livestock, as farmers also spoke about other livestock related risks and challenges (labour demand, high costs, and low market prices).

ii. The general risk-aversion leads farmers to be cautious in testing new ideas, and when there is a "path-breaker" they do not undergo complete transformations, rather first test their changes on a small-scale. For this reason, I think that transformability is not seen much in this region. The one example of transformation is biogas. However, the guaranteed prices and subsidies provided by the German government essentially negated all risks associated with biogas investments.

2. Farmers feel abandoned by the government.

   a. The government enables globalization and competition with the world market and its low prices (also critical of EU eastern expansion). At the same time, the government also increases the regulations thereby costs on the farmers and allows "lower-quality" product on the market. All of the respondents spent a significant amount of time discussing this issue. They believe that this can resolved by requiring imports to be held to the same standard as German goods. This above all shows the lack of communication between policymakers and farmers, as this is not possible under many trade agreements – something that I do not believe is known to the farmers.

   b. How this affects their learning and decision making:

      i. The situation is hard to reconcile, as one would expect that these feelings would strengthen the bond and solidarity amongst farmers. However, that is not the case in this region. Farmers are not particularly active in their Farmers' Association and the association was peripheral on the maps and often only added once prompted by the interviewer.

      ii. Some farmers have begun hiring consultants to make sense of how to implement the new regulations and remain competitive, as their complexity and cost are too much for the managers to take on themselves. From the interviews, consultants are not seen as highly influential and are used on a rare and limited basis.

A8.5 What external (to the farm) factors influence decision-making, and how?

<u>Policy and Regulations:</u>

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Policies and regulations are the number one influence on decision making. Based on the interviews, farmers see the regulations and policies as burdens. The amount of bureaucracy which has resulted from increasing regulations cuts into farming profits, as farmers now have to spend their days in an office and not in the fields. Farmers also face costly fines when they fail to comply with the ever-changing bureaucratic demands. Each farmer had an example of how a different policy was nonsense. Nonsense in that the regulation does not have to do with environmental protection or health and safety. The farmers perceive a large gap between policy makers and the reality with which farmers deal. The main issue that many of the interviewees had is that there was no room for their own decision making. On top of that, the farmers are not consulted and feel like they cannot influence policy or regulations, which means that the farmers are at the mercy of whatever new regulation comes. This dynamic between policy makers and farmers results in farmers feeling unprepared and unable to mitigate risks because they are left out of the conversation. Some of the interviewees described it as always sitting and waiting to put out the next fire.

The only "positive" policy referenced was EEG, which guaranteed biogas prices in Germany. From the interviews, this was the only policy which offered farmers an opportunity as opposed to putting on restrictions. When positive policies exist, they catalyse farmers to learn about new technology and opportunities to expand and transform their business. In the interviews where farmers discussed their decision to become involved with biogas, the farmers spent extensive amount of time researching privately with literature as well as going to conventions and utilizing their farmers' networks to visit the path breaking farms to see how they implemented biogas.

Skilled Labour Shortage:

Labour was a topic which was present in all interviews to varying extents depending on the farm and their current situation. In the best situations, where the manager said that their farm was currently not affected by the labour shortage, the farms were still concerned about labour in general. For example, one farm took over one year to find a trainee[4], which is a significant amount of time. Another farm which also said that they were not currently affected by labour problems also said that they could not find anyone to work in their livestock jobs. Generally, in the Altmark, the labour shortage is specifically in regard to qualified labour and or management. This is because there is limited work that someone without agricultural qualifications could do. This is mainly due to technological advancements, where the skills required are equally about how to use expensive equipment as well as the general agricultural knowledge, like knowing when a cow is sick. Wages are also quite low in agricultural, and farmers see a direct connection between wages and the quality of labour that they receive. However, farm managers do not have the funds to pay higher wages and feel trapped.

[4] In Germany, there is an "Ausbildung" system which could be compared to a technical school – part school part practical work. In agriculture, some farms would become registered and approved to be places where students could do their practical work.

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Labour problems have forced farmers to learn about and decide to implement labour- substituting technology. However, this technology sets up another labour risk, as it demands a higher quality of labour. Additionally, the technology is quite expensive, and farmers are already working with low profit margins. Labour dependency, like the unexpected changes in regulations, was cited as a reason to exit livestock production.

A8.6 What are the key risks in your case study farming system, as identified by farmers?

Provide a summary of the key risks identified. Also include how farmers define risk.

Land market – the land market for buying and renting land has sky rocketed in this region, which farmers are finding difficult to manage. On average farms tend to own 1/3 and rent the rest of their land. Their investments have been calculated based on the income that could be generated operating at that size for X amount of years without massive shocks, such as rapidly increasing land prices which threaten production levels.

Bureaucracy - Bureaucracy is an area which all farms stated was a large challenge and created risky situations. The amount of paperwork has increased significantly in recent years. The bureaucracy is complex, expectations are not communicated clearly from government agencies to farmers, and there is a lack of consistency between auditor's requirements. Failing to comply results in fines and/or delay or loss of direct payments. The increase of bureaucracy increases the chances of penalization.

Regulations – The increasing and unexpected regulations present great risk to farmers in the Altmark. The risks with regulations are the costs that they add to farming operations. New regulations often require adopting new (expensive) technology or increasing bureaucracy, both of which are costly. The main risk is the unexpected nature of the regulations – that they are created and implemented without farmer consultation which creates uncertainty and thereby risk.

Populism – Farmers in Germany face populism targeting agriculture, which has resulted in regulations and demands which do not make sense. In comparison to other countries, German consumers are particularly vocal about the way in which they expect their food to be produced. I have labelled this as populism since it is often a movement of rapidly-spread public opinion based on opinions and not science (e.g. Germans anti-GMO stance). This is a risk to farmers in two ways: one, an actual risk of break-ins from activists especially if the farm has livestock, and two: the result of unexpected and irrelevant regulations. The latter is a greater risk overall as it is more frequent and affects all farms. Politicians respond to their constituents concerns without engaging the farmers which results in increasing regulations (cost) for farmers. On top of this, consumers then still choose the cheapest option in the supermarket, which is almost always not-German so is not produced under the conditions which they demand that farms in Germany produce.

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Extreme weather events - Extreme weather events are increasing in frequency and intensity. In recent years, the farms in the Altmark have dealt with drought (leading to wildfires), hail, extreme frost, and floods; all of which affect their harvest and ability to provide feed for their livestock.

Skilled labour shortage –Farms are unable to find and maintain skilled labour in the Altmark. This creates risks when it comes to both crops and livestock. Livestock relies heavily on labour, and lack of or unskilled labour will result in costly mistakes. For crops, the labour needs to be increasingly skilled as the technology the large-scale farms use is increasing in complexity.

Poor regional infrastructure – This creates geographic monopolies and a situation where farmers are price-takers.

When asked directly about risk, farmers responded to the challenges which they could do little to mitigate. Specifically, the regulations and bureaucracy was listed as the largest risk as farmers do not believe that they can influence what is happening. Additionally, the changes make it difficult for farmers to do any long-term planning, such as investments.

A8.7 What learning strategies do farmers adopt for managing risk and adapting to change?

Please indicate what learning strategies and/or attributes farmers demonstrate in your case study to allow them to manage risk and adapt to change. Here you may wish to include skills and/or knowledge acquisition, incremental innovation and experimentation, learning from past experiences, improving existing practices, change in underlying values or attitudes, social learning, reflexivity, openness to new ideas etc.

Improving existing practices:

- Farmers are improving existing practices of stakeholder relations by reflecting on the state of relations and experimenting with new ideas (see below for landowner relations and labour search).
- Managers are improving their current public relations and outreach practices. Farms in the region have a history of outreach, but farmers are focusing on improving this practice past the village level to engage in public relations. They have done this to adapt to the challenges of populist opinions on agriculture

Reflexivity

- Farmers are reflecting on their strategies based on the ongoing or even growing risk. For example, the skilled labour shortage risk has resulted in farmers to reflect on their advertising and outreach strategies.
- Farmers are reflecting on their daily allocation of their labour (field vs office) given the risks that they face from bureaucracy.

Skills and knowledge acquisition:

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- Conferences / Fairs are a common place farmers go to seek out new skills and knowledge with regard to biogas and new farming techniques

Experimentation with new ideas:

- To address challenges on the land market farmers are experimenting with new ways to create, improve, and or maintain relationships with the landowners, such as throwing yearly parties for landowners.
- Farmers are experimenting with direct marketing to try and manage the risks of being price takers. Examples of this experimentation are milk stations.
- Farmers experiment incrementally with new ideas such transitioning to organic, testing out new extreme weather-resistant crops, diversifying new crops.
- Farmers are trying to increase their labour pool candidates by trying out new recruitment ideas, such as recruiting from non-agricultural backgrounds.

Openness to new ideas

- The interviewees were all open to hearing about new ideas, however their strategies to manage risk were to experiment incrementally and only after they had relative certainty that the experimentation was low-risk.

Social learning:

- Farmers are using their social networks to learn about new business opportunities such as the possibility to expand.

Changes in values or attitudes:

- One famer mentioned that he is visiting workshops to understand the labour market with the young generation (e.g. changing employers after several years, moving, changing careers). Generally, there is an understanding that there needs to be an adjustment in the values and beliefs on employment to match "this generation" of employees values and beliefs.

A8.8 What are the most important factors in enabling learning in the adaptive capacity cycle?

Critically assess what enables or constrains farmers in adopting these strategies. Can you identify examples of single- and double-loop learning (or even triple-loop learning)? How and when do they occur and what is the outcome?

Constraining factors:

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Lack of representative association – one of the predominant risks was the uncertainty brought on by the unexpected changes in regulations. Farmers are hesitant to try new ideas because they are often expensive and require long-term investments, which is not suited to the uncertainty created by the regulatory changes. The changes are unexpected because farmers are not consulted in the process. The fact that there is not a functioning representative association in the region which could lobby on behalf of the farmers constrains their process of experimenting with new ideas.

Risk-adverse attitude – Farmers in the region can be classified as risk-adverse. Risk can be classified as the uncertainty of outcomes. This constrains farmers from engaging with new technology as well as experimentation.

Mentality of being trapped – during the influence mapping exercise, the respondents referred to their own experiences as being a driver in decision making. However, based on the interview data, the respondents never spoke about reflecting on how to do things better. Rather, they placed themselves as passive – things were happening to them and no matter what they did, they could not do anything to change the situation (land market, agricultural market, regulations).

Enabling factors:

Farmers have access to extensive agricultural literature (agricultural newspapers and journals). Additionally, the farm managers have a university equivalent education and a few have their doctorates. This foundation enables them to seek out relevant literature as well as apply it to their context where appropriate.

Tendency to go to conferences and conventions provides exposure to new ideas and the chance to network with other farmers.

Government financial support / guarantees provide the respondents with the security they need to implement radical changes and invest in expensive technology.

Some willingness for peer to peer learning - Although the respondents all stated that there was no interest in long-term peer cooperation organizations, it appears that there is openness in peer to peer learning if one farmer contacts a path-breaking farmer, one who is trying something new and succeeding, to visit their farm.

Examples of single, double, and triple loop learning:

Single loop learning

Labour: increasing job advertising in technical schools – improving existing practices of recruiting and incrementally experimenting with new recruitment techniques

Bureaucracy: farmers adapting from fieldwork to office work – learning from past experiences that too much time out of the office and in the field increases risks of failing to comply with the bureaucratic regulations (e.g. not knowing about the paperwork as well as not being able to get all the paperwork done).

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Land: farmers are improving their existing practice of maintaining relationships with landowners

Based on the interviews, single loop learning is predominant, as the farmers were reacting to situations and not trying to transform.

Double loop learning

Bureaucracy: The two attempts to organize farmers for representation in the political sphere. This has occurred as a result of farmers being frustrated with their current situation. The outcome has so far been unsuccessful, as there is a lack of interest from other farmers.

Labour: Implementing technologies which do not require labour. This has occurred because the labour shortage is extreme and only becoming worse. The outcome has been neutral, as technology is expensive and creates new risks, even though it minimizes labour risks.

Social: farmers are trying out new PR methods to create a connection to the non-agricultural community (e.g. milk stations). This became a trend in Germany a few years ago, which some farms have picked up on. All who have the milk stations say that it is PR that pays for itself and find it successful. However, the success depends on location; access to consumers.

Triple loop learning

The implementation of biogas plants transformed the farming systems and enabled farmers to be resilient to shocks and stresses.

This is an example of farmers' assumptions being transformed because the ascent of biogas was caused by EEG (renewable energy act which guaranteed prices for a fixed amount of time). Farmers feel constrained and unsupported by the government, but with this policy and the relative success of biogas, which brought economic stability in a volatile agricultural market, transformed farmers beliefs that government *could* support them.

A8.9 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

Critically assess the role of learning in the adaptive capacity cycle. Are you able to identify any indicators of learning for robustness, adaptability and transformability? How do farmers prepare for future challenges (e.g. experimenting, trying out new things, thinking about how to improve activities, keeping up to date with technology etc.).

Robustness

Many farms have displayed learning to become robust in order to absorb the shocks which are brought on by the aforementioned risks and challenges farmers face.

Some examples of this are storing their produce and or feed until the market offers higher prices. This helps the farmers absorb environmental (bad harvest) and market (prices) shocks. Farm

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managers also see room are looking to improve their operations by increasing their liquidity so that they have flexibility when shocks come. Farmers are trying out new ideas when it comes to addressing the labour shortage by marketing their farms locally and at technical schools.

Adaptability

The farms have shown several examples of learning which indicates adaptability.

In response to the environmental challenges the farmers are experiencing, they are learning about new technology which change their farming methods to withstand climate change. Farmers are also adapting to regulations and market prices by either exiting livestock production or growing their livestock production to an economy of scale much higher than exists. Adaptation in the face of labour challenges can be observed by the learning about and experimentation with labour-substituting technologies. Farmers have learned to adapt to the bureaucracy by working in the office instead of the field. The managers are also learning to adapt to the populism regarding agriculture by trying out public relations strategies.

Transformability

The main example of transformability is the presence of biogas plants on these farms. With the introduction of biogas, farms have transformed their systems from food production to also include energy production. However, this is not a permanent transformation, as many farms are unsure if they will continue to produce once their guaranteed prices have run-out, which will coincide with when the biogas plants will require major investments to continue to run. The respondents varied in how they were preparing depending on when their tariffs were running out. All of the biogas plants have several years left, and while there was interest in continuing with biogas production, the respondents had the approach that "they will have to see what comes [in terms of energy prices and policy changes]." In order to maximize their plants, the respondents go to biogas conventions to learn about new technology and opportunities and stay up to date with new technology options by researching them.

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Appendix 9: Italy Country Report

A9.1 Who/what are the most important influencers on farmer decision-making, and why?

The most prominent influencers on farm decision-making process are undoubtedly the members of the family. Indeed, family-farms are the core of the hazelnut sectors, and very often all the family is involved in the farm business, which explains this result quite clearly. Moreover, many nodes refer to family as the "trigger for change", especially when decided to convert to organic production (often pulled by new generation's values and belief), or to expand (or not) the farm size in view of the future generational renewal of the farm management. Furthermore, personal (i.e., family) experiences prompted many changes on the farm, and the decision of going through a certain transition is previously debated within the family. Concerning the influence map, 'family members' is cited 11 times with an average score of 1.4 that put them in the very centre of the map.

Gathering together public institutions, they account for 10 mentions and an average importance of 3.5, mainly negative. The latter is mainly due to the delay in providing II pillar subsidies, especially those related to farm investments. Moreover, some interviewees explained how II pillar measures destined to the organic conversion (i.e., payment per hectare converted) eventually encourages conventional production systems by financing first-stage investments. Many claimed such payments during the first 5 years of plantation, when the hazelnut is not producing and the monetary investment is relatively low. Once the tree enters in its production phase, they "abandon" the organic production and start the conventional one. Generally speaking, public subsidies also provide positive incentives for farm investments (i.e., via II pillar measures), and well support the loss in yields when producing according to the organic standards.

Another crucial agent in decision-making are professionals, especially the agronomist. This figure is often present in the farm management, as she provides scientific-based support for technical decisions related to both agronomic and administrative/beaurocratic tasks. Indeed, experimentation of new techniques on-the-field often sees its origin from a suggestion made by the agronomist. Likewise, the decision of adhering, or not, to certain CAP measures is frequently taken accordingly to what the agronomist suggests. However, his/her support in the decision-making process is not central, as revealed by the influence map, in which the average score for this figure is 3, albeit being cited by 8 interviewees.

The local farmers' community heavily affects the decision process. Indeed, there exists a strong sense of agricultural community, everybody knows each other, and the word-of-mouth is possibly the speediest way through which information and innovation is conveyed. The organic conversion is the example of how the community interacts; indeed, agricultural tradition of conventional production methods prevails, and for those who converted to more sustainable form of productions, neighbours do not spare criticisms. This, in some cases, seems to hamper the change in this way. On the other hand, positive influences is also exerted by spreading quickly new information about market and innovations, as well as giving all type of support to neighbours and

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other members of the community. The result that the influence map reflects is somewhat different from what the researcher retrieved by coding: 7 mentions and an average of above 4, encompassing a marginal importance in the day-to-day management.

Farmers' associations (i.e., Producers Organizations (PO's), National and Regional agricultural associations) entails a significant effect on farm-related decisions. Indeed, via PO's farmers have quickly access to EU-related funds destined for investments (mostly related to machinery-renewal, new machinery purchasing, and storage facilities), and harvest-related incentives (i.e., the double-harvest incentive that grants a premium to those deliverying their harvest in the very first period of the harvest-time). Moreover, associations often promote seminars and meetings, bringing in new technical skills, administrative suggestions on how to better manage the farm, and a moment of confrontation and sharing among the community. This encourages on-farm changes. Despite they are present in 7 influence maps, their average importance is approximately 3.

Machinery suppliers are often listened before the purchasing, renewal, or modification, of some machinery. Farmers rely heavily on this agent when mechanisation processes are involved, mainly because they are part of the historical evolution of the sector (i.e., active role in the mechanization of the hazelnut sector) and strongly rooted into the territory. However, since investment in machineries is not an everyday activity, their average importance, regarding the influence map, is approx 4, and they are present in 6 records.

Likewise, other further agricultural technicians cover an important role in the farm decision-making process. Cited 6 times, with an average score of 3, this broad category includes centre for financial assistance (CAF), and centres for agricultural assistance (CAA). Their involvement in day-to-day decision concerns labor-related issues, farm's legal assets, and norms.

Public research centres also account for a significant presence in influence mapping, with 6 mentions, and a marginal importance of approx. 4. On the one hand, some farmers expressed their disappointment toward the local University, since it does not provide useful information regarding new threats (i.e., the so-called Asian bug and new investments in non-traditional areas), new production methods (i.e., organic), and current problems (i.e., water scarcity, environmental pollution); on the other hand, they also supply brand new information on some techniques and organise seminars and technical encounters on both agronomic and subsidies-related that are useful for enriching the farmer's background.

When undertaking changes farmers often apply what they saw around, relying upon what the neighbours are doing and have already done. Nevertheless, this is not always the case, and when farmers innovate, in the strict sense of the word, family members still represent the main influencer. In such cases, both the agronomist and other technical services gained in importance, since their support is very well welcomed by farmers. In few cases, the farmers' collaboration with local research centres prompted the change, supported by science-based suggestions. Interestingly, when converting to organic the agricultural community exerted a negative impact: the coral suggestion was against the switching, but farmers did not take into consideration such

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suggestion and preferred to go ahead with their intuition. Albeit this has not emerged from the influence maps, the internet (i.e., official and technical websites) sometimes provided useful technical information before a change, and sometimes is used in the day-to-day management, for example for deciding the right time to sell according to the price trend.

A9.2 Do these influencers change over time in relation to different decisions/risk management?

When undertaking changes, both the importance and significance of those actors do not vary significantly. Family is at the very focal point of decision-making, and all the other categories just "orbit" around it.

When technical changes are involved, the agronomist, Universities, and the agricultural technical centres gain in importance, since their feedback is of importance for farmers, relying on science-based support. Furthermore, they organise ad-hoc seminars and meetings with experts, providing the farmer community with a space of confrontation and sharing of information and experiences.

If the change involve some on-farm investments or the possibility of significant CAP subsidies, then public institutions enter in the decision-making process: converting to organic and the per hectare payment provided by II pillar measures, as well as heavy investments in new machineries and facilities, and the possibility of getting access to other II pillar measures covering part of the investment, make them an important agent in the decision process.

Farmer associative forms, especially PO's and Cooperatives, also provide large amount of significant information and space for discussion and confrontation among farmers, which eventually enrich farmers' background information and help out in taking decisions. However, in some cases, the local community works in the detriment of the change, as in the case of conversion to more sustainable production systems. This may prevent the change for some farmers, while for others, often young farmers still undergoing agricultural-related studies, this does not entail any obstacle for converting.

Nevertheless, from the interviews it emerged a clear path of youngest farmers to also rely on the internet for retrieving data about international prices, techniques, and economic performances of future structural changes they would like to apply (and applied afterwards). This is true also for highly-diversified farm businesses, that is those for which agritourism and other non-farming (but related) activities represents a significant source of income. Indeed, they heavily hinge on the web for both collect information and market their products. On the same line, many innovative farmers attend fairs and meetings on new techniques, CAP, and machineries to be up-to-date and look for useful innovations to bring into the farm.

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A9.3 How do farmers' attitudes and beliefs influence their decision-making?

From the interviews performed, the main pattern retrieved from the coding activity relates to the passion young people seems to feel for the agricultural sector, which eventually defines their willingness to take over in the family farm business, often with a background of academic studies related to the agriculture. This fosters (and is fostered by) the early involvement of sons and daughters in the farming activity, and, hence, in the decision making process. Indeed, many times farm strategies of enlarging the size is aimed at providing a more solid future farm for the incoming generations.

Regarding farm conversion to organic, personal beliefs and values play a very pivotal role in the decision making process. Indeed, as described before, there exists a deep and rooted cultural tradition of conventional farming. This, besides preventing the change toward more sustainable production methods due to the lack of good examples and technical inputs for such different farming, potentially hampers the change because of fearing a societal denial. That is to say, when a given farm converts, the values and beliefs are stronger than the cultural blockage in the area. With the entry of new generations in the farming system, attitudes changes: such blockage seems to be weakening, as fresh new principles regarding farming and the way it interferes with the environment are introduced.

A9.4 What external (to the farm) factors influence decision-making, and how?

Firstly, the high profitability of the hazelnut sector seems to be a strong reason for young people to stay in the family-farm business. This is widely seen as a fortune, as the socio-economic status of hazelnut growers is quite above the average in the case study area. On the other hand, there is also an inner intention of new generations to remain in agriculture, probably due to their very early involvement in the farming activity and administration, together with a very widespread "hazelnut-culture", which, many interviewees stated, is everywhere, is part of their daily life since ever.

Such culture developed through the years, and affected other sectors of the local economy: machinery suppliers. The hazelnut sector featured a quick mechanisation process that in a very few years lead this sector to be highly-mechanised. In this process, a pivotal role has been expressed by the local suppliers, whom have been able to design well-suited mechanical instruments, reducing the demand of manual labor in the countryside, improving workers' safety and security, and, eventually, representing a central figure for the hazelnut district. They provide full assistance, and they are always prepared and available for designing tailored solutions according to farm-specific needs. Similarly, the local community is a source of new information and may prompt some change, by word-of-mouth mainly. This is because hazelnut cultivation is so spread in the case study area.

Academic and other private and public research centres, together with local administrations and farmers' associations and cooperatives, provide the local agricultural community with seminars, meetings, and technical encounters regarding the CAP, new agricultural techniques, and other

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agricultural-related topics. This is very well seen by interviewees, who can share ideas, participate in discussions with experts, and listen to other farmers sharing their experiences. This is common with the entry of fresh new generations of farmers, and because of the presence of farmers-first adopters.

The usage of the internet is increasing, especially for retrieving data about international prices, new techniques, and economic performances of particular sectors. This is outmost true for those farms for which agritourism and other non-farming (but related) activities represents a significant source of income: the web is a crucial instrument for both collecting information, and communicating and marketing their products and services.

Political institutions (i.e., the EU, National, Regional, and Municipal governments) are of importance whenever the change involves some on-farm investments and the possibility of receiving subsidies. This is the case of conversion to organic (the per hectare payment provided by Rural Development Policies), as investments in new machineries and facilities (the possibility of get public cofinance to cover part of the investment).

Machinery suppliers are often listened before the purchasing, renewal, or modification, of some machinery. They represents an important agent within the farming system, as they prompted the mechanization of the hazelnut sector, and are deeply rooted in the territory, despite their international breadth.

A9.5 What are the key risks in your case study farming system, as identified by farmers?

According to farmers' definition of risk, the latter represents a loss for their wellbeing, both in terms of health, labor, and income of course. In the following lines a summary of the main risks per category is presented.

Economic risks: this category entails risk related to the market power of the confectionery industry that makes farmers price-takers and very much affected by their decisions. In particular, farmers fear that prices will decrease in the next years due to the positive trend in hazelnut plantations (again boosted by the downstream industry, seeking a larger and less geographically concentrated supply). Other economic risks are represented by the high dependency on Turkish prices and policies, price volatility, and financial management issues.

Environmental risks: bugs (already present and potential ones) are the main challenge, together with the scarcity of groundwaters and droughts, with the latter being more present than in the past. Wild animals (e.g. wild boar) also are a concern since they damage the crop and the soil, hampering the mechanical agricultural activities. They also mentioned risks related to frosts and environmental pollution due to the use of agrochemicals. They usually link frequent droughts and frosts to climate change.

Institutional&Societal: policy-related issues concern the delay in CAP Pillar 2 payments (Rural Development Policy), which exposes farms to financial risks. Local culture and tradition seems one

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of the main challenge for changes, particularly for organic conversions. They also mentioned the lack of researches on organic hazelnut farming and water management.

Labour: regarding workforce, the main risks are related to their health (i.e., agrochemicals and injuries due to machines), and the scant supply of skilled people for particular kinds of agricultural works.

Risk of the Unknown: the general economic risk seems to prevent some investments and harm the farm management.

Technological: the high-dependency on machines during a critical farming period (i.e., harvest) increases the risk of losses caused by break-down of machines. In this period of the year all harvesting machinery available in the area is busy

A9.6 What learning strategies do farmers adopt for managing risk and adapting to change?

For better coping with uncertainty and improve the farm productivity, farmers proved to be flexible by integrating new techniques, machineries, and production methods. This relates to the conversion to organic production, mainly to avoid conventional market-related risks, which takes place despite the local societal reluctance to that. Furthermore, farmers proved to be able to adapt to changes by modifying their agricultural techniques for reaching foreign (niche) markets (e.g., the Japanese organic market), or modifying their machineries for increasing productivity or maintaining It after the conversion to organic. Generally speaking, when the change took place, further changes followed for the farm to fully adapt to the new state.

Being flexible means being open to new ideas, without any prior experience or knowledge, being pioners with respect to new techniques, applying what they learned from studying agriculture-related carreers, or what other farmers already applied. Conversion to organic, apart from being flexible, requires the farmers to be open to something that their neighbours do not accept nor practice, that is, something brand-new.

Experimenting is another strategy widely applied by hazelnut-growers. They often experiment the change (or the potential change) on a smaller scale to analyze results and impacts. This happens concerning some new products and techniques (e.g., fertilizers, cultivars, and other products for the fighting of bugs), and machines. Concerning the latter, it is widespred the on-farm modification of machineries for their better functioning, according to the soil characteristics. However, such experimentation is almost often carried out together with the support of the suppliers of input: machine-companies support the modification of the machineries, while chemicals or natural products are offered by the suppliers. That is to say, learning also comes from the others agents of the supply chain. Cooperatives and POs are also crucial in the spread of information and, hence, innovation, being the most relevant centres of aggregation for farmers. This reasoning also applies to the whole agricultural community: places where the community aggregates often offer a floor for confrontation among farmers, spreading information, and innovations.

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Learning-by-doing seems to be a further process of learning and risk-management strategy. Once they experienced the consequences of a risk, they start to implement strategies for reduce that risk in the future. This also applies to the learning of new skills, since being involved in other tasks, such as administrative or agritourism services, increased their background. This strictly relates to reflexivity. Past experiences shape their knowledge and their ability of being farmers, cementing some skills and introducing new ones.

Universities are also mentioned as helpful, especially regarding technicalities (young farmers are currently studying agricultural-related careers in the nearby Universities), and when cooperating with farmers in research projects aimed at understanding how to improve some agronomic activity (e.g., fertilisation, plantation structure). This is a way to get new and updated information.

Summarising what emerged from the interviews, farmers resulted in being mostly reflexive, taking decisions and managing risks according to their current and past experience on the field. There is a strong sense of belonging to a community where the word of mouth is the main vector with which information is spread and transmitted. There is a strong sense of entrepreneurship. Indeed, there are two sorts of farmers. Those who are followers, so they apply to their business what they see around, and first adopters, whom are more innovative and try out new things coming from diverse sectors or self-tailored according to their needs.

However, it is clear that external influence is significant in bringing-in new ideas and risk management strategies. As described above, PO's, research centres, and other local agricultural services, often provide room for discussion and confrontation with professionals and other farmers. This utterly enriches farmers' background and supports the decision process and the management of risk (e.g., by a more thorough use of EU subsidies).

Cooperativism is widespread and consolidated in the hazelnut sector, primarly prompted by the need of facing together wholesaler's and transformer market power. However, this is also because there is the need of sharing information, and adopt similar strategies other already implemented. Furthermore, PO's provide incentives through their Operational Programs that are financed by means of the Common Market Organization of the CAP. These institutions also influence farm risk management strategies, as cooperatives and PO's started offering insurances tailored on the hazelnut-growers' needs (but so far very weakly implemented).

For new farmers, the web also represent a valuable source of information. Before converting to organic production, some checked the rentability of this type of farm on dedicated and official websites, while others use it for checking spot prices and decide the best moment to sell, or checking the trend and previsions of the Turkish production and market that strongly affect the international market for hazelnut.

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A9.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

The first enabling factor for learning and adaptive capacity that emerges from interviews is the local agricultural tradition. This leads new generations to be involved in the farming business since young age, transmitting the culture of farming, make them very receptive to grounded, as well as innovative, farming techniques. They rely on the oldest generations for useful suggestions and practical issues, albeit often they brought fresh values and beliefs (e.g., environmental-friendly techniques) that are not very welcomed by the local community. Indeed, such diverse cognitive factors are somehow replacing the oldest ones, and are sometimes accepted by previous generation of farmers (when new and old generations work together the decision of converting is shared between the twos). This represents an example of double-loop learning, since changing the production practices towards more sustainable methods is quite a radical innovation for the farm management.

Of course, such adaptation is not only pushed by personal values, but also by economic reasons. Almost all the interviewee fear that the hazelnut sector will shortly became a commodity, due to the planned extensive plantation in different territories. Thus, they fear a flattening in prices and an increasing market power exerted by the downstream industry, together with the current price volatility, which is strongly tightened with the Turkish's market conditions. The organic hazelnut market seems a reasonable way to tackle such drawbacks, reaching a niche market that is less volatile, receiving higher prices, and diminishing the pressure on the environment and the related health risks. Others double-loop learning are characterised by functional diversifications, that is providing agricultural-related services, such as agritourism, since it entails a different and significant managerial effort.

On the other hand, examples of adapting cycles occurring in the front loop are several: in response to severe and frequent droughts, farmers invest in irrigation systems; to stabilise the price, and , hence, their income, they started a first light processing, by cleaning and drying hazelnuts. According to their needs during farming activities, they propose to machinery suppliers what changes should be done on the machinery, to gain in efficiency. Finally, there is a clear trend in enlarging farm size, entailing several reasons, from a more efficient employment of machines and labour, to the ability of reaching economies of scale and better compete on the market.

Triple-loop learning are also present in the farming system. Some farmers gradually transformed their farm in a more comprehensive business, shifting the importance from the agricultural production to agricultural services. In this way, agricultural production is marginal, while agritourism and recreational activities, in a couple of farms, are at the core of their activity. One example is well depicted by a farm initially produced olive oil, and gradually became more oriented to tourism, restoration, and involved in educational and non-profit activities. Likewise, a brand-new farm that is challenged by the difficulties the farming activity bears, tries to switch to more tourism-oriented activities, developing a wellness centre in the middle of the farm. Indeed, old generations often employed in the agricultural sector marginally, but when this perennial

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became highly-profitable, many decided to fully dedicate to agriculture, and start eliminating previous crops (e.g., grains, vineyards, olive trees, chestnut trees).

A9.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

As described in the above sections, farmers mainly rely on their selves for taking decision and managing the farm business, especially by past experiences and experimentation. This has a significant and clear impact on the robustness of the farming system: experimentation makes one to adopt (or not) a particular technique, cultivar, machine, or commercial strategy for the entire farm, and those that succeeded in being effective and efficient are applied. Their application by one or more farmers foster their implementation by others, being the community a crucial factor for conveying information. The latter strictly relates to the strong cooperativism characterising the farming system, fostering the sharing of strategies and ideas, and aggregating agricultural producers. Such improvement in farmers' bargaining power has been helpful for the setting of tailored EU-subsidies, such as the double-harvest incentive.

Besides robustness, experimentation and information-sharing fomented the adaptability of the farming system to the changing situation occurring in the sector. The conversion to organic production is increasing, as a response to market instability and potential increasing competition and the availability of policy support. On-farm processing is nowadays widespread, obtaining higher prices, together with storage facilities for stocking the harvest and sell during higher-price periods.

Transformation occurred in the past, as when vineyards, livestock, grains, and other crops were substituted by the more profitable hazelnut. Such high profitability made also many people fully dedicate to the agricultural sector, leaving their other off-farm jobs, which represented their main source of income, whereas agriculture was a marginal activity. The mechanization allows to reduce labour requirement: this allowed to devote families to obtain some further income or producing food product for self-consumption.

However, transformability is occurring now in the farming system, with some farms switching their core business from farming to agritourism. This entails a transformation in the way the business is managed, the information needed for a healthy activity, and how to communicate and marketing their products. Regarding the latter, the use of the internet is of pivotal importance, since the targeted consumer is many times from outside the region, and the word of mouth is not sufficient.

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Appendix 10: Netherlands Country Report

A10.1 Who/what are the most important influencers on farmer decision-making, and why?

Generally speaking, the actors who had a big influence were positive influencers (e.g. family, farming colleagues, agronomist, accountant), while actors with a relatively small influence (e.g. Ministry of Agriculture, EU) had a negative influence on farmer decision making. The most trusted actors were the ones who had a large and often positive influence (e.g. family, agronomist, colleagues). Some farmers indicated that the longer they collaborated with someone, the more trust they had in him or her. Long-term relationships seem to result in more trust.

It is striking that negative media attention is one of the key external factors influencing decision-making (see section 5.4) and perceived risks (see section 5.5), but that it is not considered to be the most important influencers. If listed at all, (social) media scored between 4 and 6 on the influence maps. We have no explanation for this.

The six key influencers in the Dutch case study were family, farming colleagues, cooperatives (and agronomists), accountants, the Ministry of Agriculture, and the EU. Each of these influencers will be discussed in more detail below.

Family (incl. partners, children, parents, siblings)

Most farmers indicated that their family was one of the most important influencers on their decision-making. Most of the interviewed farmers had a family farm that was often managed together with their partner. Together with their family, most of the decisions were made. This explains why family was often listed as a key influencer. One exception was R09, he indicated that his family had no influence at all on his farm. However, he was a relatively old farmer that was close to his retirement without having a successor... His family was not active on the farm.

Farming colleagues

Farming colleagues affected decision-making and fostered social learning in three ways: (i) sharing new ideas and discussing practices together; (ii) experimenting together, and (iii) having social contacts.

First, farmers shared new ideas and discussed successful practices in small groups or in study clubs. Most farmers preferred discussions in small groups, as this led to more in-depth information. Some farmers were a bit disappointed about study clubs, as they often did not learn as much as expected.

Second, farmers experimented together. For example, R01 experimented together with his neighbour by introducing valerian (a new crop) on his farm. They shared the risks together and spilt costs.

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Third, farming colleagues affected decision-making by maintaining social contacts. Some farmers liked the social contacts with colleagues; sometimes, farmers adjusted their decisions to maintain good contacts with their colleagues. For instance, R02 collaborated with his neighbour – a livestock farmer – by exchanging land. He considered to cultivate corn on his neighbour's land, but his neighbour did not like this idea at all. Although it was financially a more attractive option, R02 did not cultivate corn to maintain good contacts with his neighbour.

Cooperatives (and agronomists)

In our case study region, most farmers deliver their starch potatoes, seed potatoes and sugar beets to cooperatives. These cooperatives hire agronomists who advise farmers and provide them information about good farm practices. For instance, farmers learned from agronomists as they often advised farmers about the best timing to spray against plant diseases or helped farmers to buy farm inputs (fertiliser, seeds). Most farmers had regularly contact via WhatsApp with their agronomists.

Accountants

Accountants provided farmers a financial overview of their farm. Farmers learned from their accountant in two ways. First, they often discussed the financial consequences of planned future changes. For instance, some farmers learned from their accountant by discussing several what-if scenarios. They talked about the expected financial consequences if they wanted to sell some land or cultivate a different crop. Second, the accountant provided information about the financial situation of their farm. For instance, some farmers only reached out to their accountant on a yearly basis to prepare the financial statements of the farm.

The magnitude of the accountant's influence differs a lot between different farmers, which can be explained by the fact that some farmers planned to make big changes – with large financial consequences – while others did not.

The Dutch Ministry of Agriculture

The Dutch Ministry of Agriculture was mostly perceived as a negative influencer. They recently introduced a ban on glyphosate and neonics. Although these decisions were made on EU-level, farmers held the Ministry of Agriculture responsible for the regulations; they found that the Ministry of Agriculture did not support them enough. Farmers felt restricted by these new regulations and considered themselves unprepared to deal with this. Most farmers indicated that they did not know any alternative for these crop protection products. Since last year, the amount of trust in the Ministry of Agriculture has been decreasing due to these new regulations.

EU

In the same fashion as the Ministry of Agriculture; the EU sets regulations that farmers have to respect. Farmers perceived that the regulations were too restrictive. These regulations create the operating boundaries for farmers; often, changes in regulations were not expected by farmers

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and they felt ill-prepared to deal with them. Some mentioned that suffered from the decoupling of direct payment during last CAP reform.

A10.2 Do these influencers change over time in relation to different decisions/risk management?

How key influencers changed over time depended on which changes took place on different farms. One farmer mentioned that building a new shed was a big change, while another indicated that it was scaling down the farm business and buying all of his land instead of renting. The size of the change affected the amount of information required and the change in network. Generally speaking, the bigger the change(s) on the farm, the more likely farmers looked for new sources of information and the bigger the changes of influencers over time were. Larger on-farm changes often result in more new influencers and sources of information because farmers are often too specialised in agricultural activities to make these changes on their own.

Using three examples, it will be illustrated how farmers looked for new sources of information outside their existing network. The first example is about a farmer who started a new farm, the second example explains how three of the interviewed farmers looked for new information sources when they installed solar panels, and the third example explains how farming fair enabled farmers to meet new influencers.

Starting a new farm

After the municipality had bought R05 of his old farm, he had to start a new farm from scratch. To start the new farm business, his jurist played an important role, as he knew more about regulations and how to start a new business. The jurist advised him how to start the new farm and which legal form was most suitable for his farm. The farmer implemented most of the advice as he was not so familiar with all the financial regulations and legal requirements.

Solar panels

Three of our interviewed farmers recently installed solar panels on their farm (R03, R04, and R09). All three farmers used different sources of new information. R03 visited other farmers who had solar panels on their farm and talked with them. R04 talked a lot with the bank to gain a better understanding of the financial consequences of installing solar panels. After the bank agreed, he started experimenting with solar panels and invested more. Finally, R09 was one of the pioneers who installed solar panels on his farm. There were no farming colleagues in his network with whom he could discuss this. He visited 5 solar panel suppliers and asked them about the estimated costs. These companies provided him with financial information and influenced his decision to invest in solar panels. Another important new source of information for R09 was the government, who provided SDE+ (sustainable energy) subsidies. Up to 50% of the investments were subsidised.

Farming fairs and networking events

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R07 and R08 went to fairs and networking events to learn about how to implement their changes in the best way. R07 was planning to visit an organic farmer fair to learn about organic farm practices which might be interesting to implement on his farm. He was very eager to learn from them and hoped to gain new insights. R08 visited an agricultural Bed and Breakfast fair and met a lot of farmers who already had a Bed and Breakfast on their farm. She learned a lot from this fair and gained a few good ideas that she could implement on her farm.

A10.3 How do farmers' attitudes and beliefs influence their decision-making?

We found that farmers' risk attitudes, self-identity, subjective norms, values, and beliefs were the most important cognitive and affective factors that influenced decision-making. These five factors will be discussed in more detail below.

Risk attitudes

Risk attitudes considers preferences under risk; it is often assumed that decision-makers are risk averse (Pratt 1964). Farmers who were less willing to take risks often struggled to make changes and big decisions on their farm. They preferred to delay these decisions until more information was available. Having to make big changes made some farmers feel uncomfortable as they preferred to maintain the farm in the current state. On the other hand, farmers who were more risk taking, experimented more with new crops and were more often open to new technologies. R02 and R04 indicated that taking risks was part of farming (and this reflected in their self-identity) and that you have to take risks to survive as a farmer (e.g. by regularly investing in new technologies). In this context, farmers who were more willing to take risks were more open to learn.

Older farmers or farmers with uncertainty about succession were less willing to take risks than younger farmers. A plausible explanation for this might be that that older farmers are closer to their retirement and do not see the need to invest anymore. Farmers who do not know if they have a successor are uncertain about the preferred time horizon of their investments and are less willing to take financial risks.

Self-identity

Self-identity explains how farmers adjust their behaviour based on their own internal perceptions of how one should farm (Hyland et al. 2016). Some farmers had a strong self-identity as a (conventional) farmer. This indicates that they identified themselves strongly as a (conventional) farmer and see farming as their role in society. They (R02, R04, and R05) did not like their organic farming colleagues. On the one hand, these farmers were eager to learn from other (conventional) farmers, but on the other hand, they were not open to learn from other non-farmers or from organic farmers. Farmers who had a less strong self-identity were more open to ideas from non-farming actors. For example, R06 was a farmer who had a less strong self-identity as a farmer and he learned from non-farming actors (e.g. his customers and the media). Some

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farmers (R02 and R04) explained that taking risks was part of farming; they indicated risk taking behaviour is a part of farmers' self-identity.

Subjective norms

Subjective norms reflect upon farmers' perceptions of social pressures to behave or not behave in a certain way (Beedell and Rehman 2000). We found a couple of subjective norms in our farming system, among others, (i) the general expectation that the son should take over the farm and not the daughter; (ii) that farming is hard work and it is expected that you work more than people with desk jobs; (iii) family members are expected to take over the family farm and not any third party; and (iv) there is a strict division between conventional and organic farmers, indicating that it is often expected that conventional farmers cannot collaborate with organic farmers.

Some decisions of farmers were in accordance with these social norms. For instance, R03 took over the business from his dad and he was the fourth generation farmer in the family. Although his sister was active on the farm as well, the son took over the business. Another example of a decision driven by social norms was found in the interviews with R04 and R05. Both farmers were sceptical about organic farming and indicated that they would rather quit farming than to become an organic farmer.

On the other hand, some farmers disagreed with the subjective norms; this sometimes resulted in being unaccepted in the farming community. For instance, R06 was an organic farmer who had a son and a daughter. His daughter is interested in taking over the farm, but his colleagues found this strange. This resulted in some tension between him and his colleagues, as he thought that his daughter was a suitable candidate, while it was expected that his son took over the farm business. Also, the fact that he was an organic farmer and most of his colleagues were conventional farmers introduced some tension.

Values

The most important values that influenced decision-making were: (i) to treat others as you wanted to be treated; (ii) to enjoy farming, (iii) to take good care of your land; (iv) to spend enough time with the family. These values often influenced farmer decision-making. For instance, farmers took good care of their land to ensure good land quality and high yields. This stimulated farmers to learn about good land stewardship by attending study clubs, experimenting with cover crops, or conducting research about the amount of organic matter in the soil to gain insights in the soil quality of his land.

Beliefs

Most farmers found it important to show citizens why they applied certain crop protection products. It stimulated them to think about how they could reach critical citizens about the current agricultural practices. Some farmers started agricultural education activities and actively reached out to the local community to explain why they sometimes had to apply crop protection products.

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A10.4 What external (to the farm) factors influence decision-making, and how?

External factors had a huge influence on the interviewed farmers. Farmers often perceived external factors as negative influencers as these external factors sometimes introduced restricting boundaries, rather than opportunities. Farmers found it hard to deal with external influencers because they had no influence at all on them. External influencers were often listed as a risks as well (see section 5.5 for a further elaboration on farmers' perceived key risks). The three most important external influencers were: crop protection and manure regulations; policy changes; and (often negative) media attention. These external factors will be discussed in more detail below.

Crop protection and manure regulations

Changing regulations restricted farmers from using crop protection products (neonics, glyphosate) or applying a sufficient amount of manure on their land. These regulations forced farmers to either change their input mix (e.g. more fertiliser and less manure) or resulted in uncertainty due to the unavailability of suitable alternatives (e.g. there are no alternatives available for neonics and glyphosate). Farmers struggled to adjust to these changing regulations and were often not able learn from this. An explanation for this might be that the crop protection regulations recently changed and that farmers will need more time to adopt or develop alternatives for these crop protection products.

Policy changes

The last CAP-reform introduced the decoupling of the direct payments. It was one the main external factors affecting decision-making. Especially for arable farmers in the Veenkoloniën, this was a major external influencer. They cultivated a lot of starch potatoes and wheat and the CAP-subsidies reduced heavily for these crops. It has been mentioned that decoupling the direct payments resulted in big financial losses. Some farmers mentioned the role of Avebe – one of the largest starch potato cooperatives in the region – that helped farmers receiving a better price for their starch potatoes. This compensated for their losses in direct payments. Together with Avebe, farmers learned about how to overcome the decoupling of the CAP payments. The SDE+-subsidies for sustainable energy were an example of a positive influence of a newly introduced policy. These subsidies stimulated farmers to invest in sustainable energy and had a positive influence on farmers' decision-making.

Media

Media were another important external influencer and could have both a positive or negative influence on farmers. An important information source is Twitter; examples of how social media enabled farmers to learn were: (i) farmers who stayed in touch with other farmers via Twitter and learned about best farm practices and (ii) gaining new information via Twitter about Dutch policies. For instance, by following Dutch politicians and agricultural lobbyists on Twitter or looking up new information on the internet.

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On the other hand, media were sometimes classified as a negative influencer. Farmers described a lot of negative media attention and that they felt sometimes ashamed to be farming. They learned from this because they now understand how society thinks about agriculture and which expectations they have. We think that the negative influence of media dominates the positive influence. For some farmers, all the negative media attention was one of the triggers to invite more people on their farm or to teach agricultural education on primary schools. In this way, they were able to tell their story and show society that farmers do care about what society thinks about agriculture and farming.

A10.5 What are the key risks in your case study farming system, as identified by farmers?

In the Dutch language, explaining the concept "risk" to a farmer is a bit tricky. When we asked farmers about the main risks on their farm, they usually answered that the main risk was not being able to work on the farm anymore due to, for instance, injuries or death. Often, further elaboration on how we understood risks was needed. Farmers usually related risks to personal risks, while "challenges" were interpreted broader and often included economic, environmental, social, and institutional risks. Usually we asked farmers about "challenges" instead of "risks" to get an overview of their perceived key risks

Financial, price, and production risks dominate classical agricultural risk management literature and are often described as farmers' main risks. Surprisingly, farmers did not perceive any of the price or financial risks as most challenging. The results are consistent across most interviews. Farmers perceived unexpected (or unanticipated) risks as most challenging risks; as well as the risks that they could not influence (e.g. media attention, politics turning against agricultural, public acceptance or stricter regulations). Often these were "external" risks caused by off-farm actors. We found similar results for the risk perception question in the Dutch farmer survey (T 2.1).

Literature indicates that risk perceptions are the product of the subjective probability and subjective impact (e.g. Meraner and Finger, 2017). Risks that could be managed by the farmer himself using risk management instruments were often mentioned as risks (e.g. price volatility could be managed by production contracts), but were not perceived as major risks (i.e. they did not have a high impact). This might be explained by the fact that these risks were expected (i.e. it is at least known or farmers are able to roughly estimate subjective probabilities) and that farmers could prepare themselves to tackle these risks. This may illustrate that farmers care more about the impact of risks, than about the probability.

We found that risks that were either unexpected or risks that were not being managed by risk management (e.g. "external" risks as policy changes or regulations) were the highest perceived risks. An alternative explanation for this might be the affective component in risk perceptions which is among others described by the risk as feelings model of Loewenstein et al. (2001). They describe that feelings about risks – together with the perceived probability and impact – are an important affective component in determining farmers risk perceptions. Farmers experienced negative feelings about unexpected risks and unmanaged risks and this may increase their risk perception.

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Our interviewed farmers understood the concept "risk" as follows: risks are the (often unexpected) events which cannot be managed using risk management strategies. Note the conceptual similarities between this definition of risk and the understanding of vulnerability in development economics and development resilience literature (see e.g. Cissé and Barrett, 2018, Barrett and Constas, 2014, Klasen and Waibel, 2013), where vulnerability is defined as the effect of risks that cannot be managed using risk management strategies, on their income or change or other system states (Barrett and Constas, 2014). Farmers' understanding of risks can be explained by resilience theory and the SURE-Farm framework, as both distinguish between expected and unexpected shocks and stresses (Meuwissen et al. 2019). It seems that unexpected risks were perceived as major risks, while expected risks were not.

The three key risks (in descending order of importance) were: changing and too strict regulations; negative media attention; and droughts. These three risks will be discussed in more detail below.

Changing and too strict regulations

Especially related to the recently introduced ban on some crop protection products (e.g. neonics, glyphosate), strict manure regulations (including nitrogen and phosphorus regulations that restricted farmers from applying enough manure on their land), and the current and past CAP reforms (especially the decoupling of the direct payments has been perceived as a risk). Nearly all farmers mentioned changing or too strict regulations as a key risk; they felt unable to come up with good risk management strategies to deal with this.

Negative media attention and how this affected public acceptance and societal expectations

In the last couple of years, Dutch media reported an increasing amount of agricultural scandals. Examples that were mentioned during the interviews were: stable fires, manure fraud of livestock farmers in Brabant, the negative effect of neonics on bees, and that farmers were paid to allow drug dealers to dump their waste on their land. These examples negatively affected public acceptance; farmers perceived that society had a (more) negative view due to negative media attention. Some farmers tried to deal with this by talking to citizens, inviting people over on their farm, or providing agricultural education. However, most farmers thought that did not help to fully tackle this risk as nearly all farmers mentioned this as a key risk.

Drought

Last summer, most arable farmers suffered from a long-lasting drought. This was only a risk for the 5 farmers that were interviewed in November and December 2018 (after the drought occurred). Last summer's drought had a huge financial impact to some of the farmers. 2 out of 5 farmers perceived this as a key risk, while the other 3 farmers did not: "Well, you know that you have some bad years in farming. If you cannot deal with this, you shouldn't become a farmer" (R09). Most farmers were prepared for a short period of drought, but not for a long drought. Some farmers had irrigated their land to deal with droughts; however, when the drought

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continued for a longer period, water availability became an issue and farmers were not allowed to irrigate their land anymore.

A10.6 What learning strategies do farmers adopt for managing risk and adapting to change?

Our understanding of the relationship between learning and risk management is twofold. First, learning is an important pre-requirement for successful risk management. Second, learning can be understood as a risk management strategy to overcome social risks.

Learning facilitates managing risks and adapting to change

We observed that learning processes often involved multiple learning strategies and multiple learning outcomes. This might indicate that farmers' learning processes are iterative and that these learning processes build upon previous learning strategies or outcomes. For instance, one of the learning processes of R03 resulted in experimentation with solar panels as a final learning outcome (illustrated in Figure 1). However, the learning process consisted of three stages. First, he visited a couple of farming colleagues who had already installed solar panels on his farm. This learning strategy (learning from others) resulted in an increasing interest in solar panels. Second, he decided to actively look up more information about how he could implement solar panels by contacting several solar panel suppliers. The learning strategy (seeking out new information) resulted in an improved knowledge about solar panels (learning outcome). Finally, he started to experiment with solar panels by installing a couple of solar panels on his roof. Once again, experimenting can be understood as both a learning strategy and learning outcome.

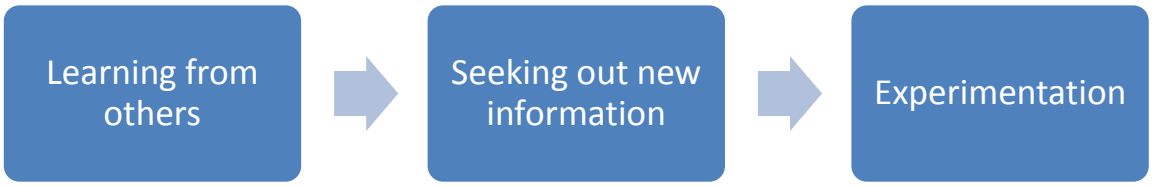

Figure 4 An example of a learning process that involves multiple learning strategies and learning outcomes

We found indicators that farmers' learning strategies which fostered risk management included, experimentation, learning from others, acquiring new information, reflexivity, and being open to new ideas. These learning strategies helped farmers to acquire knowledge and improve their understanding about risks and farm practices. This is an essential requirement for good risk management. The importance of learning in fostering risk management can be illustrated using the strategic risk management cycle of Hoag (2009). The strategic risk management cycle (Figure 2) explains which phases farmers go through to make risk management decisions. Learning may contribute to all of the phases described in Figure 2, but we found indicators that learning

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especially contributed to the following five stages of the strategic risk management cycle: (i) establish risk goals, (ii) determine risk sources, (iii) identify management alternatives, (iv) estimate likelihoods, and (v) monitor and adjust the current farm practices.

Figure 5 The phases of the strategic farm risk management cycle (Hoag 2009)

Experimentation, learning from others, acquiring new information, reflexivity, and being open to new ideas are examples of learning strategies that facilitated risk management. These learning strategies will be discussed in more below. It will be explained how each learning strategy influences several phases of the strategic farm risk management.

Experimentation

Example of experimentation include experimenting with new crops, technologies, farm inputs or trying out new practices to improve soil quality. Most farmers experimented with new crops before they actually implemented it on their farm. Farmers learned about alternative varieties to overcome plant diseases, for instance *phyotophora,* and adapted themselves in this way to these changes. This specific example, relates to identifying (risk) management alternatives in the strategic risk management cycle (Figure 2).

Learning from others

The most important actors from whom farmers learned were: farming colleagues, study clubs, agronomists, and family members. Learning from others helped farmers to determine risk sources, to identify management alternatives, and to estimate the likelihood that risks occurs (Figure 2). For instance, R03 indicated that he learned from his farming colleagues and study club about new management alternatives to meet the greening regulations of the CAP by growing

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cover crops in an alternative. Another example of how learning from others fostered risk management was when farmers learned in study clubs about new risk sources by discussing the impact of a potential *phytophora* outbreaks or the likelihood of potential *phytophora* outbreaks.

Acquiring new information

For instance, R07 acquired information about his soil quality by inviting an agronomist to measure the amount of organic matter in his soil. He compared the results with those of neighbouring farmers (both organic and conventional) and found out that his current soil quality was good. Acquiring new information gave him insights that there was no need to manage this risk. It relates to three stages of the strategic risk management cycle (Figure 2). First, it gave him insights that helped him to understand that his soil quality was no risk source for him. Second, he realised that soil quality was not a risk goal that should be managed. Third, he understood that he did not had to identify any management alternatives to manage his soil quality.

Reflexivity

As a learning strategy, reflexivity facilitates risk management by contributing to farmers' ability to monitor, adjust their current farm practices, and set new risk goals (Figure 2). Reflexivity might either facilitate risk management as it helps to understand how to prevent existing risks or it might not facilitate risk management if it results in new insights that current risk management strategies are unsuccessful. For instance, R02 cancelled his hail insurance after he had experienced problems with receiving pay outs of his insurance claim. His reflection on the hail insurance concluded that the costs were too high compared to the benefits; this was for him the reason to cancel the hail insurance.

Being open to new ideas

Farmers that who more open to new ideas found it easier to identify new management strategies and this might foster farmers' capacity to manage risks. For instance, R08 managed a B&B and farming camping as a secondary activity. She asked her guests for feedback and received a lot of new ideas from her guests. One of the ideas that was introduced by her guests was to organise farm tours on her farm and talk about agriculture with them. Being open to new ideas helped R08 to identify new management strategies, in this case organising farm tours. She decided to adopt this new ideas and started to organise farm tours.

Learning as a risk management strategy

Our second understanding of the relationship between risk management and learning, is that learning can be understood as a risk management strategy. Learning strategies which could be understood as risk management strategies include the ability to be flexible (e.g. flexibility with respect to input sources could be a risk management strategy to overcome high input prices), experimentation with new technologies, and learning from others (e.g. learning from others in a study club helps farmers to acquire more information about certain risks which helps farmers to better understand how to manage risks) could be understood as a risk management strategy.

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Another example of how learning can be understood as a risk management comes from the farmer survey results (Task 2.1). Preliminary results of the survey indicated that public distrust (weighted mean = 4.9 on a 7-point Likert scale) and low societal acceptance of agricultural practices (weighted mean = 4.8 on a 7-point Likert scale) were two of the highest perceived risks among 924 Dutch farmers from different farm types. These social risks affect public trust in farming and learning can be used as a risk management strategy to cope with this. For instance, one of the interviewed farmers (R07) indicated that he learned from the local community about their expectations to gain a better understanding of their point of view.

A10.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

This section describes what enables or constraints farmers' learning strategies and provides some examples of single-, double-, and triple-loop learning. We found that factors enabling or constraining farmers' ability to learn included external factors and cognitive and affective influencers. The results of our interviews indicated that farmers' learning processes could be most often described as single-loop learning.

Enablers and constraints of farmers' learning strategies

A combination of external and cognitive and affective factors enabled farmers to learn. An example of an external factor enabling farmers to learn was the introduction of SDE+-subsidies for sustainable energy. These subsidies stimulated farmers to invest in solar panels and enabled them to learn about how to adopt new technologies. On the other hand, networks enabled farmers to learn; farmers with bigger networks had access to more sources of information and could easier obtain the needed information. Finally, farmers' personality may enable them to learn. For instance, farmers with a positive attitude and high self-efficacy – the perceived ability to succeed an activity (Bandura 1977) – found it easier to learn.

Factors constraining farmers from learning included external and cognitive and affective factors. External factors that constrained farmers from learning included strict regulations; a lack of information or uncertainty; and financial lock-ins. For example, strict regulations were perceived as a factor constraining farmers from learning as they became demotivated to adjust their farm practices to the new regulations and waited until more information was available. On the other hand, farmers' personality may also constrain from learning. For instance, farmers with a strong self-identity identified themselves strongly as a farmer and were less open to ideas from non-farmers.

Examples of single-, double- and triple-loop learning and their learning outcomes

Learning plays a role in the adaptive cycle via single-, double-, and triple-loop learning (De Kraker 2017). Single-loop learning can be understood as incremental changes to meet goals by improving the effectiveness of outcomes (De Kraker 2017). Double-loop learning involves more fundamental learning, and changes the underlying assumptions systems goals (*ibid*). Triple-loop learning relates

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to transformability, creates new paradigms, and changes the norms and values of the current system (*ibid*). Most learning processes can be described as single-loop learning, while we found less indicators of double- and triple-loop learning. Some examples of single-, double-, and triple-loop learning will be discussed below.

Single-loop learning

Examples of single-loop learning include adopting new technologies, experimenting with new crops, openness to innovation, and learning from study clubs. For instance, some farmers experimented with new crops and sometimes decided to keep the new crop in their crop portfolio. The result of these incremental changes (i.e. the introduction of a new crop) made farming more efficient. However, the introduction of a new crop to their portfolio did not result in any changes in farmers' goals, so there is no double-loop learning involved.

Double-loop learning

R07 is a conventional farmer who is interested in organic farming practices. He contacted several organic farmers and joined a sustainability study club to learn about organic farming. After several discussions, he realised that soil quality is as it important as the profitability of his farm. To improve soil quality, he already implemented some organic farm practices. This illustrates double-loop learning, as the farmer rethought his assumptions and redefined his goals (i.e. he realised that soil quality is as important as farm profitability).

In our opinion, this example does not illustrate triple-loop learning as the farmer did not fully convert to an organic farmer. A full conversion to organic farming would indicate triple-loop learning, as this is associated with a paradigm change and questioning norms and values.

Triple-loop learning

Agricultural tourism and recreation became more important for R08. After having visited several agricultural tourism fairs, she decided to start experimenting with the B&B., R08 decided to shift the main business focus from farming to agricultural tourism. Because of the hard financial times in farming, R08 changed the main business focus from farming to tourism. This illustrates triple-loop learning, as she questioned her past norms and values. The farmer did not feel like a farmer anymore, but as someone who was working in tourism, which illustrates a paradigm change.

A10.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

This section discusses the role of learning in the adaptive cycle and identifies potential indicators of learning for robustness, adaptability, and transformability. We found that some learning outcomes (e.g. having a large network) might be an indicator for general resilience and not for one of the resilience capacities (robustness, adaptability or transformability). Finally, it will be discussed how farmers prepare for future challenges.

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Indicators of learning for general resilience, robustness, adaptability, and transformability

Some learning outcomes affected farmers' general resilience and none of the resilience capacities (robustness, adaptability, or transformability). We found indicators that having a bigger network potentially enhances farmers' general resilience. Farmers with a bigger network were well-connected to peers and their network of influence, which made it easier to overcome shocks and stresses. These findings are in line with the 5 generic resilience principles of the Resilience Alliance (2010). A bigger network might affect the tightness of feedback in a system as farmers within their networks or close ties in their network more likely to receive feedback from their network.

We found five potential indicators of how learning might enhance robustness, adaptability, and transformability. These five indicators and learning strategies are: reflexivity; self-efficacy; innovation and experimentation; openness to new ideas include; and feeling uncomfortable to transform.

Reflexivity

In our opinion, reflexivity might contribute to farmers' robustness and adaptability. Farmers who reflected more on their own farm were better able to identify how they could overcome unexpected or expected shocks and stresses. This made farmers more aware about their own robustness or if they had to adapt to overcome risks. We found no indicators that reflexivity might influence farmers' capacity to transform.

Self-efficacy

Farmers who have a higher self-efficacy are better able to overcome unexpected shocks and stresses. This might indicate that farmers with higher self-efficacy are more robust or better able to adapt.

Innovation and experimentation

We found indicators that farmers who enjoyed innovation and experimentation were better able to adapt themselves to shock and stresses. Often, innovation and experimentation resulted in changes in input mix, cultivation of different crops, or experimentation with machinery.

Openness to new ideas

Openness to new ideas stimulated farmers to adapt, for instance, by adopting new technologies or new farm practices. It might be that farmers who are more open to new ideas are better able to adapt themselves. On the other hand, openness to new ideas can be understood as a pre-requirement for transformability. As transformability involves radical changes and fundamental new ideas, farmers have to be open for new ideas in order to transform.

Transformability makes farmers feel uncomfortable

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Some farmers were aware that transformation will be needed in the long-run in order to survive as a farmer. For instance, R07 indicated that reflexivity (i.e. he reflected on his farm business by investigating the cost-price and market position of his farm) made him aware that he might have to transform in the future. However, he felt not comfortable to transform as there was a lot of risk involved in transforming the farm business.

Learning and farmers' future challenges

Our interviews illustrated that learning helped farmers to be better prepared for future challenges and risks. Five key learning processes that helped farmers to prepare for future risks: seeking out new information, learning from others in study clubs, being open to new ideas, reflexivity, and experimentation.

Seeking out new information and learning in study clubs helped farmers to be better informed about future challenges. Farmers who were open to new ideas (e.g. from researchers, network events or citizens) felt better prepared to overcome future challenges because they were more likely to experiment and try out new solutions proposed by others. Finally, reflexivity turned out to be crucial for farmers to better understand which specific farm practices will need to be improved to deal with future risks.

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Appendix 11: Poland Country Report

A11.1 Who/what are the most important influencers on farmer decision-making, and why?

Family - The conducted research shows that the closest family members had the biggest influence on the decisions made in analyzed farms. In the case of young farmers, they were mainly parents. "My parents help me there, they support me in terms of knowledge and practice, because I do not have enough knowledge or skills. It's very helpful" (Resp. 6 PL). *"We three sit together* (mother, father and son) *and discuss ... what we are going to sow, we are talking about what had a good price last year. This is very important"* (Resp. 2 PL). In the most of other farms, decisions were taken jointly by spouses. *„Decisions are made together by wife and husband"* (Resp. 1, 3, 4, 7, 8, 9 PL) based mainly on their own experience *„Nobody here can tell me anything, I know better"* (Resp. 4 PL); *„All the information need to be sifted through. It is important to think reasonably. Everything need to be thought through"* (Resp. 3 PL); *"All of what we are doing we do according to our ideas, our views"* (Resp. 7 PL); *"My own thinking was the most important here, that is the thinking based on the previous experience in the farm and the appropriate education, which paid off here in proper cultivation and in fine operation of the farm" (*Resp. 8 PL), although the role of men and women in running farms were different: *„Decisions are made together by spouses. Husband is running the farm and wife is taking care of retail sales"* (Resp. 2 PL); "When the need comes the wife is adapting and currently she is helping in harvesting, growing and weeding - gentler women's tasks" (Resp. 8 PL); *"Managing the farm is done by me, my wife helps in conducting non-agricultural activities"* (Resp. 5 PL).

Farming neighbours – The significant influence on the decision making came from local farmers, but mainly in the areas with highly developed farms. *„Fellow fruit-growers… We are in one association and we talk to each other. We give each other advice and help. For example: about the emergence of threats in the orchard…. which spray to use. Just like in the countryside, everyone knows everyone"* (Resp. 9 PL); *"An important source of information are people from the industry, and there are numerous ways to get those information - word of mouth – we have many friends and acquaints"* (Resp. 3 PL); *"An information exchange between farmers is very important"* (Resp. 4 PL); "The second thing is talking with friends who grow such plants …. friends who convinced me to this field of cultivation because it pays off. All you need to do is to approach it well … … they told me in which purchase centers sell my products, what are costs…. now friends are more likely to come to me …. I was one of the first in my town cultivating soft fruits and some people come to me for a seedling and for advice on how to plant, what to plant, and what to plant in inter rows" (Resp. 8 PL). An example of such action was the creation of producer groups: e.g. Association of Fruit and Vegetable Producers in Polubicze (Resp. 9 PL) or „Kalgrup Ltd in Steniatyn Kolonia – fruit and vegetable producers group" (Resp. 2, 3, 4 PL).

Consumers, traders and processing plants - *"We produce what the customer is interested in, currently we sell all our products in retail*" (Resp. 1 PL); "*A cold store nearby is located in Łaszczów,*

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there is also a cold store in Zamość. Also three purchase points have been established close from here. Even in Kryszyn there is one buying point that takes straight from the field (by units), so the profitability was good. There was a demand"; (Resp. 2 PL); *"Due to change in consumers' tastes the farm changes the varieties of fruit trees. There is ongoing rotation, we constantly change the trees. When a new variety of fruit is popular among customers – it will be popular for around 5-6 year"* (Resp. 3 PL); *"The main influence on the decisions to increase the production of strawberries and raspberries was the increase of demand stated by the local fruit purchase centres (with cold store). Those institutions, those purchase centers… Those facilities, those cold stores, they have the most influence, which you have to take into account and align to their demands… If we didn't have them we wouldn't plant it"* (Resp. 7 PL)*;*

Internet – Irrespectively to the level of farmers' education and a size of a farm, all surveyed farmers indicated the importance of the Internet in the process of obtaining information.

„Currently most needed information is obtained from the Internet…. everything can be found in the internet and it is possible to order seeds faster and cheaper…. Owners also look for the information about market tendencies in the internet" (Resp. 1 PL); *"If you read something in such magazines as Modern Orchard or Jagodnik, then you use the internet to deepen your knowledge about given topic…. you use the internet to find proper trees, which rootstocks are adapted to our soil conditions… each variety is very well described there. What variety and what it means …. whether it yields earlier or later, whether it blooms during the forecasted frosts or later*" (Resp. 9 PL); *"We didn't know much about the Internet, but our sons were finding information on plant protection products against diseases…. our sons helped us…. Now it's the internet, but before there were journals. Now in the internet I read some new things"* (Resp. 7 PL); "Internet helps a lot, very much, If you want – you can …. now in the Internet there is lots of information and conversion possibilities…. even about economic topics" (Resp. 8 PL).

Public Research Institutes, universities from the agricultural and horticultural sector – 8 out 9 respondents indicated the significant role of Universities and Research Institutes, their publications, conferences and seminars *"From the books e.g. „Fruits, vegetables, flowers"… I also continuously read the „Word of horticulture" and text-books from seventies authored by prof. Szczepan Pieniążek. When prof. Szczepan Pieniążek lived he published a lot. I also read books by prof. Mika, prof. Pieniążek and their colleagues. I took trips to Skierniewice, Albigowa and wherever something was happening in our sector, you can see there properly cultivated cherry, sweet cherry and apple trees. Each year I go somewhere. As far as I know now those institutes are not as strong and can't do as much"* (Resp. 5 PL)*; "*Research units are playing a large role in the first period of farm activity. *We used to ride to Limanowa (city) very often. And to the Agricultural University in Lublin where professor Makosz organized conferences, seminars and other meetings. And as well to other meetings in Albigowa, Lublin, somewhere nearby Warsaw, Sandomierz*" (Resp. 3 PL)*; "Fruit and horticulture trade fairs in Warsaw. During fairs we also participate in conferences. You can learn, for example, about new varieties that would be worth to plant*"(Resp. 9 PL).

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A11.2 Do these influencers change over time in relation to different decisions/risk management?

A significant influence on the attitude change of the majority of surveyed farmers was the system transformation (which began in 1989) and the accession to European Union (May 1st, 2004). According to stereotypical beliefs, Polish farmers are perceived as anti-reformers, opposing the ongoing changes. Farmers in this study have provided examples that contest those beliefs. Through the undertaken economic activities, drawing from best experience both domestic and foreign they took advantage of the opportunities that occurred in the market and created new patterns of economic and social behaviour in their local communities. Such example is farmers cooperation in production groups e.g. „Kalgrup Ltd –fruit and vegetable producers group" (Resp. 2, 3, 4 PL) or „SAD-POL - fruit producers group" (Resp. 9 PL). Main source of information in first period of the system transformation and after Poland accession to European Union were domestic and foreign conferences, seminars, trainings, fairs and exhibitions. The study shows that sources of information which farmers are using have changed significantly. Currently, irrespective of level of education and level of a farm development, most farmers in the study used the internet as a main source of information. The internet was used to obtain information, track market trends and purchase production means. In some cases farmers even tried to sell their products by the internet. The development of broadband data transmission technology was important factor in popularizing the use of the Internet. The role of agriculture and horticulture research institutes and universities in dissemination has significantly decreased. According to the surveyed farmers, at the turn of the 20th and 21st centuries these institutions enjoyed high prestige and were a key source of information and progress in agriculture. Currently in opinions of farmers their role is much more smaller. " ***"As far as I know now those institutes are not as strong and can't do as much"*** (Resp. 5 PL).

The surveyed farmers also pointed out that the role of state advisory institutions such as Agricultural Advisory Service "CDR" or Main Inspectorate of Plant Health And Seed Inspection is declining. Currently there is significant increase in the role of consultancy provided by the trade and production companies which are supplying production means or buy crops, as well as companies which provide economic and financial consulting services(preparation of applications for CAP funds, loans, tax settlements).

In all interviews respondents stated that a specialist literature is the first source of information necessary to run the farm *"if I do not know something, I take a book and read it"* (Resp. 1 PL), "*from books, all the time from books*" (Resp. 5 PL). The second source of information is the Internet "*You can find everything in the Internet… everything about given variety… seeds can be order online which is faster and cheaper"* (Resp. 1 PL), *"Internet provides plenty, one can said 'to want is to succeed'…. now in the Internet there is a plenty information …. how much you should spent, how to calculate all of this."* (Resp. 8 PL).

Next sources of information are conferences, seminars, fairs and demonstrations *"Trips to Skierniewice, Albigowa and to places where there was something going…. In those places you could*

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see well-conducted sweet cherries, sour cherries, apple trees. Every year we went somewhere " (Resp. 5 PL). Following this the next stated source of information is personal relationships with other farmers *"very important is to have talks with other farmers in person"* (Resp. 4 PL), *"We are in one association and we talk to each other. We give each other advice and help. For example, we tell each other about the emergence of threats in the orchard, what to use against it. It is like in every countryside, everyone knows everyone"* (Resp. 9 PL). It should be noted that these personal contacts were not random, but, as the respondents emphasized, with people running large, modern farms. Many of the respondents also had foreign contacts - either they participated in abroad trips or hosted farmers from the European Union (Resp 1, 2, 3, 4, 5, 6, 8 and 9).

A11.3 How do farmers' attitudes and beliefs influence their decision-making?

The analysis of conducted interviews shows that the decision made to engage in agricultural activities (in this case fruit or vegetables) was the effect of a deliberate decision among family members, usually with the spouse and parents. Farming was one of the alternatives for respondents (with the exception of two students) since, before the decision to run the farm, they worked outside the agriculture (trade, consulting, agri-food industry, transport, services). With the exception of the respondent 1 PL, who started agricultural activity by purchasing the farm, all the others took farms over from their parents as a whole or partially. The main motivation for these decisions was the vision of a "better life" working on the farm. By making decision to switch they activity to agriculture they intention was to develop their farms. The result of this decision was increased professional activity which could be seen by, inter alia, increase in farm area by purchasing or leasing a land; investments in buildings, tractors and machines; adjustments of production structure to respond to a market demand.

Only two respondents have had agricultural qualifications (completed higher agricultural studies), although all respondents noticed the pace of changes and understanded that they need to learn to follow it *"we learn throughout all our lives"* (Resp. 5 PL).

Because of those experience they started using a western agriculture standards as a point of reference. Readiness to accept distant, foreign ways is a very important change in perspective, a manifestation of "opening to the world" and a positive attitude towards new solutions.

All interviewed persons are reading professional agricultural magazines (Działkowiec; Hasło Ogrodnicze; Owoce, Warzywa, Kwiaty; Sad nowoczesny, Jagodnik Top Agrar).

The analysis of answers shows that all farmers were characterized by high independence and perseverance in pursuing set objectives. Most indications was related to the implementation of accepted plans and belief in own experience and decision making *„All the information need to be sifted through. It is important to think reasonably. Everything need to be thought through. Even in when it comes to the consulting. It is also necessary to think by yourself about a plant protection"* (Resp. 3 PL); *„Nobody here can tell me anything, I know better"* (Resp. 4 PL). All interviewed farmers were sure that their first decision was the right one. It could indicate high self-esteem, self-confidence, but also readiness to take risky actions, often yielding effects in the distant future.

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The analysis of conducted interviews shows that over a half of the respondents identified themselves with the profession of a farmer or a fruit-grower. This group emphasized its close relationship with farming. But for some of respondents, the unambiguous definition of their professional position was not so obvious. This was justified by the change in the specificity of the farmer's work and the transition from the traditional economy to a modern commodity farm. The term "farmer" understood by this part of respondents does not reflect the modern nature of work in agriculture. Not all respondents were eager to define their professional status in one word. They tried to choose between the words: farmer, entrepreneur, agricultural producer ("because agriculture is about entrepreneurship, it is not enough to just sow"). They were reluctant in using English word „farmer" as it is foreign to them. **All in all, there are two identity groups: old fashion one that thing of themselves as "farmers" and the modern one which identify themselves as "entrepreneurs", which for them is more than being "farmers" because they do more than cultivating land and growing plants, but doing also marketing, management etc.**

People who started their agriculture activity before the system transformation stated a sentiment towards the past system and pointed out the disadvantages of the market economy.

A11.4 What external (to the farm) factors influence decision-making, and how?

The surveyed respondents have listed the following external factors that have had a significant impact on the decisions made in their farms: agricultural land market, the system of employing seasonal workers, access to CAP funds, increased competition and embargo on exports to Russia, inefficient intervention policy on the fruit and vegetable market, withdrawal of effective plant protection products.

Agricultural land market. Respondents from all surveyed farms indicated that the main factor for choosing given production (fruit farming or gardening) was limited access to land. Analysis of current small farms and historic data show of farms which started with the area between 5 and 12 ha (**except of the farm 2PL)** the main way to increase profitability was to was/is to intensify the organization of production.

Shortage of seasonal workers. Due to the shortage of employees, respondents made decisions to reduce the share of labor-intensive crops, such as orchards, vegetables and to introduce species of trees or vegetables in which harvest of them can be mechanized.

Access to CAP funds. All surveyed respondents stated an interest in applying for CAP funds (other than direct payments) in order to develop their farms. Only one of those farm did not received financial support form CAP **(despite of submitted application - 7 PL).** The rest of the surveyed farms received financial support under the following measures: restructuring of small farms **(1 PL and 8 PL),** generational change - a young farmer **(2 PL and 6 PL**) and investments in an agricultural holding **(2 PL, 3 PL, 4 PL, 5 PL) , 8 PL and 9 PL).** These funds were most often used for the purchase of land or agricultural equipment.

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Increased competition and an embargo on exports to Russia. Due to the increased competition and the embargo on the sale of fruit and vegetables to Russia, farmers started to self-organize themselves and create producers groups **(2 PL, 3 PL, 4 PL, 8 PL, 9 PL).** Thanks to that, among others, they reduced transaction costs. In addition, small farms have adopted their own strategies, for example r**esp. 1 PL** started sell almost all of their vegetables in retail. Other example is the farm 7PL which started selling partially processed cabbage, which increased the added value.

Inefficient intervention policy on the fruit and vegetable market. Farms producing dessert fruits in periods of significant overproduction utilized their excess fruits (composting or free donating to hunting clubs for feeding wild game).

Withdrawal of effective plant protection products. Introducing plant varieties that are more resistant to diseases.

A11.5 What are the key risks in your case study farming system, as identified by farmers?

Economic - price fluctuations and fall of the production profitability mainly due to increased costs. Prices have remained at a similar level for many years but the prices of pesticides, fertilizers, fuels and salaries of seasonal workers are constantly increasing. Problems with distribution, changes of consumer tastes is causing the necessity to change the types of fruit trees. Also growing demands toward quality is important.

Succession - in more than half of the surveyed farms there are no successors. Children work outside agriculture or have their own companies. Surveyed farmers also consider to sell the farm in the future. In few farms, due to the possibility of obtaining a pension, only the formal transfer of the successor's farm will take place, the real management of the farm will remain unchanged. In two cases, the takeover of the farm by the successor will depend on the improvement of the economic situation in agriculture.

Environmental - droughts and ground frosts, hail, intensification of pest appearance (mainly insects, which requires a much larger number of plant protection treatments). Very effective pesticides, eg. glyphosad, were withdrawn from the sale. The Fluctuations in yield.

Labour - fruit and vegetable production requires a lot of labour inputs and the situation on the market is tough - it is hard to find workers. It is increasingly difficult to find seasonal workers from both Poland and abroad. So far, working Poles usually go abroad or take better paid jobs outside agriculture. Due to the increasingly bureaucratic system, there are also difficulties in employing employees from outside the EU (mainly from Ukraine).

Institutional - politics, etc. - a highly bureaucratic system of employing employees from abroad. A bureaucratic system for obtaining quality certificates for GLOBAL GAP, TESCO, etc. Withdrawal of effective plant protection products. The implemented system of auctions for supply of fruits to public facilities (public procurement for hospitals, army, penitentiary facilities) mainly factor is the price not the quality of supplied products, often they come from imports. System of land market and direct payments slowed down the turnover of land, payments don't always reach the farmers

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cultivating the land. Bureaucratic system of application for funds other than then direct payments from ARMiR for small farms. Embargo for export to Russia.

A11.6 What learning strategies do farmers adopt for managing risk and adapting to change?

The analysis of the conducted interviews shows that respondents used following learning strategies:

- learning from parents, relatives and friends,
- schools and agricultural colleges/universities ,
- reading professional books and magazines,
- participation in trainings, courses, seminars, conferences, study visits, fairs, exhibitions,
- learning from experiences of farmers who are successful in their business,
- learning from customers as well as suppliers and by observing market trends,
- acquiring information from the Internet,
- belonging to producer groups
- experimenting and trying new ideas on a small scale – e.g. buying small greenhouse before starting large scale production (see the examples below).

Due to the fact that the analyzed period covered the years 1986-2018 learning strategies have evolved. Until the beginning of the systemic transformation (1989) the main strategies were based on learning form the experience of parents, relatives, friends, neighbors and through education in agricultural schools and colleges. All respondents also pointed to the importance of professional literature, mainly books and magazines. They also participated in trainings, courses, seminars, conferences, study visits, fairs and exhibitions, mainly national ones. They also paid attention to activities carried out by farmers who were successful in their businesses. This period was perceived by all respondents as very beneficial for agriculture, the market was very absorptive and there were no problems with sales. The main management strategy were based on taking actions aimed to maximize production through correct and timely performed agrotechnical measures. During this period, the farmers were trying to keep their machineries up to date, however it was not easy because until 1989 sell of agricultural equipment was regulated.

The next period of 1990-2018 was characterized by not seen before pace of political, economic, demographic, social or ecological changes that significantly affected the situation of farms. Three periods were distinguished in these years: the political transformation of 1990-1997, the pre-accession process (1998-2004) and from 2004 the European integration. Respondents adaptation

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behaviors during those phases were very diverse and depended on their starting position. Respondents 1 PL, after losing their job as a result of the liquidation of the enterprise (the effect of systemic transformation) see their chances in agricultural activity. For the severance pay and loan they buy a farm with the intention of starting production of vegetables, including production under covers. Due to the lack of experience, at the beginning they built a small greenhouse, which brings in a larger income than traditional plant production. They made the decision under the influence of friends who had been running greenhouse production with a very good financial effect since the 1970s. Encouraged by the income from this small greenhouse, they took a loan to expand it. After a few years, due to the competition by imported tomatoes, they abandoned this production and switch to cut flowers, after some time they abandon winter production (due to the high costs of heating). Subsequent decisions regarding the structure of production were made after the in-depth market analysis. This is an example of experimentation and trying out new ideas based on learning form others and researching options. They also use information from their customers and adjusts production to their expectations. According to this respondent, information from suppliers of means of production, e.g. seeds, also plays an important role.

The surveyed respondent did not have agricultural education, therefore, when possible, he have used courses and trainings organized by the agricultural advisory center, professional literature, specialists of the gardening association and from 2010 also the Internet. In his learning strategy, he did not include learning from his neighbors.

The general situation in the early transformation period in Poland also influenced the decisions of other respondents, e.g. 7 PL. The decision to take over a farm was due to the lack of opportunities to work outside agriculture. However, the farm taken over from the parents where main production was a traditional grain production was too small to provide for a family of five, hence the decision to undertake additional economic activities (door-to-door selling). As a result of the increase of competition from a supermarket, the respondent suspends commercial activity and starts growing strawberries, raspberries and vegetables. In this case, the motivation for change comes from a close observation of what is happening on the market, so the main strategy of this respondent was to learn from the clients as well as suppliers and by observing market trends. This is an example how the respondent was open to new ideas.

Both examples clearly show that these farmers are watchful observers of economic life (changes occurring in the market) and are able to take advantage of their experiences to meet new challenges (frequent changes in the production structure, undertaking additional activities not related to agriculture). Internet has become an important source of information.

All surveyed respondents modernized their farms in a greater or lesser extent, using (among other things) financial resources as part of the SAPARD (Special Accession Program for Agriculture and Rural Development) or later the Rural Development Program. In many cases, these modernizations were based on innovative solutions e.g. the use of "ULO" (Ultra Low Oxygen) technology for fruit storage. Other examples of introduced modernization and innovations include: new irrigation systems - mainly orchards; experimenting with new, often imported from

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abroad varieties, and the replacement of the old machineries to a new, a more efficient, ones. Introduction of these changes was usually preceded by participation in trainings, seminars (to get know-how) and conferences, study visits both in domestic and (more and more often) foreign universities, scientific institutes, fairs, exhibitions or other farms.

An important learning strategy adopted by some respondents (2 PL, 3 PL, 4 PL, 8 PL and 9 PL) was to undertake some form of a formal cooperation. The main motivation was to learn from each other and also to benefit financially. In the case of these respondents it wa joining to, or creating producers groups. According to the research, these farmers observed a number of benefits resulting from membership in such a group. Among other things, they mentioned the possibility to get more favorable prices for fruits and vegetables or cheaper means of production. They also mentioned access to information, participation in training and financial assistance. In addition, producer groups were able to apply for financial resources for the development of their activities, which, according to the interviews, they did and benefit from it.

A11.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

In farms starting their activity back in the nineties (or like in the case of PL 8, where the respondent took over the farm in 2010) the strategy of learning from parents, acquaintances and even neighbors became increasingly less important, mainly due to traditionalism of those people. In that place the new important strategy was to opening themselves to "external" sources of information (generally information from outside of the farm, especially electronic and verification of the information in practice – explained below) Only the youngest respondents 2 PL, 6 PL and 9 PL relied on the knowledge and experience of parents and siblings. Farms which were hand over to successors were characterized by a relatively high level of development and profitability.

In the learning strategies, respondents use less and less books and more and more magazines or information published in the Internet (mainly the Polish website, very rarely they look at foreign sources due to low command of foreign languages). They are aware that the sources they are reading need to be carefully selected and then verified whether it is trustworthy (that is by talking to others, etc.). So in application of this strategy, they see a great importance of exchanging experiences with other farmers in the industry, e.g. members of producer groups, producers encountered at fairs, exhibitions, seminars, conferences or study trips. All in all, in those new learning strategies increasingly important become "multistage verification" (i.e. verification of the obtained knowledge with people at various stages of application of this knowledge – e.g. other farmers, advisors, input provides etc.) (that applies not only to information from the Internet, but also various types of trainings, seminars or sales representatives. Exemplification from some interview transcripts' are presented below.

Respondent 1 PL

"Husband was trained gardener and fruit-farmer, a "master", after courses……. if I do not know something, I take a book and read it…… everything can be found in the internet and it is possible

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to order seeds faster and cheaper. If you buy new varieties of plants you need to find information on how to seed them, for example, one variety of carrots per hectare need to be sown with 1.5 million seeds and another with 3 million. Nowadays it is impossible to use the knowledge from the grandfather and great-grandfather……. as it is needed we also use the services of a private adviser, mainly in the area of legal and economic advice……. we produce what the customer is interested in, currently we sell all our products in retail".

Respondent 9 PL

"The main knowledge I get from magazines, various trainings, for example, what new means to use …… If you read something in such magazines as Modern Orchard or Jagodnik….. then you deepen the knowledge in the Internet. And to this comes information from neighbors, eg. about varieties. Then, on the Internet, trees are sought for rootstocks adapted to our soil conditions…….. Fellow fruit-growers. If you go to the training and find out something about the new varieties, it's the Internet. Each variety is very well described there. What collection, what means ……. whether it yields earlier or later, whether it blooms during the forecasted frosts or later".

A11.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

Based on the research, it is difficult to quantify the impact of individual learning strategies on the resilience of their farms (robustness, adaptability, transformation). But having in mind the fact that the project will be carried out for another two years I suggest an additional study. A methodology of this additional study could be based on an questionnaire in which the learning strategies indicated by farmers under the measure„WP2 T2.2 Farmers' learning capacity" would be included. Such survey could be directed to farmers which were surveyed before and ask them to valuate the impact of individual learning strategies on robustness, adaptability, and transformability, e.g. on a scale of 1-9 (1 is the smallest impact and 9 largest).

The conducted interviews show that surveyed respondents first tried to identify future challenges and then look for possibilities to overcome them. A list below presents such challenges and strategies to address them:

Drought - application of irrigation (Initially use of irrigation system according to own idea. Due to a very high consumption of water abandoned. Search for more optimal solutions was based on the conversation with farmers who are using other irrigation techniques/technologies.) - *learning from others strategy*. 5 PL.

Lack of seasonal workers - changes in the structure of sowings (reduction of labor-intensive crops) or introduction of innovative technologies reducing labour intensity (use of already proven technologies in other farms) 2 PL – *applying solutions working on other farms*.

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Production quality - The use of "ULO" technology (Ultra Low Oxygen) for a fruit storing, but only in part of the chambers. The observed effects (experimental) can be used to decide if installing such technology in the remaining chambers. 3 PL – *that is implementing innovations.*

Introduction of a new activity - Greenhouse production initially on a small scale in order to gain experience and market recognition, then construction of new greenhouse facilities 1 PL- that is *experimentation strategy.*

Planting a japanese quince on the area of 1 ha and, depending on the profitability of production, the possibility of increasing the area up to 5 ha. Gained experience will allow to make further decisions on production strategy: seedlings or fruit? 5 PL - *that is trying things out slowly.*

The introduction of pumpkins, initially on a small area (about 1 ha), and only after two years, the cultivation area increased to 10 ha. 9 PL.

Resilience capacities vs learning strategies in facing certain challenges:

1. ROBUSTNESS: mainly learning from others
2. ADAPTABILITY: applying solutions working on other farms, introducing innovations, trying out slowly new solutions
3. TRANFORMABILITY: Experimenting with new activities

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Appendix 12: Romania Country Report

A12.1 Who/what are the most important influencers on farmer decision-making, and why?

Three categories of influencers were identified as having an impact on farmer decision making: individual influencers (listing 25 different types), influencer organisations (listing 24 types) and other influencers (listing 23 types).

In the first category (individual influencers), the most frequent were the ***family members*** (parents, children, in-laws, relatives; they were mentioned in 11 of the 14 cases, both for past and present decisions. With very close frequency appeared also the ***wife/husband/partner*** of the respondent (10 of 14 cases). It's not a surprising result, because the Romanian case study is about small-size, family farms, and any decision regarding the farm management is very likely to strongly affect the livelihood of the family. Yet, the slightly higher frequency of the enlarged family shows the persistence of the multigenerational model of the households, but also the fact that in many cases, the ownership of the land is formally unclear (multiple inheritants, common ownership, etc.). Another reason may be the fact that the farm management and operation is passed to younger generations, but the retiring farmers are not willing to hand over also the full ownership of the land / assets, and wish to still have a say in any major decisions regarding the future of the farm.

The ***self-identity*** of the respondents appears in one third of the cases, in equal share with the ***agronomist***. Young farmers and new entrants which take over farms or start new ones are generally well-determined, more open to new ideas and willing to improve technologies, or shift to new and more profitable activities, actively seeking better selling channels for the farm products. In many cases, these farmers have no prior agricultural education, training or even experience, so they perceive the need to consult an agricultural specialist to gain knowledge and avoid mistakes.

Rather important influencers appear to be ***researchers and university professors*** (21.4%), which have an impact in terms of information and novelty sources, and are considered to be the most reliable sources of good quality information, either when farmers are experimenting with new plant varieties or animal breeds, or when farmers face apparently unsolvable problems (pests, plant and animal diseases or nutritional issues).

In this category, the least influential were the (individual) ***input suppliers*** (seeds, chemicals) and ***financial suppliers*** (bank officers and local investors). The input suppliers are seen more as "a necessary evil"; in one case only [24], where the respondent is a young agricultural engineer, input suppliers are perceived as a reliable information source. Most of the respondents were against

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working with banks and credits, either as a personal (or educated) belief, or due a direct negative experience with them (difficulties in loan repayment or even bankruptcy).

The second category includes influencer organisations. The most frequently mentioned are the ***specialized TV broadcasts*** (mainly the one aired on Sunday mornings on the national TV channel). It shows successful and innovative examples, discusses the main problems the farmers are facing, and it often invites high officials to present the latest news or new regulations and policies ready to be applied.

Next comes ***APIA (the Payment and Intervention Agency)***, which is very influential (in a positive sense because it provides the direct payments which in small size farms may cover 20-30% of the field crops costs), but is negatively perceived by the farmers raising livestock in their farms (e.g. due to the 3-years inflexible registration of the number of eligible heads for animal subsidies).

NGO-s operating in agriculture are positively perceived as influential by 21% of the respondents; they are active in Nord-Est region and are actively involved in helping farmers to find new ideas for activity diversification, to seek and find new opportunities and markets to sell their products, as well as in facilitating the organisation of fairs and other meetings which allow the farmers to meet, socialize, share information and promote their products.

The ***Local Action Groups*** are seen as influential organisations by 18% of the respondents. Their activity intensified in the second programming period of the Romanian NRDP (National Rural Development Programme), that is since 2014, and it proved to be helpful for young farmers in accessing various EU-funded projects.

In the interviews, ***processors*** have been mentioned among the least influential organizations (less than 4%). It may seem counterintuitive, but the respondents pointed out that partnerships with processors (mainly in dairy farming) proved non-profitable if not harmful for small-size farmers. In their business relations with small-size farmers, the large processing companies do not comply with the contracts and cut down the prices paid to farmers for their milk deliveries, pushing the farmers in the area of very low to no profitability, or even to bankruptcy. The respondents said that their response to that behaviour was either terminating their partnerships with processors, reducing milk production to the level of the family consumption and shifting to new activities for profit, or more frequently, to start on-farm milk processing.

In the third category (other influencers), the strongest influencer appeared to be ***Internet*** (as information source), explicitly mentioned in more than one third of the cases (almost 40%). It is easy to access, relatively cheap and readily available, due to penetration of smartphone technology and stationary Internet links generally coupled with cable TV. It is used to find

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suppliers, clients, but mostly to replace or complement the limited availability of speciality books and press, as well as of public consultants. It facilitates finding people with similar interests, problems or concerns. Younger the farmers, more frequent is its use. On the other hand, its use is sometimes associated with the problem of information credibility.

Weather, as main expression of climate change is seen as an important influencer (21%); both on short term, under the form of extreme and destructive events (drought, flooding, hail), coupled with the generally perceived failure of insurance instruments for agri-business; but also on long-term, resulting in the application of risk management strategies such as changes in the crop production structure or use of plant varieties and animal breeds better adapted to local conditions. One should bear in mind that Nord-Est region is located at the extreme eastern geographical limit of the EU, with more severe climate characteristics than in other regions (very cold winters, intense heat during summer and limited rainfalls, thus making drought the main climate hazard.

The ***local community*** is perceived as being not very influential (11%), or negatively influential. In many interviews, respondents mentioned the envy, selfishness and lack of trust among the community members, resulting in its disunity and incapacity to identify common goas and rally around them.

Table 1 - Influencers and their frequency of occurrence in the influence maps (cumulated for past and present)

Influencers	Total no. of occurrences	Share in total (%)	No. of occurrences in position					
			#1	#2	#3	#4	#5	#6
INDIVIDUAL INFLUENCERS	112	-	47	21	13	18	5	8
Family members	22	78.6	11	9	2	0	0	0
Wife/husband/partner	19	67.9	14	2	2	0	0	1
Agronomist	9	32.1	2	1	1	1	0	4
Myself	9	32.1	8	0	0	1	0	0
Farmers (other local)	6	21.4	2	0	1	2	1	0
Researchers / university professors	6	21.4	4	1	0	1	0	0
Friends	5	17.9	0	3	1	0	0	1
Employees	4	14.3	0	0	1	3	0	0
Business partner	3	10.7	2	1	0	0	0	0
Clients	3	10.7	1	1	0	1	0	0
Farmers abroad	3	10.7	0	0	0	2	1	0

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Influencers	Total no. of occurrences	Share in total (%)	No. of occurrences in position					
			#1	#2	#3	#4	#5	#6
Veterinary surgeon	3	10.7	0	0	0	3	0	0
Accountant	2	7.1	0	0	2	0	0	0
Contacts at research organisations	2	7.1	1	1	0	0	0	0
Farming neighbours	2	7.1	0	0	0	0	1	1
Lessors	2	7.1	0	1	0	0	1	0
Real estate agents	2	7.1	2	0	0	0	0	0
School teachers	2	7.1	0	0	0	2	0	0
Thieves	2	7.1	0	0	0	1	0	1
Bank expert (officer)	1	3.6	0	0	1	0	0	0
Employers (off-farm)	1	3.6	0	0	1	0	0	0
Individuals from chemical companies	1	3.6	0	1	0	0	0	0
Individuals from seed companies	1	3.6	0	0	1	0	0	0
Input suppliers (for processed food products)	1	3.6	0	0	0	0	1	0
Local investor	1	3.6	0	0	0	1	0	0
INFLUENTIAL ORGANISATIONS	74	-	13	19	12	12	5	13
Specialised radio/TV broadcasts	9	32.1	2	3	0	3	0	1
APIA (Agency for Payments and Intervention in Agriculture)	7	25.0	1	0	3	1	1	1
Local council	6	21.4	1	1	0	1	0	3
NGOs operating in agriculture	6	21.4	1	2	1	2	0	0
LAG (Local Action Group)	5	17.9	1	2	1	0	1	0
Public research institution (RDRP)	5	17.9	0	1	1	2	0	1
Ministry (Agriculture)	4	14.3	2	0	0	0	2	0
OJCA (County Office for Agricultural Consultancy)	4	14.3	0	1	1	1	0	1
AFIR (Agency for Funding the Rural Investments)	3	10.7	0	2	1	0	0	0
ANSVSA - DSV (National / County Sanitary Veterinary and Food Safety Authority)	3	10.7	0	0	1	0	0	2
County agricultural authority (branch of the Ministry of Agriculture)	3	10.7	0	2	0	1	0	0
ADR (Agency for Development Nord-Est Region)	2	7.1	0	0	0	0	0	2
Banks	2	7.1	1	1	0	0	0	0
Cooperative	2	7.1	2	0	0	0	0	0

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Influencers	Total no. of occurrences	Share in total (%)	No. of occurrences in position					
			#1	#2	#3	#4	#5	#6
Local market	2	7.1	0	1	0	1	0	0
Organic certification bodies	2	7.1	0	0	1	0	0	1
Producers Organization (LAPAR)	2	7.1	0	1	1	0	0	0
County local authority	1	3.6	0	0	1	0	0	0
EU (CAP regulations)	1	3.6	0	0	0	0	0	1
Ministry (Tourism)	1	3.6	0	1	0	0	0	0
Processors	1	3.6	0	1	0	0	0	0
Seed companies	1	3.6	1	0	0	0	0	0
Specialised fruit and vegetables shops in town	1	3.6	0	0	0	0	1	0
Traders/wholesalers	1	3.6	1	0	0	0	0	0
OTHER INFLUENCERS	**58**	**-**	**16**	**13**	**13**	**14**	**0**	**2**
Internet (as information source)	11	39.3	4	1	2	3	0	1
Books	6	21.4	3	0	2	1	0	0
Weather	6	21.4	1	1	0	4	0	0
Competition	4	14.3	1	0	2	1	0	0
Farming press	4	14.3	2	0	0	2	0	0
Local community	3	10.7	2	0	1	0	0	0
Booking.com	2	7.1	0	2	0	0	0	0
Customs and traditions	2	7.1	0	0	2	0	0	0
Examples of good practices from abroad	2	7.1	0	2	0	0	0	0
Faith	2	7.1	0	2	0	0	0	0
Mentalities (people's mentalities)	2	7.1	0	0	0	1	0	1
Specialized agricultural advertising	2	7.1	1	0	1	0	0	0
Social media (agricultural producers' Facebook group)	2	7.1	0	2	0	0	0	0
Economic context	1	3.6	0	0	0	1	0	0
Entrepreneurship spirit	1	3.6	0	1	0	0	0	0
Freedom (sense of freedom)	1	3.6	0	1	0	0	0	0
Freedom to travel and get experience	1	3.6	1	0	0	0	0	0
Laws and regulations	1	3.6	0	0	1	0	0	0
Link with nature / environment	1	3.6	1	0	0	0	0	0
Market	1	3.6	0	0	1	0	0	0
Social context	1	3.6	0	1	0	0	0	0
Tourism blogs	1	3.6	0	0	1	0	0	0
Working environment	1	3.6	0	0	0	1	0	0

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A12.2 Do these influencers change over time in relation to different decisions/risk management?

Family members were identified as the most influential on the decision-making process. Over time, their influence generally remained very important. The intensity of influence decreased in very few cases, linked to either the disappearance of the influencer (death) or to a change in the managerial power of the influenced person.

Wife/husband/partner was the second very important influencer, it also generally remains constant over time. It increased if the influencing spouse became more involved in the agri-business, and decreased if the influencing spouse either disappeared, or diminished its involvement in the agri-business (took an off-farm job or cared more of new/young children)

The self-identity of the respondents as influencing factor again remained constant, showing that over time, they were happy with the decisions they made, and they don't intend to give up their position of main decision-maker in the farm.

The position of the ***agronomist*** (as consultant) as influencer generally remained constant over time; in several cases he appeared in the second examined period in the group of top six influencers, indicating that the farmer acknowledged the need to consult an agricultural specialist, mostly in the process of adaptation or transformation of the farm business, or just to overcome the lack of insufficient agricultural education, training and knowledge.

A similar trend is valid for ***researchers and university professors***; their increasing influence is seen more in the farms that are either experimenting with new plant varieties or animal species, or in businesses that develop and specialize, and there is need for highly specialized technological input / advice.

The degree of influence of ***other (local) farmers*** is more volatile that the previously mentioned influencers. It either increases if they start a partnership with the respondent, or decreases by solving old conflicts.

Employees show an increasing influence in the case of expanding businesses, through their reliability and loyalty to the employer (farmer / manager of the agri-business). This is particularly important, since the major risk signalled by all the respondents was the frequent unavailability and lack of seriousness of unskilled and skilled labour. It is also particularly important in expanding farms with livestock, where the animals have to be taken care of on a continuous basis. The migration phenomenon worsens this trend.

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Banking officers are among the least influential persons in the region investigated in the case study. The reason is that small-size farmers are very reluctant to take bank loans, and once they finished repaying them, the influence of the bank disappears.

Clients are mostly influential in those farms which sell processed products. The respondents included in this category of farms have a direct relation with their clients (lists of deliveries, fixed days in the market or even a farm's shop); and in some cases, the products delivered by the farm are custom-made (according to the taste or the requirements of the clients). In this case, the clients become also learning sources for the farmer (e.g. ideas for new or improved products, new recipes, etc.).

In the category of influential organisations, the most frequently mentioned were the ***specialized TV broadcasts***. In time they increased their influence due to fact that in the last 15 years cable TV companies penetrated even in the most remote villages, and also because there are several specialized TV shows that proved in time to be serious and provide interesting information, news and business models for farmers.

APIA (the Payment and Intervention Agency), increased its influence in time due to the fact that farmers have become accustomed over time to the procedures and also because the direct payments increased gradually in value, becoming a real support in particular for the small-size farmers.

NGO-s operating in Nord-Est region in agriculture increased in time their influence, due to the fact that they helped farmers to develop and diversify their activity, and facilitated the organisation of fairs and other meetings which allowed the farmers to meet, socialize, share information and promote their products.

The ***Local Action Groups***, despite the intensification of their activity, their influence somehow diminished in time, probably because the respondents perceive them as influential at the beginning of their collaboration; later, the common activities become 'routine'.

Processors – their influence decreases in time, with the end of the contracts; the large dairy processing companies are seen currently by the small-size farmers (who had the misfortune to work with them) just as bad business partners and as serve as comparison term for low prices paid to farmers for their milk.

In the category of 'other influencers', the strongest one appeared to be ***Internet*** (as information source). In time it increased its influence due to the fact that it is a cheap and readily available source of information. In a few cases, its influence diminished, but it was correlated in general with an increase in the agronomist's, researchers' and university professors' influence. This

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happened mainly in the cases where the farm business developed, expanded, and it needed more specialized advice.

Books (in particular speciality books) seem not to lose their influence as important influence source, given also the fact that they are perceived as more reliable than the Internet, with which they compete in terms of availability and easy access.

Weather, as main expression of climate change tends to slightly diminish its influence in farmers' decisions; it seems that the application of risk management strategies such as changes in the crop production structure, use of plant varieties and animal breeds better adapted to local conditions or investments in irrigation provide the farmers with (for the time being) sufficient tools to deal with the weather risks.

A12.3 How do farmers' attitudes and beliefs influence their decision-making?

Openness for novelty is the main driver for searching out new ideas and learning that generate changes at farm level in Nord-Est region. Most investigated farmers are aware that the chance of small farms to enter and maintain their position on the market is closely linked to identifying and fructifying new market niches to create a competitive advantage, i.e. novelty / rarity / uniqueness of their products.

Risk-taking attitude seems to influence the Nord-Est region farmers' willingness to try out new ideas and push them to find out innovations that increase the value-added of their business.

Farmers' willingness to be independent, through ***the development of a business on their own*** using the position rent they own – location in an area with high agricultural potential, with an increasing sale market on which uncovered market niches exist, as well as land ownership / access to land (own or inherited land) – represent another important driver for the interviewed farmers' decision-making.

The interviewees signalled out the ***selfishness / reluctance of other (farmers) in sharing info,*** which some of the farmers who wanted to adopt technological innovations on their farms were facing. It seems that these interviewees could find solutions to surmount this difficulty by experimenting on their farms, learning from their own mistakes and/or through implementing change a little at a time to reduce the risk of failure.

On the other hand, ***mistrust*** (in the evolution of economic environment) and ***attachment to the traditional way of doing agriculture in the area*** are more likely linked with the decisions that enhance robustness.

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Embracing the ***ecological way of thinking*** directs the learning process and drives farmers' decisions through finding and changing the way of operating the farm.

A12.4 What external (to the farm) factors influence decision-making, and how?

The most important external factor that influences decision-making in the interviewed farmers from Nord-Est region of Romania is their willingness ***to change their economic-social status*** by transforming the subsistence or semi-subsistence farm into a market-oriented business and / or acquiring the businessman status, owner of own business to be managed according to their own values. Following this path, farmers got re-oriented towards niche products, such as:

- shift from vegetable growing to the production of vegetable seeds;
- shift from field crops growing with extensive technology on relatively small areas to innovative crops with high value added organized on small areas (lavender, Paulownia trees, medicinal herbs, vegetable eco-products etc.);
- shift from the production and sale of raw agricultural products obtained under extensive system to the integration of crop and livestock production and household farm specialization in processing and short-chain sale of processed or niche products (preserved fruit and vegetables; cheese; meat preparations; home-made pastry products, according to special recipes; quail meat and eggs, etc.);
- farm production orientation to organic production.

The second influence factor is ***access to the labour*** at the region level, especially skilled labour. This determined farmers to be more flexible in establishing the farm production structure in order to adapt to the regional labour force deficit. The learning processes were generally focused on production orientation towards a structure that does not require external human effort, i.e. that can be supplied by the household members and / or resizing the farm according to the ability of family members to cover the labour needs.

Having an off-farm job is the third external to farm factor influencing the decision at farm level. Thus, the fact that the farm owner had or still has an off-farm occupational arrangement gives him a relative financial stability and makes the farmer have (at least partially) the financial resources to support the implementation of his innovative ideas, without endangering the continuity of the farm.

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Access to technology is the fourth external factor that influences decision at farm level. Access to new technologies is ensured in several ways depending on farmers' ability to access information sources:

- the literature that documents the new techniques and technologies (printed materials – books, periodicals – that presents in detail the innovations in agricultural techniques and technologies);
- fairs and exhibitions presenting the innovations in agricultural technologies where demonstration documentary materials are presented or even new technologies are tested;
- partnerships with the research institutes and stations by which farmers experiment, in practical conditions, the new varieties and cultivars developed by the research stations;
- access to digital materials and on-line consultations with the farmer groups growing the same crop by which the new technologies are documented.

Farmers' approach to learning is a mix between economic triggers (low profitability of traditional agricultural system, non-integration of small farms in the food chains, changes in the consumer preferences, willingness to increase the value-added at farm level and the economic performance of farms), farmers' pre-existing off-farm skills (food processing) and their openness to novelty (new technology, new varieties and species etc.).

A12.5 What are the key risks in your case study farming system, as identified by farmers?

Most interviewed farmers from the Nord-Est region consider that risks represent those processes external to farms that have a negative impact upon farm performance.

The risk that was most frequently signalled out during the interviews in the Nord-Est region is ***availability of labour***, especially skilled labour, which was signalled out by two-thirds of respondents. The main cause of the low availability of labour is related to migration for work, mainly abroad.

In a significant share, the interviewed farmers pointed to Environmental risks. More exactly, two-thirds of farmers declare that one of the major risks they have been facing is represented by ***extreme weather events and climate change*** affecting the traditional crops in their vegetation period in the region. Furthermore, half on the interviewed persons declare that they have been confronted with risks related to ***pests and diseases*** on their farm.

Half of the interviewed farmers declare that they have been facing risks related to the small farm size (in terms of land and / or livestock herds). The ***risk of being too small*** reduces the chances of

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small farms to be integrated into the agri-food chains as they do not have the production and bargaining capacity enabling them to enter and maintain their position on the agri-food market dominated by the large companies. In close relation to the above-mentioned risk, ***lack of cooperation among farmers,*** especially due to the ***negative perception of cooperation (distrust among cooperative members),*** makes the negative effects of low farm size perpetuate over time. Individual solutions seem to be the key for risk management, as long as cooperation is not embraced by farmers.

Bureaucracy is considered a challenge when farmers get into contact with authorities, at any administrative level. The interviewed farmers declared that in many cases bureaucracy determined them to give up completing certain procedures (for instance, the organic re-certification procedure). The multitude of documents and institutions along the procedural chain that farmers need to go through as well as the waste of time, pretended for carrying out certain activities on the farm, define rigid bureaucratic institutions tributary to rules and not to operation efficiency.

Each of the participants in the interviews mentioned that they are subject to at least one economic risk. Among the economic risks, the following were mostly frequent:

- ***low prices*** (mainly at harvesting time and for the agricultural products that are part of the traditional crop structure in the region – cereal crops);
- ***non-integration of small farms in the food chains*** (as they cannot deliver sufficiently large quantities on continuous basis to retailers);
- ***high costs***.

One-third of the respondent farmers in the Nord-Est region declared that they are confronted with ***uncertainty about successor,*** which affects the continuity of their business. One-third of them are also aware of facing technological risks determined by the ***lack of experience and knowledge,*** which adversely impacts their farm performance.

A12.6 What learning strategies do farmers adopt for managing risk and adapting to change?

The ***ability to seek out information*** and choose the proper way / channel to find out the necessary knowledge for the implementation of changes at farm level has been proved by most interviewed farmers. Thus, two-thirds of them declare that they are trying to get informed on novelties by ***individual documentation***, directly from on-line sources (***internet***) or from specialised publications (available under electronic or printed format – books, periodicals). A documentation channel with significant impact in farmers' learning process in the region Nord-Est is represented by the specialised TV programmes, which disseminate replicable examples of good practices and

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exemplary agricultural business cases (many of them innovative). Through individual documentation, farmers ***are searching / documenting new ideas*** that they can adopt on their farms; documentation helps them understand the change advantages and risks and make an informed decision.

One-third of the interviewed farmers have proved ***openness to the new ideas*** by seeking out novelties to inspire them in technological updating, in risk management and / or change of farm production structure, to increase farm performance. These farmers prove ***flexibility,*** being non-locked into the traditional way of operating, specific to the region. These searched for and adopted new crops, with high value added, suitable for the agro-pedo-climatic conditions of the region, to replace the traditional cereal crops specific to the region's farming system. Other farmers searched for (and adopted) innovative ideas in farm livestock production, adopting species that do not represent a tradition for the region. These farmers' searches generally aim at covering market niches that increase the economic performance of their farms with minimum human and financial effort required by the change process.

In the learning process, the involvement in supportive social networks has had a decisive role for all interviewed farmers.

- ***The networks with the greatest influence in the transfer of knowledge and information*** at the level of farmers in the Nord-Est region are ***based on trust and close social relations*** (family or friendship relations). Thus, the advice of ***trusted farming friends*** is accepted / perceived as valid in the knowledge transfer process by half of the interviewed farmers. One-third of farmers valorise the advice by the ***experts*** in the field (***with whom they have friendship relationships*** and thus, trust-based relationships) when they take into consideration the idea of change on the farm. In the decision on change***, family support*** also seems to be very important.

- ***farmers/workers that acquired experience by working abroad*** are also important actors in the process of skills and/or knowledge acquisition for half of the interviewed farmers. It seems that the Romanian farmers have a greater trust in transparency and openness in sharing experience with farmers / farmer groups or workers who worked in agriculture in foreign countries. On the other hand, the orientation towards learning from the experience of farmers operating in other countries is also determined by the innovative character for Romania of changes that the farmers from Nord-Est are implementing and consequently by the lack of experience of Romanian farmers or experts in these new fields.

Eight of the fourteen interviewed farmers chose as learning modality ***experimenting*** on their own farms by introducing new varieties, cultivars or animal breeds in their production structure

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(lavender, Paulownia trees, medicinal herbs, quails, goats, rabbits, etc.) or adopting new technologies (organic farming). If experimentation had good results, farmers decided to ***gradually implement change, a little at a time*** in order to avoid the risks of lack of experience and knowledge regarding the new farm products and new markets.

The previously mentioned precaution, in relation to the lack of expertise in the new fields of activity that farms are adopting, has triggered learning processes through which farmers have accessed training courses and / or acquired knowledge in alternative ways of farming.

The experiences and experiments on the farm represent an important learning source for half of the interviewed farmers. These have equally learnt from their own mistakes / successful experiences. Half of the farmers also prove their ability to ***reflect*** on their own farm activity and by this to identify / find out modalities through which they will be able to better manage their business in the future. In many cases, these reflections led to conclusions on the need to adopt major changes in the production structure, in the farm size, in the way of farming, in placing the farm products on the market.

A12.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

Old age and uncertainty about farm succession are the main factors that constrain learning processes in Nord-Est region:

- old age is associated with limited abilities in terms of access to information by using the new communication channels (ICT), obstructing the learning processes as far as the newest knowledge / information is presented under virtual format and is less accessible in classical formats;
- the uncertainty in terms of successor reduces farmers' motivation to develop their business, these following conservation strategies for the business under its current size or even reduce its size up to the level at which the farming business produces sufficient incomes for a decent living for the members of the small family.

The most important factors in enabling learning in farmers are the following: ***their willingness to change the socio-economic status***; their ***abilities to seek out new ideas and information*** on how to implement these ideas at farm level and ***having an off-farm job and income***:

- the willingness to change their socio-economic status is determined by their need to become independent in economic terms and have an activity in consonance with their self-identity and values;

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- the ability to seek out new ideas that at the same time are possible to implement on their own farm is specific to the young farmers who have recently taken over the farms. These have different views on how to do farming: they are looking for market niches for a much more efficient use of the natural and human resources of farm, they are looking for off-farm funding sources – European funds – and do not fear to experiment the latest technologies;

- the ability to seek out information necessary for their proposed changes (especially, due to their ICT skills) gives farmers a competitive advantage, that of product novelty on the market;

- having an off-farm job and income provide farmers with the financial resources for knowledge acquisition, for initiating new ideas, experiments and invest in them without depriving the farm's current activity.

Single-loop learning – the interviewed farmer with number 15 is a woman aged 56, who currently sells on the neighbourhood urban market dairy products processed in her own household and preserved vegetables and fruit obtained from raw products from her farm. Starting up the processing and sale activity was at the initiative of a foundation (NGO) that provided support to farmers in the area to add value to their farm production (through processing and short chain marketing). The innovations brought in the farm activity are incremental ones, having in view to adapt the processed products to the tastes of the closed group of consumers (salty, free of salt; spicy or sweet, etc.). Following previous experiences, the housewife adjusts her recipes to the tastes of her loyal customers.

Double-loop learning – the interviewed farmer number 202 is a young successor (30 years old) who partially took over his father's farm after a migration experience abroad and several off-farm jobs. He has a vision on how to do agriculture that is completely different from his father's. Thus, while his father got oriented towards field crops, the son is experimenting, on part of the land that he took over from his father, with innovative crops (Paulownia trees, lavender) and is permanently open to new ideas, being an internet seeker. The young farmer has not fully changed the crop structure of the farm, maintaining the crops that his father has been growing by tradition, since the latter has still a word to say in the management of farm.

Triple-loop learning – the 28-year old respondent is a young female farm manager who started the farming business in the year 2012, after she came back to Romania following external, non-agricultural occupational arrangements. The young family with migration experience decided to return to Romania and invest the money gained in working abroad in a farm with innovative specificity for the area where it is located – integrated farm growing goats, processing and short chain marketing the cheese produced from the raw milk obtained on the farm. The business idea was based on a trend in consumers' preferences – growing demand for dairy products from goat

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milk – and the market niche existing on this chain in Romania. The young people had no previous experience in agriculture, but they got documented on this business, also by visits and experience exchange with farms from the Netherlands (the country where they worked before returning to Romania). The young people took over a (disused) farm in the Nord-Est region that they fully transformed into a goat and dairy farm. The farm also produces most part of the necessary fodder for feeding the animals. Since its establishment in 2012 until present, the farm went through a learning process in selection and reproduction of the most productive animals for the farm needs (high milk yield and long lactation period). At the same time, as a reaction to the challenge represented by the increasing demand of urban customers in the proximity, the farm significantly increased (eight times) the number of animals and shifted from the sale on the flywheel market to the sale of goat milk products through intermediaries (small local deli store networks) and in own commercial premises.

Triple-loop learning – the interviewed farmer number 2 is a young new-entrant (41 years old) who bought a fruit farm and transformed it into an agro-touristic boarding house according to the model he saw during his visits to boarding houses in Western Europe. The invested funds come from off-farm family business and from a project with EU funding destined to boarding house development and processing the fruit obtained in the farm orchard.

A12.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

Learning has played an important role throughout the entire adaptive capacity cycle for all interviewed farmers.

Single-loop learning is produced following the interactions with trusted neighbouring farmers and the NGOs that provide support to farmers in ***adding value to the products of their farms***.

Double-loop learning has the following information sources: specialized publications, inspirational TV programs, experts from the research stations. These influencers inspire farmers *to* ***experiment new ideas on their farms*** and ***induce changes*** in the farmers' set of values.

Triple-loop learning is generally produced under the influence of the willingness to change the economic and social status and presupposes ***radical changes of the farm organization form and functions*** under the influence of knowledge targeting successful business models in other countries from Western Europe.

Nord-Est farmers are preparing for future challenges through:

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- ***increasing the production structure flexibility*** in terms of its adjustment according to the available human resources, having in view that the labour force deficit is a major risk on the rise in the region;
- ***keeping updated with the latest technologies*** in their field of activity through internet searches, participation to fairs and exhibitions, discussions with experts in this field;
- ***experimenting*** new crops with high value added;
- finding ***new niches on the local market*** and production orientation to cover them;
- searching ***new markets for production sale***.

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Appendix 13: Spain Country Report

A13.1 Who/what are the most important influencers on farmer decision-making, and why?

The number and type of influencers vary, and depend mainly on farmers' attitudes and experiences. In general terms the average number of influencers is 10. The number of influencers varies widely among farmers (standard deviation, 5.4, min:3 max: 26). The influencers who have been more frequently identified are the veterinarians, the farmers' union, the family members, other farmers in the region and cooperatives. Among them, families are in the first influence level, followed by vets and, other farmers. Additional influencers have been identified such as research institutes-Universities, internet, agro-environmental local and regional government offices and financial institutions.

Family represents, in almost all cases, the prominent influencer, both in terms of opinion sharing and emotive support for decision-making. In particular the farmer's father/brother/son have a significant influence when they are involved in the business. The farmer's wife is also supposed to have a remarkable importance in emotionally supporting farmers in decision-making.

Another remarkable influencer is the **veterinary** who, in most cases, seems to be more than a simple technician, and rather a source of trustworthy support. Veterinaries are fundamental for improving knowledge and awareness about livestock care and handling; they are also a source of new innovative ideas.

Other farmers are significant influencers in interviewees' opinions. Other farmers represent a real network of knowledge sharing and of opinion exchange. In many cases they are the main source for new ideas to copy; they are probably the first source of knowledge when a farmer needs to find new solution for coping with challenges. However, contrasts and conflicts can lead farmers to gather information and share knowledge with farmers of other regions.

Farmers' unions, associations and cooperatives are common influencers, but in most of the cases, they are not so relevant. Cooperatives appear to be slightly more influential whereas associations support farmers mainly to deal with bureaucracy. Geographical Protected Identification is not so relevant. However, associations and cooperatives represent a space for sharing ideas and opinions.

Local and regional administrations do not have a high influence in many cases. In some cases agro-environmental offices also influence the farmers. Nevertheless, local administrations have the major role in informing farmers.

Research institutes and universities have had a significant role in influencing farmers, specifically in terms of experimentation of new practices and innovation, especially for breed selection, technology in extensive management and feeding techniques. Some argue that there is a decrease of interest from universities and research centres.

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Some influence is recognized on both sides of **providers and buyers**, although it is not so significant. In the few cases that farmers have employers, co-workers can influence decision-making. Financial institutions are influential, just in few cases, but they are never salient. Other actors are not significant influencers.

Material sources of information such as farming and **local press, internet, media and social media and scientific publications** are not significant for all farmers, but overall they are not common sources of influential information. Social networks are not generally trustworthy and they represent a very generic source of information. The main role of social network is probably to strengthen farmers' network and contacts among them.

A13.1 Do these influencers change over time in relation to different decisions/risk management?

The farmers were asked to identify the influences in the past (twenty years ago), when they decided to enter the sector or make an important decision. The influencers have changed over the time, mainly in number. The average number of influencers in the past was 7, whereas, currently, there are 10 influencers (standard deviation, 3.3, min:2; max: 14).. The increase in the number of influencers is explained by technological progress and new forms of organization in the farming system. Indeed, increasing economic pressure may imply look for more support.

According to influence maps, the top four influencers for farmers have remained the same for the past twenty years: family members, veterinarians, farmers' unions, and other farmers in the region.

However, there are some variations in top ranking influencers between the past and present day; Local farmers' unions and cooperatives have ranked higher today than in the past. Although the impact of other farmers within the region has been marked slightly less by farmers as a top influencer, the rise in the ranking implies that farmers who do rank them, find them slightly more instrumental in the present than in the past.

In terms of the remaining, and lower ranked influencers, neighbours and local governance are not as instrumental today as they were twenty years ago. This is partly due to the depopulation of the rural areas.

The internet and financial institutions are new sources of knowledge today that were not ranked twenty years ago.

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Table 1.The ten most important influencers in the present

	Frequency	Rank (1-6)
Family members	13	1.23
Veterinarians	10	2.10
Local Farmers Union	10	3.80
Other farmers in the region	9	2.67
Coooperatives	9	3.00
Research institutes	6	3.33
Internet	5	3.40
Agri-environment local offices	4	2.00
Regional government	4	3.00
Financial Institutions	4	3.75

Table 2. The ten most important influencers in the past

	Frequency	Rank (1-6)
Family members	16	1.19
Other farmers in the region	11	2.45
Veterinarians	9	2.33
Farmers Union (National and local)	8	4.38
Cooperative	6	2.67
Research institutes	6	4.00
Agri-environment local offices	5	3.80
Regional government	4	3.75
Local Government	4	4.00
Neighbours	3	1.67

The importance of cooperatives and associations has changed depending on the farmers' attitudes and experience. For some farmers, cooperatives represent the main opportunity for development; for others, cooperatives represent an extra cost which does not guarantee any improvement.

A13.2 How do farmers' attitudes and beliefs influence their decision-making?

Generally, farmers show a strong and deep feeling for their work, its importance and for their animals; sheep farming is what they like most. Therefore, those feelings influence their decision-making, particularly farm improvements and decisions to not change the specialization. There is also an attachment to the region and its traditions that can be resumed in rural identity; such a feeling leads to the implementation of strategies that address the threats of the territory, as to not abandon it. They feel responsible for maintaining the villages and the rural population.

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Farmers are divided in those who have an attitude for associationism and those that show a more individualist attitude. Clearly, this difference implies diverse types of farm management strategies. Associationism implies a deeper involvement in experimentations, social learning and sharing knowledge, thus these farms are more likely to innovate and improve the prior system management. On the contrary, more individualist farmers generally (but not always) tend to find more drastic as well as linear strategies such as cost reduction, intensification or total transformation to another activity. Confidence between farmers is decreasing.

In terms of institutions, many farmers feel abandonment from police-makers, above all, in higher level institutions. Farmers believe that there is no interest for extensive farming and its functions, or they think there is no capacity at policy level. These beliefs can depress farmers' attitudes which disincentives them to improve their farms; as a result,, institutional relations or lack thereof have some influence on farmers' decision-making.

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A13.3 What external (to the farm) factors influence decision-making, and how?

Several external factors have influenced decision-making and changes in the farming system. The **decreasing profitability** is the most important factor that influences the farmers' decision making. Farmers have to face the low and weak profitability of their farms mainly explained by steady sheep meat prices and increasing inputs costs (cereal prices and labour costs). This external factor has forced farmers to find solutions to reduce costs - animal feeding based on fruit pulp, intensifying animal feeding and investing in new technologies, and innovating to reduce labour costs making the farm more extensive to decrease feeding costs. Finally, increasing meat production by animal pursuing strategies such as breed selection, better bird control, and an increase in prolificacy. Some farmers also look for new local distributors that offer better prices than wholesalers or cooperatives.

Additional relevant external factor is the **CAP aid**, in particular the direct payments. Due to the low profitability, farmers count strongly on the aids, and every change in policy creates uncertainties. The decoupling of payments has generated relevant distortions and influenced the decisions-making process of the farmers. Decisions to look for new deals to rent "eligible" hectares, diversification, transformation, and even quit the sector have been pursued by changes in policy aids. However, economic reasons are not the only explanation for the impact of the CAP on farmers' decision-making. Indeed, the increased bureaucracy has influenced farmers' decision making by enhancing their participation in farmers' organizations and cooperatives to help them with the paper work.

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The **lack of skilled workers** also has influenced decision-making. It constrains the sector in terms of opportunities for developing, farm size and organization. The lack of workers has led to a number of measures taken by the farmers, such as livestock reduction, intensification, base activity on family support, land abandonment, but also experimentation on new technology and innovation for managing the livestock in absence of a sufficient number of employees.

An **overall trend of decreasing lamb meat consumption** is affecting the sector by making farmers implement relevant changes in farm specialization and organization. It is worth highlighting the decisions to belong to cooperatives to ensure the sale of their entire production, to find new markets, or get some product promotion to mitigate the reduction of consumption. Belonging to the Geographical Protected Indication (IGP) has been also pursued because of the reduced demand to ensure quality products and attract the costumer.

Finally **the existence of successor/s** who takes over the farm influences the farmer's decision making. When a successor exits, it is more likely that the farmer invests in physical assets, increases the heard size or takes more risky decisions. Succession influences farmers' confidence on the sector's future and their son/daughter success. Succession definitely has a positive effect on decision-making and farm changes, since farmers plan in the long term as a result; they have incentives to find new solutions for coping with challenges. The lack of successors does not incite the farmers to make decisions and change.

A13.4 What are the key risks in your case study farming system, as identified by farmers?

Economic, institutional, social and environmental risks have emerged from the interviews analysis. Most of the risks identified are related to the economic and institutional dimensions. Almost all **economic and market factors** represent a challenge for the sector: i) the *low profitability* is generally low due to stable-low prices of lamb meat and an increasing feeding and labour costs; ii) there is an *increased competence* from imports, intensive agricultural sectors and other sectors that increase the competition over land; iii) a *decreasing consumption* of lamb meat; iv) *changing value chain* in which local markets (local butchers) are disappearing and farmers have decreasing bargaining power.

On the **institutional side**, many challenges and risks have been detected. Two mains issues need to be highlighted. Frist, *the decouplement of payments* and the definition of *"eligible" hectares* have impacted famers. They have seen how their pasture hectares were not eligible to receive the aid. This situation has forced them to look for new eligible hectares, in some cases they are more expensive and far away from their farms, and they increase the handling animal costs. Second, the payments based on historical rights have highly impacted the sector. People with no ewes receive aid for the ewes he/she had in the past (decouplement date). *The unequal distribution* of the aid contributes to the collapse of the prices, explained by the fact that there are farmers who can sell their sheep production at prices below the costs. They receive aids for an activity with no costs and earn money with other upper-profit activities rather than the ovine. Second, *the sanitary controls and bureaucracy* is a challenge for farmers. Many farms have been

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forced to close or reduce the size herd. Administrative controls are tedious and can represent a barrier and imply costs for farmers.

Regarding the **social challenges**, there is a *general lack of human resources* and an overall phenomenon of leaving the sector and rural areas. Specifically, there is a deep lack in skilled workers and people interested in working in the livestock sector. The sheep sector is very labour intense and it does not allow a balance between work, family and personal life. The lack of interest in the sector is constraining the transmission of the knowledge to new entrants.

Together with the lack of workers, *potential successor are not interested i*n taking over the farm. Indeed the farmer encourages his son/daughter not to continue in the extensive farming. New generations study in the cities, and they do not want to come back to the field.

Finally, farmers have to face **environmental risks** such as wolf attacks that are likely to increase in the future, the general issue of animal illness and diseases which is not currently a pressing issue and the more frequent droughts that imply higher feeding and pasture costs,

Due to labour costs, lack of people interested in long working hours, and the increasing land prices, in many cases herd management tends to be less extensive (the pastoralism limits to a low number of hectares). As a result, the herd grazes fewer hectares which lead to forest abandonment and more likely forest fires.

A13.5 What learning strategies do farmers adopt for managing risk and adapting to change?

Please indicate what learning strategies and/or attributes farmers demonstrate in your case study to allow them to manage risk and adapt to change. Here you may wish to include skills and/or knowledge acquisition, incremental innovation and experimentation, learning from past experiences, improving existing practices, change in underlying values or attitudes, social learning, reflexivity, openness to new ideas etc. Suggested section length: 2-3 pages

Four different learning strategies have emerged from the interviews analysis. The learning strategy most implemented is "**learning by watching**". Farmers usually observe what other farmers do, and learn from them. They learn by observing if other farmers' initiatives are successful or not. Then, farmers decide whether or not to carry out what they have seen. Farmers share ideas with those they are observing and ask family and friends for opinions. Many strategies have been implemented by farmers through this learning strategy, such as change from extensive to intensive or transformation to intensive pig farming, and even diversification in crops, almonds and olive trees production.

This learning strategy is also considered as the knowledge transmission between family generations. Many strategies are implemented only because they have been previously implemented by prior generations. They mainly refer to day-to-day activities such as labour time

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scheduling, family involvement in the farm, or belonging to a cooperative or farmer's organization.

Experimentation is also a relevant learning strategy followed by farmers in the sector. Many famers have learnt by doing, trying new things and implementing changes incrementally. In most of the cases, experimentation is supported by cooperatives, farmers' associations and research centres. They provide technical support in the implementation of new technologies, innovations and innovative practices.. Some examples of the strategies that have been implemented by farmers through experimenting are: i) improve animal handling: ii) invest in genetic (breed) improvement; iv) increase prolificacy and birth control; electric or virtual shepherds; new machineries, drones, GPS collars and breed selection. Additional experimentation activities, supported by research centres, have emerged from the analysis; these include assessments on the benefits of pastoralism in clearing forests and the contribution of extensive farming to maintain biodiversity. Young farmers' individual experimentation initiatives have also been identified in the analysis concerning transhumance and the implementation of new technologies to take care of the herd. These individual initiatives are less common, and they rely, to a greater extent, on a famer's attitude and capacities.

Two additional learning strategies are similarly implemented by farmers in the case study: **collective learning and learning by seeking out information**. The former covers every learning initiative that implies learning with other farmers. These include the organization of meetings and discussion groups, specifically ones organized to share experiences and ideas among famers and provide information about the current concerns of the famers. These meetings are organized by cooperatives and farmers' organizations. Not every farmer agrees with participating in these meetings or similar activities because they do not trust the cooperatives nor do they find the meetings useful. Regarding the latter learning strategy, many farmers learn by seeking out information and new ideas in media, research reports and training sessions. This strategy also embraces the initiatives that seek advisory from veterinarians and other technicians. They seek information about new farm management trends, opportunities or threats. The services are mostly provided by the cooperatives and farmers organizations. The farmers who do not trust these institutions do not follow this learning strategy.

A13.6 What are the most important factors in enabling learning in the adaptive capacity cycle?

One of the most important factors that enable learning is the **farmers' confidence** in *the future of the sector* and the *main actors* of *the farming system* identified as sources of knowledge: Other farmers, cooperatives and research institutions.

Regarding the confidence in *future of the sector*, trust is very important to enable learning for two reasons; 1) If the farmer is confident about the future of the sector he/she will be willing to learn how to improve and adapt the farm to new challenges. On the contrary, the lack of confidence fosters learning oriented to find new activities and transformation; 2) If the farmer is confident

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about the future, he/she will be willing to share his/her knowledge with future generations, contributing to learning capacity towards innovation and adaptation. On the contrary, the farmer will prefer to encourage the potential successor to introduce new activities and transform or even to work in a different sector.

Trust farming system actors enables the leaning processes. Different learning strategies supported by cooperatives, farmers' organizations and research institutes-Universities have been previously identified. Farmers' trust is crucial to enable knowledge transmission and learning on how to improve and adapt. Many farmers do not trust the cooperatives and think their initiatives are not useful, so they decide not to be involved in these learning strategies.

Similarly, the **affective factors and values** facilitate the learning process. The positive attitude is considered a driver of learning, as well as the farmers' affection for the ewes. Farmers want to take care of the animals and they are eager to improve their methods.

It seems that if the farmer is confident with the sector and wants to participate in cooperatives and farmers' organizations because they rely on them, the role of learning in the adaptive capacity cycle is single loop and double loop, depending on the degree of confidence. The outcome is learning, associated with incremental innovation, to improve the farm and adapt the farm to new circumstances (i.e. increased prolificacy, improved breeds and feeding). In this sense, the support of these actors can play the role of enabler for innovations, that is, for double-loop learning. Triple-loop learning takes place when the farmer does not trust the future of the sector and looks to transform the activity (move to intensive sector with high level of technology). Such transformation decisions are made through learning strategies such as "learning by watching" and "seeking for information", in which the information and knowledge support individual initiatives rather than collective ones.

The farmers' affection for the ewes and their commitment to their animals' welfare, the environment and the rural population, promotes learning to improve farm management, animal handling, and their social and environmental impacts (i.e. pastoralism, electric fencing). Farmers' affection facilitates single-loop and double-loop learning associated with innovation and growth. Triple-loop learning towards transformation has not been identified if farmers have affection for the animals. Taking care of sheep properly does not allow time to pursue new activities on the farm.

A13.7 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

The interview analysis shows that learning outcomes enable, to a greater extent, the adaptability capacity rather than robustness and transformability capacities.

Learning outcomes have facilitated the implementation of strategies such as adapting animal handling (feeding, prolificacy, and management), investing in IT (electric fencing video /remote surveillance), belonging to cooperatives, adapting herd sizes, and improving meat quality. The

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farmer adapts the farm to the new circumstances and prepares for future challenges by implementing the mentioned strategies. The cooperatives and research centres/Universities are the main sources of learning for implementing these strategies. **The farmer's confidence for these institutions and /or social networks is crucial to enable the impact of learning the adaptability capacity.**

Some evidence emerges from the analysis that shows how learning contributes to robustness capacity. Farmers have learnt that they have to adjust during hard times by dedicating more time, using the savings, or asking family or friends for extra-support. The main source of learning is the family. **Robustness capacity is inherited to a greater extent than adaptability or transformability.**

Learning capacity has also enabled by the transformability capacity. Some transformations emerged from the analysis, mainly relating to the process of diversification that, in some cases, have led to a "marginalization" of the original production (lamb meat production); that is to say that other productions are currently predominant in farms that formerly specialized in extensive sheep farming. Those changes are likely to be the result of a 'learning by watching strategy'. Usually, farmers make this kind of decisions by observing market trends and feedback from other farmers. It seems that **transformability capacity emerges from individual decisions** influenced by neighbouring farmers' actions. Transformability does not correspond to joint actions encouraged by the sector's organizations.

In conclusion, it is possible to find a link between collective learning, individual learning and their impact on different resilience capacities. Robustness seems to be mainly enabled by collective learning based on the transmission of family knowledge. Family plays a very important role in enhancing robustness capacity. Adaptability is mainly enabled by social learning. In this sense, cooperatives, associations, research institutions and other kind of social networks play a crucial role to enhance adaptability. Finally, individual learning impacts to a greater extent on transformability capacity. In this sense trust, confidence and commitment of the farmer influence the transformability capacity.

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Appendix 14: Sweden Country Report

A14.1 Who/what are the most important influencers on farmer decision-making, and why?

Drawing from the results of the influence mapping exercise, the importance of family on decision-making becomes clear. All farmers (6/6) mentioned family members as having impact on decisions and most were given high relevance, placing the family member within the 3 inner circles (out of 6) on the grid. When mentioning family, it was often the upcoming generation that was referred to, as their input and ideas influence how the farmers choose to plan their farm business activities. It could also be the previous generation or other relatives that had impact, though in the case of more distant relatives, their impact was not as significant as closer family. The farmer's partner, wife or husband was only mentioned by 4/6 as having any impact at all, but when mentioned they were given high relevance. The partner either influence the farmer directly, through joint decision-making, or act as a back-up or discussion partner.

Other important actors, named by many of the farmers (5/6), were different buying groups, i.e. the main production company with whom the farmers have a contract or slaughterhouses. These actors were given medium to high relevance. Interestingly, in the broiler sector, the production companies were mentioned more in terms of actors the farmers had to relate and adapt to rather than influencers, while the egg producers referred to their corresponding organisation as more of a discussion partner or supporting actor. These results are in line with the outcome from the demographic and narrative interviews as well, all indicating that the main broiler production companies in Sweden, regardless of them being conventional or organic, have a firm grip on their producers and highly dictate the production prerequisites in the sector.

Both farming press (5/6) and internet (4/6) were mentioned as influencers on the farmers' decision-making, but were given high or low relevance by different farmers. In the cases were these were given high relevance, they functioned as inspirational sources or as a way to stay updated on the development of the farming sector. Also other farming neighbours were mentioned (4/6) as being influential mainly as an inspiration source or to exchange knowledge and experiences with each other.

Different types of production, financial or business advisors were mentioned at most by 3/6 farmers, and were generally spoken about in positive terms. These influencers allow the farmer to make well-thought decisions and may provide new knowledge or useful tips on how to go about certain procedures in the production. While the main production company within the broiler sector is mentioned to be quite controlling, their advisors are highly thought of by the farmers.

While different authorities have been mentioned in nearly all interviews conducted within the SURE-Farm project, and mostly in terms of being an obstructing factor, only 2/6 farmers chose to add these organisational bodies to their influence maps. The reasoning was that, while the authorities are a factor that they have to adapt to, they do not influence the farmers' decision-making per se. Also, different business associations supporting the broiler and egg production

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were given quite little relevance and only mentioned by a few. Their importance seems to have decreased over the years in terms of support and impact on decision-making.

Politics and politicians were mentioned in 3/6 interviews, and were also one of the influencers that were given least trust by the farmers, while family members and advisors were generally given high trust. Also, the authorities were mentioned as actors that the farmers had trust in, and that this trust is inherent in their function as authorities, bound by legal premises.

A14.2 Do these influencers change over time in relation to different decisions/risk management?

Important to consider when trying to analyse the impact of different influencers, is that their change in relevance are given in relation to a specific event that may have occurred more or less recently. As in the case with internet, Hans and Anette at Odala Farm state that this influencer has *not* changed over time, but this is also to be analysed in the light of them referring to an event (converting their farm to organic production) that has occurred more recently. In that, internet has been an established source of information throughout both their experienced "past" and "present". In other cases, where the farmer did not relate their past and current to any specific change, past is referred to as being ten years prior.

There are limited possibilities to bring forward any general trends on how influencers have changed over time among the farmers, since the sample is very small, only consisting of six interviews, and the results in themselves are very scattered. The influencers mentioned differ between different farmers, their relevance may be higher or lower and the direction in which their importance has changed may be the complete opposite between two given farmers. Even in the cases where an influencer has had equal importance over time with the different farmers, it may have had different levels of importance among the two. Please see the document *coding sheet for influence maps* to further illustrate above reasoning.

The division between influencers that have changed over time either in level of relevance or by being relevant at all is near equal, and it is mainly in the cases where the farmer has converted into a new production system that the influencers have changed entirely. Also, for obvious reasons, the internet has grown in importance in line with the development of web services in the society over time.

In the case of family members as important influencers, their relevance have changed over time for 4/6 of the farmers, but the reason for the change differ. In one case, family had become a higher priority and in another, the family member specified had passed away.

With regards to information sources that the farmers do not have current access to, but which they wish to have can be mentioned examples such as working closer to researchers, having access to impartial advisors when e.g. building new stables or more advisors within organic chicken production, something that was mentioned by both organic broiler producers included in the study.

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A14.3 How do farmers' attitudes and beliefs influence their decision-making?

A main theme that has emerged from the learning capacity interviews is one of the farmer as an entrepreneurial spirit. In almost all of the included interviews, you find some sort of reference to being open-minded, not being afraid to explore new ideas or being a pioneer in a specific practice. While the previous generation at the farm does have an impact on decision-making, often in terms of difficulties in letting go, the farmers strongly state that one always has to be able to adapt to changing circumstances and that "trial and error" is a main strategy in finding new ways to farming. While some farmers, like Joel and Kurt, like to stay updated with research, others, such as Karl and Sixten, trust more in their own experience and adapt their ways as they see fit the outcome of their current farming practices. While these approaches are on separate sides of an adaptability spectra, they both describe ways in which the farmers approach learning and decision-making.

While some farmers underline the need for dialogue, co-operation and support from others, both family and other farmers, others have mentioned themselves and their own experience as an important basis for decision-making. Joel at Vinga farm even goes as far as to state:

"Do not trust anyone, not even your wife."

Joel is an example of a farmer who looks to others for advice, but makes the final decisions based on his own experience and beliefs. In contrast to this, Malin at Inviken farm states the importance of basing your decisions on knowledge and influence from other farmers and actors in the production chain. Requesting increased dialogue and support from advisors is particularly prevalent among the younger or early-career famers.

Persistence and independence are other themes that emerge from the interviews. Jessica at Åsen farm is an example of how a fighting-spirit has allowed for her to gain trust as a female farmer in a sector predominately run by men. Other farmers describe how their personal beliefs and values have driven their decisions to invest in new production or technology, even though being met by scepticism from other farmers or neighbours. As Kurt describes his own decision to start broiler chicken production:

"And we knew it worked well. But then there were sceptics, especially the old chicken breeders, I remember, in -95, who thought we were basically ... Yes, and not just chicken, I mean, there were dairy farms around here who thought we were stupid that built for chicken. Like: "Build a real milk farm instead." And they thought so for ten years, but they don't anymore [laughter]."

Trusting one's own knowledge and being persistent, being open to new ideas, learning from experience as well as actively seeking dialogue and co-operation are approaches that all in all sum up the results from the Swedish case-study interviews, but that do not provide a single, generalising picture of farmers approaches to learning.

A14.4 What external (to the farm) factors influence decision-making, and how?

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External factors that came up in interviews as influencing decision-making was manifold. Weather experiences of the drought in the summer of 2018 led to decision-making around storage of fodder in the future, influenced thinking around investing in technology such as cooling equipment for chicken stables and influenced what decisions could be taken on other investments. Having dealt with the drought once, farmers learned from the weather and talked about adapting practices. Further, consumer and market trends are influential on farmers' decision-making when planning their production or applying new ideas to their farm. Taking into account consumer demands and trends such as organic production helped farmers decide on direction and extent of developments. Farmers thus learnt about market trends and consumer demands in ways that were important for their decision making.

Influencers external to the farm that were important for making decisions were, amongst others, advisors and consultants. Learning from them, farmers took decisions on production, investments or business development. These included bank managers and experts on poultry production and support from experts on the environmental assessment needed to get permission to build a new stable. One farmer pointed out that it was important to get in new ideas to the farm once in a while and find the right consultant who could tell you what you did wrong and what could be changed, and not only what you are doing right and what is working. When transforming to organic farming, consultants had been used to calculate expected profit. Interestingly, we learnt from the interviews that independent advisors on broiler chicken are scarce, while laying-hen advisors are more available. Also, as organic broiler production has increased lately in Sweden, and slow growing broiler breeds and parent generation birds are only emerging in the country, advisors with experience were few. The chicken producing companies also have their own consultants that come out to the farm, and, as Karl at Ekliden farm underlined, they can be very helpful to learn about the sector and production when new to the field.

Actors in the poultry sector influence or strongly dictate decision-making among the farmers. This is mainly evident in the broiler sector, as farmers are contracted by a particular chicken production company and usually stay with the same one. New demands, regulations, restrictions and development of that company thus directly influence the farmers. Interestingly, the decision to start with broiler chicken almost always came from the initiative of such companies, or in response to such companies' advertisement, and not from the farmers' own dreams or convictions. Two of the farmers interviewed explained that when the farm had first signed a contract with their production company, it was for producing turkeys, but that later the production company had discontinued turkey production and the farmers had, without much choice if they wanted to remain with the production company, transformed into chicken production, adapting to the producing companies' wishes.

Throughout the interviews, it became clear that administrative authorities to an important extent affect the production of the farm enterprises, as farmers have to make decisions to adapt to regulations and protocols. This also affects decisions and possibilities to invest or develop the farm business.

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One of the primary influencers when making decisions about production, investments or business development was family, often the partner but also parents or children, depending on what stage of succession the farm enterprise was at. Interestingly, two farmers also pointed out themselves as primary influences of decisions.

Using other farmers as help when making decisions about production, investments or business development were a prominent theme around learning, as farmers learn from each other, and from farmer groups about what others have done in particular situations, or what might work and not.

Farmers also learnt from the animals themselves, spending time and observing the poultry and their reactions to their environment, and made decisions about future management, including feed and organisation of the stables, influenced by what they had learnt.

Lastly, a loose theme that transpired through some, but not all, of the interviews, and that was a stronger theme in the demographic interviews conducted in the SURE-Farm project, was how gender structures affected decision-making. Particularly in the egg sector, representatives and members of branch actors were male, and especially those with decision-making power. This posed challenges for some female farmers, and while the women we talked to had chosen to fight these structures and venture into the sector, it could be seen as discouraging for others. Also, reflecting more widely, comments we received that daughters/sisters had never been interested in farming could potentially be analysed in terms of how children learn what it is to be a farmer and who is suitable. Then decision-making later in life on whether or not to venture into farming and what role to take up, could be affected through learning strategies at an early stage of socialisation when gender performances are learnt.

A14.5 What are the key risks in your case study farming system, as identified by farmers?

Farmers interviewed talked about risks in terms of potential events that might (re)occur that would pose an important challenge to some part of their production and/or farm enterprise. A clear risk for farmers today are animal rights activists, who can both influence the consumer demand as well as break in to the chicken stables and even steal chicken or hens. If unauthorised people have been in the stable without proper disease preventing measures, this could lead to the culling of all animals, resulting in considerable loss for the farmer. Feelings of insecurity and threat also came up during discussion of animal right activists.

A commonly recurring theme among our respondents was the risks associated with weather. Primarily, it was issues related to the recent heat waves and climate change that came up as risks in our interviews. However, even heavy rains and storms can damage the crops in the fields.

The periods of drought in Sweden this summer has led to low harvest yields resulting in both increased crop prices and shortage of fodder amongst farmers. The low levels in the past few years have resulted in low levels of ground water in places, which becomes problematic as farmers are highly dependent on this water.

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Also, increased heat risks to lead to lower levels of animal welfare as the hens and chickens suffer from too warm stables, eating and drinking less. As the chicken bodies produces heat even at normal temperatures, rising temperatures would lead to the need for cooling equipment in the barns. Chicken react quick to increased levels of heat in their environment and without cooling equipment they could die in a relatively short period.

Increased heat also favours pathogenic microbes, potentially leading to increased animal diseases. For egg producers, an additional risk of rising temperatures is lower quality eggs, as increased heat in the stables tends to result in more hens laying their eggs on the floor, where it is cooler, instead of the egg laying compartments designed to keep eggs undamaged and clean.

Animal diseases, but also crop diseases, was another recurring theme amongst farmers during discussions on risks. Outbreaks of Campylobacter, Salmonella and to some extent Newcastle disease among the poultry are main threats to farm enterprises. Once an outbreak has occurred, the whole batch of animals are likely to be culled, and facilities disinfected. This can seriously damage animal health and farm economics.

Further, market and economic climate poses risks to production profitability. As informants pointed out, the skewed trade market in Sweden with relation to the EU makes competition between European and Swedish farmers unequal. With higher production costs in Sweden relating to higher animal welfare standards, chicken meat produced under conditions not allowed in Sweden are sold cheaper on the Swedish market. A recurring issue in relation to the market was the unsustainable, in egg producers' eyes, levels of prices of the fodder they have to buy relative the prices on eggs. The higher fodder prices are not followed by higher egg prices and thus producers face increasing difficulties in securing profit.

In relation to this was another emerging theme that was formulated as risks in different ways by respondents, namely that of dependence on, and adaption to, branch actors and administrative authorities. Sufficient quality of the chickens delivered from the hatcheries to the farm, as well as the quality of fodder from fodder producers are crucial to the production and profitability of the farm enterprises. While farmers are dependent on these actors to deliver high quality animals and crops, they are not able to influence them, and contracts make it difficult to choose other suppliers. As farmers are furthest down the value chain, one farmer explained, they are dependent on the other actors and experience a feeling of lack of control.

Dependency on administrative authorities and the risks attached to changing regulations came up in interviews. If the relationship with representatives of administrative authorities is not good, farmers are in higher risk, in their view, to not pass inspection of regulations followed. If a change in regulation is not detected by the farmer they also risk inspection and failure to comply to new standard. With an increasing, and not streamlined, aligned or harmonised process of implementing, administrative burden related to regulations and reporting, farmers felt the risk to miss something that could lead to a considerable fine or shut down of (parts of) their production. This increased administration also risks, in farmers' views, to lead to increased labour, work load or cost, should they feel the need to hire outside expertise.

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Lastly, labour was often mentioned as a struggle and challenge, and sometimes even pointed out as a risk. A family farm with few employees is vulnerable to disturbances of labour. Should anyone get sick, quit or die the farm enterprise might lack qualified people with adequate knowledge of this specific farm. It is also difficult to find qualified labour, and people who are willing to do the work required on a farm. Also, neighbouring farms can compete for the same labour.

A14.6 What learning strategies do farmers adopt for managing risk and adapting to change?

Strategies that farmers use for learning that allow them to manage risk and adapt to change vary between informants and include a range of themes. Following and engaging in research and learning directly from researchers was an important strategy for one farmer in particular, in order to develop the focus of his farm business. Other farmers learnt more indirectly of new developments and many highlighted the importance of following the farming press. Here they would come across new ideas or trends, but also read about disease outbreaks or other challenges that farmers in other parts of the country were facing. This allowed them to learn how others were tackling difficulties, and get inspiration from ideas and trends that might lead to opportunities for themselves. Social media could also act as a source of inspiration, following farmers who develop their production in interesting ways. Farmers would also visit websites of the Swedish Board of Agriculture, the National Food Agency or the individual companies relevant for the decision they were about to make, such as building companies, material suppliers, etc. for building projects or the on-line market place "Blocket" if they were thinking about creative ways to use second hand material for their particular needs. In this way farmers actively seek out information in their daily practices.

Farmers also engaged in capacity building, taking courses or other types of education to widen their knowledge at different points in their career. Further, as mentioned in the previous section, advisors and consultants were sought out when facing important decision and challenges. Knowledge exchange with other farmers came up in several of the interviews, where farmers described taking part in farming communities, information meetings, personal- and business interactions and other types of organisations in order to facilitate learning and decision-making. The extent to which farmers learnt from their farming colleagues and neighbours varied, and also depended on how they were situated.

It became clear when analysing our data that farmers gain much of their crucial knowledge from experiences, and sometimes lifelong experience, of farming. Both the farming family and their employees learn a lot from their years in the field and continually trying things, adapting to changing circumstances and adapting to what has worked in the past. All farmers had a background that included farming activities to some extent, some growing up on a farm and learning from the previous generation, and some helping out at neighbouring farms as a child.

Nevertheless, being open to new ideas was seen as important when facing new challenges. Farmers thus demonstrated a willingness to learn new things and many were open to taking in

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new knowledge and having an open mind when trying to solve problems and deal with challenges. When learning new things, farmers could adapt an approach of 'learning by doing', experiment with solutions and then adjust their practices based on what they learnt along the way. Linked to this is the important ability to make quick decisions when needed. Farmers are faced with situations where they have to act quickly, and by adjusting to changing circumstances they can make the decisions needed. This is important when facing risks, and not least when risks become actual problems. This could have to do with making a quick call to the fodder supplier when the chicken react in unusual ways, or just managing the day to day decisions of management or how to quickly adapt to new regulations.

Finally, farmers learnt from actively reflecting on their past decisions and evaluating the outcome of those decision or decision-making processes. This then helped them to make the decisions they were faced with at a later point, during challenges of similar, or even different character. We also had examples where farmers reflected on the impact of their personal relationships on the farm for the farm business. This included thoughts on how their own relation had been to the previous generation at succession and how they could do things in similar or different ways to facilitate a smooth transition for themselves, but also for the next generation.

A14.7 What are the most important factors in enabling learning in the adaptive capacity cycle?

An important set of learning strategies that farmers use to a varying degree is the use of consultants, contacts in the sector, other farmers, neighbours or family members, to exchange ideas, learn new things or discuss upcoming decisions. What enables or constrains farmers learning strategies is to a large extent the kinds of relations and networks that they are part of. What kind of family structure and farming structure they come from, as well as their social surroundings in the geographic location where their farm is place, have an impact on their resources for learning. Farming neighbours open to exchanges, or a longstanding network of branch actors, consultants and other contacts enables learning strategies, while being first generation farmers, new to the area or surrounded by non-farmers or farmers less willing to engage in exchanges constrains farmers from adopting learning strategies.

Further, farmers' own attitude and personality plays into their ability to adopt these strategies, as some are more prone to engage in social exchanges, take in other people's opinions and generally value other people's input. Farmers who tend to rely more on themselves use (perhaps to a larger extent) their previous experiences, experimentation and learning by doing to solve challenges and develop their farms. Learning from observing the animals themselves, and learning from the weather also provided farmers with learning opportunities.

In addition, learning strategies included using the internet in various ways, to learn more about potential material suppliers for potential building projects, find cheaper options on on-line market places, learn new trends and other changes from news articles, webpages of administrative authorities and branch actors, and gaining tips and ideas as well as inspiration from social media.

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Single loop learning through incremental innovation occurs most visibly through learning from past experiences, experimenting through 'learning by doing' and trying new things out. However, this can also take the form of advice from the surrounding network on how to develop the existing farm practices and organisation or through capacity building in the form or courses and education. Farmers also expressed gratitude towards the support they had received from the chicken production companies when they were new to chicken production and needed to learn the trade.

An example of double loop learning, when farmers apply more radical innovation and adaption to crisis in the system, is when farmers learned from the weather in the summer of 2018. Learning how their crops and animals reacted to such weather, and believing that it is likely that it happens again, they talked about preparing for similar challenges in the future, adapting to these new circumstances that started as a crisis in their system, through installing additional ventilation, and to put away larger feed stocks next time to prepare for harvest failure. The adaptive capacity of farmers are not only dependent on their own attitude towards learning and their networks of resource persons, but is highly influenced by regulations from administrative authorities as well as branch actors. As has become clear throughout this report, the branch actors in the Swedish poultry sector, and particularly the broiler sector, are very strong and are often the ones driving change in the sector. Farmers thus have no choice but to adapt to changes in regulations and sometimes branch actor decisions, if they want to stay in the branch. As all of the informants we spoke to were engaged in the poultry sector, none had transformed in ways that led them to abandon their broiler or egg activities in favour for other types of production. However, some of the farmers told stories of how they had transformed from other activities and into broiler or egg production, when they first started.

Triple loop learning, when the more radical innovations lead to transformation in activity can occur when a generational shift allows for new values, information intake and visions to materialise. Helge who took over from his father were more positive towards organic farming than his father, more prone to try new things. He sought out, through consultants, information about the economics of organic farming, decided it was profitable enough and transformed the farm in its entirety from conventional to organic production. At the same time, he had got an offer from a leading organic chicken production company, and decided to transform the farm business into broiler production. This shows how not only negative shocks and prolonged stress, but also positive opportunities may lead to transformation of farms.

A14.8 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

The most recurring indicators of learning in our material are related to adaptability. This may be in terms of adapting to changing circumstances or in order to meet future challenges that the farmers have identified. The farmers seek knowledge through for example consultants, advisors, family, other farmers and capacity building to facilitate new working practices, implementing new regulations or handle challenges face that require them to take tough decisions.

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While several indications of robustness and transformation have been identified as well, outlined in more detail in the extended summaries, these are not always as obviously related to learning processes as those indicating adaptability. Singe-loop learning from farmers' own experiences on the farm, experimentation and learning by doing could be seen as continually favour robustness and smaller challenges then can be overcome by drawing on what has been learnt before. However, learning from others, such as other farmers, consultants and advisors can also help with robustness. Farms Åsen and Rodal each have learning indicators related to robustness, as their knowledge seeking has mainly focused on strengthening of or survival of the farm business.

The cases of farms Odala and Bergum are the ones that mainly indicate learning for transformability. The farmers at these farms saw an opportunity in increased profit from converting to organic production following increased knowledge on this way of farming. To deal with such large changes, help and knowledge was sought from consultant and advisors with expertise in the area.

As mentioned in the previous sections, many farmers are entrepreneurial spirits and often open to new ideas or the realisation that one must adapt to survive. This mind-set follows the farmers also when facing future challenges. In a way, farmers may be well prepared for such challenges as they are already used to working based on the ability of making swift decisions and changing their practices as necessary.

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Appendix 15: UK Country Report

A15.1 Who/what are the most important influencers on farmer decision-making, and why?

Individual Influencers: The most important influencers for the farmers interviewed are family members, with 15 out of 18 respondents including them on their influence map. In most cases family members (often indicated as sons, fathers, brothers, or parents) were placed in the centre of the influence map, although in one case family scored '5'. In most cases, the farms are family farms with several family members having a role in the farm management, so decision-making is shared, as one respondent highlighted: "We very much make decisions together" (F06). Another said: "They [family] influence what we do more than anybody because at the end of the day we're a family business" (F12). However, several farmers indicated the family was not at all influential, such as F17: "Family members, I just don't … I ignore them completely, actually!". Wives, husbands or partners also scored similarly highly and were specifically mentioned by 6 respondents. Three farmers said that the most important influencers on their decision-making was themselves.

Agronomists were also very influential for the interviewed farmers, mentioned by 17 respondents and generally scoring 1 or 2, with three scoring 3. Farmers spoke about how they frequently engaged with their agronomists, discussing varieties to grow and appropriate inputs. They indicated that agronomists' role has evolved from input on plant protection products, to having a much broader knowledge of the agri-environment scheme landscape.

Financial advisers were medium influencers, with accountants mentioned by 10 respondents; and banks mentioned by 14 respondents with scores ranging from 2 to 6, thus indicating high importance for some, but less for others. Other farmers were mentioned by 13 respondents, and included farming neighbours and farming friends with scores of 1-4.5. For those who indicated other farmers are influential this involved both talking to them, finding out about their experiences and observing what they did (e.g. "you talk to someone else who's tried it, and they say, yeah, well, this bit worked, that bit worked, don't try that, do this" (F06). A small minority indicated that other farmers are not very influential: "I try hard not to be influenced by what someone is doing next door" (F04). For some, farmers from abroad were moderately influential, and they could learn from the experience of farmers from around the world as they tried out new technologies or techniques: "there'll be someone in America has started doing something… if we can adapt it and use some bits, and learning something from it" (F06). Four farmers indicated that discussion groups were influential, for two they were very influential (score of 2), while for the others they were background influencers (4/5).

Other individual influencers mentioned by some farmers include their business partner (4 respondents) scoring 1 to 3.5; employees, mentioned by 7 respondents, are fairly influential (scoring 2-4) "my employee has worked for me on the farm … since he was 17 [now 60] … so in that was we work together on the farm and that's allowed me to do things outside the farm and do the diversification because he's able to make the day-to-day decisions because he knows the

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farm as well as I do really, having worked on the farm all that while" (F13); the landowner was mentioned 4 times (2.5 to 4.5) and contractors were mentioned by 3 respondents (scoring 1-3.5).

Influential organisations: Public research institutes are moderately influential for the interviewed farmers, mentioned by 8 respondents, and industry research was mentioned by 3 respondents. However, for some farmers there was a perception that in for other European countries cooperation between farmers and researchers/scientists is much more integrated and useful as much of the research is centrally funded by government (they were disappointed that ADAS had been privatised). Similarly, seed companies and brokers were moderately influential, mentioned by 14 respondents. Government departments were seen as framing the context in which farmers operate, and were mentioned by 15 respondents. Some farmers put these as very central to their decision-making, while others gave them a more moderate position on the map. Government departments cited include Defra, the Environment Agency, Natural England, Historic England, RPA and the Health and Safety Executive. The EU was mentioned by 7 respondents, with influence varying from 1-4.

Customers (i.e. companies who buy their products) were mentioned by 4 respondents (scoring 2-5), and supermarkets by two. Land agents were moderately influential for 7 respondents, while for one land agents were very influential. Environmental NGOs were mentioned by 5 respondents with importance ranging from 1-6. The NFU is moderately influential for 11 respondents, as is AHDB for 9 respondents. Seven farmers indicated that buying groups are moderately influential.

Other influencers: The farming press is moderately influential for 11 respondents, as is the internet for 6 respondents. Social media was mentioned by 8 farmers, with influence ranging from 3-6 "Use social media a lot and just learn from around the world what people are doing" (F02). Several farmers (3) mentioned the biophysical characteristics of their farm as a very important influencer of the decisions.

An important aspect is the degree to which farmers trust their influencers. So, those in their inner circle such as family, friends, employees, trusted independent advisors etc., tend to be more trusted than politicians, the media and external input suppliers (who are perceived as promoting their own product). "Anybody selling anything I think we'd have a question whether it was good advice. So yes, there's definitely an element of trust, which is really why we've got family at number one because we are a very open and frank family, I don't think we have any secrets from each other" (F12).

A15.2 How do farmers' attitudes and beliefs influence their decision-making?

Respondents did not speak extensively about how their attitudes and beliefs influence their decision-making, although a number of factors emerged during the interviews. Firstly, farmers attitudes towards farming shapes the decisions they make, whether this is a belief that they are stewards of the land and have a duty to preserve the soil health for future generations to farm, are environmentally-minded and seek to improve conditions for wildlife across their farm, or see farming primarily as a business that needs to make a profit at all costs. Their attachments to

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particular ways of farming, often associated with their own identity (e.g. "I am a dairy farmer") can also drive decision-making, and may hinder adaptation if too inflexible.

Associated with this, is farmers' attitude towards risk, with those who are risk takers happy to try out new, experimental, ideas on their farm, perhaps taking on large amounts of debt. Others are more risk averse, and shy away from exposure to high levels of debt and prefer to continue working in the same way they have always done where possible. "I've become…you'd think as you get older you get more risk averse but actually I'm not. I'm quite the reverse. I've become more confident as time's gone on. And I've found that if it's worth doing, and you can see that there is a…it makes complete business sense, I'm not afraid to borrow money in order to do something" (F13). Speaking of other farmers, one respondent said: "And they've already got their idea of how it should be and stick to it. And a lot of them have been like that all their lives. And they're stuck in a rut in a way. And they fear changing because their neighbours are all still doing what they've always done. So it's like a bit of a tribe and they all stick together" (F13).

A15.3 What external (to the farm) factors influence decision-making, and how?

For the UK case study, a key external influence on decision-making is Brexit. For some they are holding back on further investment in the farm until they have a clearer picture of what the future of British farming will look like, while others are investing in expensive machinery now while they still have the single farm payment. Other factors include regulation (changes), access to technology and the different views on the use of technology between the generations in families, environmental limits and family crises.

A15.4 What are the key risks in your case study farming system, as identified by farmers?

The main risks identified were Brexit [18][5], volatility in grain prices [14], weather [13], pests and diseases [11], and the availability of labour [8].

Clearly for UK farmers, the biggest risk and area of uncertainty at the moment is Brexit with farmers unclear about the future nature of the new British agricultural policy, and the trading relationships with Europe and other countries. Some were very uncertain about the future viability of farming with the loss of the single farm payment, given that margins are so low. However, others saw opportunities for a transformed farming system where farmers are paid for the public goods they provide on their farms (e.g. biodiversity, carbon sequestration, landscape etc.), enabling them to farm in a more sustainable way, while also running a viable business. The uncertainty of the way forward is making it difficult for farmers to plan too far ahead, as one farmer explained: "But the other one is the big elephant, the Brexit question. We don't know what trading is ahead so should we be looking at maximising a five year stewardship plan, bearing in mind there's all sorts of problems with payments and that sort of thing under stewardship schemes, or should you be just holding your powder dry on that and looking at the market

[5] Number of respondents mentioning issue indicated in brackets.

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ahead?... so what am I going to be looking at, am I going to want park keeping equipment or am I actually going to want arable farming equipment" (F14). Along with this there were concerns about competing on the global marketplace and the challenge of keeping the high standards of food production when food can be grown elsewhere much cheaper, often because environmental and safety standards are less stringent. "If they [the government] are going to push us down some sort of slightly sort of high-level environmental way of farming, that's fine, but that needs to reflect the fact that we can't then compete with cheaper imports" (F05).

As the main cereal grown, wheat is traded on the global market and is subject to the volatility of global wheat prices so farmers must manage these fluctuations and endeavour to sell their grain when prices are high, keeping a check on global markets and events that may impact on grain prices for the coming season (e.g. droughts in key grain growing areas of the world). Exchange rates also influence the price achieved when selling grain. These risks were seen as beyond the control of the farmer, but need to be managed and anticipated. "When you're growing primary products, you are open to world market conditions, and it's beyond your control, and you can't forecast shortages, or over-supplies in advance, so you're always at risk from that" (F11).

Another related economic risk mentioned is managing cash flow. One farmer talked about feeling exposed to risk because he is renting more land – he has to pay the rent on the land, but is exposed to the risk of fluctuating markets and costs which make it difficult to manage cash flow. Others explained that the risks of weather, grain and input prices all make it difficult to estimate and manage cash flow because the margins are very low.

Weather is also cited as a major risk, again beyond the control of the farmer. Although respondents feel that the climate is becoming slightly warmer, it is the extremes of cold (severe winters), heat (summer droughts) and severe storms and flooding that are difficult to manage. The East of England is particularly prone to spells of dry weather during the summer months. "The unpredictability of farming is such that I could have a bad year, through no fault of my own, 2016 was a good example, there was a very, very low amount of solar radiation in June, which is a critical time for lots of crops… we ended up producing two thirds of the amount of wheat that we normally produce" (F04). A number of respondents felt that the climate is changing, and leading to increased incidence of extreme weather (dry periods, floods etc.).

Pests, diseases and weeds were a major risk for arable farmers, including:

- Blackgrass (*Alopecurus myosuroides*), which is fairly common on heavy clay soils and causes yield losses and has high resistance to herbicides.

- Cabbage stem flea beetle (CSFB) (*Psylliodes chrysocephala*) on oilseed rape causing crop damage – more of a challenge with the ban on neonicotinoid seed treatments (since 2013) for oilseed rape. The only current option is foliar pyrethroid sprays, but widespread resistance in CSFB means effectiveness is limited. Some farmers indicated they have stopped growing oilseed rape because of this pest, at least for the time being.

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- Mammals (rabbits) and birds (e.g. pigeons) which eat and damage crops.

Regulations, particularly around crop protection products, was also considered a risk in terms of enabling or constraining what products a farmer can use, and thus what crops it is viable to grow. The ban on neonicotinoids was seen as a barrier to growing oilseed rape and sugar beet, dramatically reducing yields, and respondents felt that removal of these chemicals should be phased out alongside developing appropriate alternatives. Respondents indicated that phyrethroids have limited effectiveness. Future concerns were around a possible ban on glyphosate, particularly for those adopting minimum till cultivation methods. More broadly, respondents felt that some regulations are overly restrictive and inflexible, such as the 1 metre cross compliance strip around every field, which is not always practical and the three crop rule which can be overly restrictive for contract farming.

The final major risk identified was the availability of labour. Respondents indicated that working on a farm is not an attractive career choice for many young people today, as they don't like the unsociable hours it requires. Many said that their employees were approaching retirement age, and had been working on their farm all their working lives. They were concerned about how they would replace these hard-working and experienced farm workers. However, for a number of farmers who had transformed from dairy to arable farming, they indicated that the labour situation was now easier, as dairy farming requires more labour. There was concerns, though, that seasonal labour (e.g. at harvest time) would be difficult to secure when the UK leaves the EU, as much of this labour comes from Eastern Europe. Respondents suggested that the issue is both with skilled and unskilled labour. With increasing technology, there is a rising demand for highly skilled operatives to work with complex, and expensive, machinery. "Labour is another one, obviously we have a lot of migrant labour, agencies we use, they're struggling to get people of any quality. … But full time staff doing certain jobs is an issue. This year I've got a full time spray operator, Bulgarian ... His brother's here helping irrigation. Sandra who comes in the QC room to do all our quality control she's Lithuanian. Chris in the workshop is South African. So, we've got quite a mix of nationalities out there and doing probably senior positions to be fair. The spray operator is the big one" (F16).

Another, more longer-term risk, mentioned was that of succession. For some there was no clear successor as the farmer's children did not want to farm. While the children would inherit the farm it was not clear if it would be maintained (and presumably contract farmed) or sold.

A15.5 What learning strategies do farmers adopt for managing risk and adapting to change?

Learning from others, particularly other farmers, is a key learning strategy for respondents: "it's about getting out and learning from other people… I enjoy going out to meetings and sharing knowledge, listening to what other people are doing. I think it's an important part of learning and it's continual learning" (F02). This involves talking to farming neighbours, engaging in discussion groups, observing what other farmers are doing ("I go to a lot of talks, visits, look at what other

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people are doing" (F02)) and seeking out advice from other farmers. This is particularly useful when farmers want to try out something new and engage in trials. Some farmers highlighted that this networking and self-organisation between farmers has increased since ADAS was privatised – previously the government led knowledge sharing and best practice through public research organisations such as ADAS, since then manufacturers, who undertake research on their products, have influenced farmers, but farmers felt that this was not always in their best interests. A number of farmers spoke about Monitor Farms, an initiative facilitated by AHDB where groups of farmers who want to improve their business by sharing performance information and best practice come together around a network of host farms across the country. For some this develops into close cooperation with their farming neighbours in order to save costs: "But since getting together, and I've actually got to know my neighbour better, by going to these meetings … we've got a better relationship and we are doing bits and pieces together where we can; so such as having seed delivered to one address to save a drop-off fee, and buying stuff like that together; and have your seed dressed together. Just working together really" (F06). Cooperation is a risk management strategy, whether it be sharing equipment or forming a cooperative or buying group.

Experimentation was also an important learning strategy, with farmers trying out new things on their farm and seeing how they worked. This was often done a little at a time, in combination with learning about the new approach through seeking out information and talking to other farmers. Experimentation may occur both in terms of agricultural production, but also for diversification activities.

Respondents also spoke about the need to be open to new ideas, to be flexible and reflexive "sometimes you need to take a breath, look up, go and visit other farms and get involved in pushing your boundaries of where your knowledge is and why you're doing it the same you you've always done it" (F02). "You've got to like new in this job. You can't stand still" (F10).

A15.6 What are the most important factors in enabling learning in the adaptive capacity cycle?

In the UK case study, our findings align more to a typology of learning that distinguishes between cognitive, normative and relational learning (Baird et al., 2014, Haug et al., 2011, Huitema et al., 2010, Munaretto and Huitema, 2012) rather than the single-, double-, triple-loop learning classification. Respondents' expressions of learning related more to the nature of learning (i.e. cognitive, normative, relational) rather than the perceived value of learning (i.e. single-, double- and triple-loop learning). The hierarchical concept of single-, double- and triple-loop learning suggests that the higher levels of learning are preferable, but the typology of cognitive, normative and relational learning treats the three types of learning equally (Baird et al., 2014). Table 1 indicates how learning expressed by our respondents maps onto the cognitive, normative and relational learning typology.

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Table 1: Typology of learning strategies from UK case study

Type	Definition/indicators of learning effects (from Baird et al. 2014)	Evidence of learning type in UK case study interviews
Cognitive learning	Acquisition of new knowledge; restructuring of existing knowledge	• Seeking out new information • Pushing the boundaries of existing knowledge (which may challenge existing way of working) • Acquiring new skills (e.g. new technology, marketing, how to buy options and future on markets)
Normative learning	Changes in norms; change in values; change in paradigms; convergence of group opinion	• Being flexible and open to new ideas • Experimentation which leads to changed values, opinions and practices
Relational learning	Improved understanding of mind-sets of others; building of relationships; enhanced trust and cooperation	• Enhanced trust & cooperation between farmers • Learn from others who have done things differently • Observing what other people are doing • Engaging in discussion groups, Monitor Farms (benchmarking) or other networking opportunities with other farmers • Experimentation and trialling new ideas with other farmers • Talking to neighbouring farmers • Engaging with farmers around the world through social media or overseas visits • Translating learning from non-farmers (e.g. conservation organisations) into 'farmer practice' that can be applied • Learning between the generations

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As Table 1 suggests, much of the learning expressed by respondents was relational, involving learning from others, either through one to one engagement with other farmers, or collectively through social learning among farmer networks. Learning for resilience is about applying a range of learning strategies as well as having an openness to learn. Alongside this, cognitive learning is important in for acquiring new knowledge, skills and information. There was less evidence for normative learning but some respondents spoke of how their approach and attitude towards their farm changed through experimentation (e.g. observing improving soil quality after trialling no till or reduced till techniques).

The strategies identified by the farmers in this case study suggest that learning is about both **how farmers think** and **what they do**. So farmers need a particular mind-set that allows them to learn: they need to be open to new ideas, be flexible and have a reflexive approach to their business in order to persist and adapt (or transform) when needed. They need to be willing to learn from others, and share their own experiences. They also need to practice behaviours that enable learning, such as experimenting and trying out new ideas, engaging in networks with other farmers and seeking out information. Further, these learning activities occur at both the individual level and the group/social level. Thus, farmers learn through their own experience and trying out different things, but they also learn from observing and talking to others.

Learning can be constrained either by the individual not having a mind-set open to learning, or by external factors that limit the degree to which farmers can learn and adapt. Respondents indicated the inflexibility of regulations as not enabling and encouraging adaptive behaviour. The privatisation of ADAS in 1997 as a public research institution was also mentioned as detrimental to knowledge-exchange between farmers, but over the past two decades there has been an increase in self-organization amongst farmers in terms of peer-to-peer learning and knowledge exchange.

A15.7 What are the implications of the analysis in terms of SURE-Farm's resilience framework (robustness, adaptability, transformability)?

It is difficult to indicate particular learning strategies for the discrete concepts of robustness, adaptability and transformability. As outlined above, learning is a process that involves a particular mind-set that is open to learning, and a set of behaviours, combining strategies that can be classed as cognitive, normative and relational learning. However, we suggest that robustness is likely to mainly require cognitive learning; adaptability both cognitive and relational learning; and transformability all three types of learning.

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References for appendices

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