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# 2

## *The Importance of Improving and Enlarging the Scope of Risk Management to Enhance Resilience in European Agriculture*

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### 2.1 Introduction

Risk and risk management are essential elements of farming and affect the well-being of the farming population. Farm businesses face a wide range of risks, such as production risks (uncertain quantity and quality of production), market risks (volatile prices, changes in consumer demand), social risks (health issues, family breakdown, succession problems), financial risks (faulting on financial obligations) and institutional risks (shifts in the political and regulatory context). These risks and uncertainties reduce the well-being of risk-averse farmers and their incentives to produce, invest and innovate (e.g. Sunding and Zilberman 2001; Gardebroek 2006; Cerroni 2020; Iyer et al. 2020). Moreover, high uncertainty may also limit successful farm transition. Ultimately, the insufficient ability to address risks and uncertainty affects the resilience capacities (i.e. robustness, adaptability and transformability) of farm businesses and entire farming systems (e.g. Meuwissen et al. 2019; Slijper et al. 2020). Robustness relates to stability, aiming to absorb risks in order to maintain the status quo (Folke 2006). Adaptability represents a farm business's and farming system's ability to adjust processes in response to stresses and shocks, while transformability is the ability to radically change a business's and farming system mode of operation when needed (Darnhofer 2014; Meuwissen et al. 2019).

Agriculture has been traditionally one of the riskiest economic activities (e.g. due to its dependence on the variability of natural factors).

It is likely that exposure to risks will further intensify for European farm businesses and farming systems in the future. This will increase the demand for innovations in the field of risk management and for policy interventions (Chavas 2011). For example, climate change leads to increasing weather variability and a higher frequency and magnitude of extreme events such as heat waves, droughts and heavy rainfall that harm European agriculture (e.g. Trnka et al. 2014; Webber et al. 2018, 2020). Moreover, market risks such as volatile prices on liberalized markets and policy risks from changing agricultural and environmental policies are increasingly important for European farms (e.g. Tangermann 2011; Meraner and Finger 2019). For example, societal debates about agricultural policies and their effectiveness and efficiency in reaching desired (environmental, social and economic) goals may lead to policy regime shifts (e.g. Daugbjerg and Feindt 2017; Huber and Finger 2019; Pe'Er et al. 2019; Schaub et al. 2020). Moreover, farmers face previously unimaginable risks (i.e. so-called unknown unknowns), such as those experienced during the Covid-19 pandemic, the Russian Embargo or Brexit (Meuwissen et al. 2019, 2020; Vigani et al. 2021).

Farm businesses can respond to production, market and institutional risks by taking measures on or off the farm. Farmers' responses to risks are driven by past risk experience and perceived levels of risk (Meraner and Finger 2019). For example, farmers adjust production and marketing decisions in response to risk exposure or decide to allocate more resources (labour, money etc.) outside the farm (de Mey et al. 2016). Such risk management measures are often costly and have implications beyond the single farm and farm household. They can affect entire farming systems, including up- and downstream industries as well as the environment. For example, risk perceptions and risk preferences shape farm-level decisions on land use and the use of inputs that are critical to the environment, such as fertilizers, pesticides or water (Möhring et al. 2020a, b). Whether farmers reduce production risks by controlling yield losses (e.g. using hail nets or irrigation systems) or by using a financial insurance that may substitute or complement these measures has massive implications for the variability of the supply to regional markets (Behzadi et al. 2018). To cope with these risks at the level of agricultural and farming systems, the adaptive capacity and risk management options in European agriculture need to be improved at the system level, focusing on long-term, rather than short-term, viability of farming systems.

An enabling policy environment is crucial to support this process. Indeed, risk exposure and risk management are of great policy interest (see, e.g., Bardají et al. 2016; European Commission 2017; Meuwissen et al. 2018). As a response, the 2013 reform of the Common Agricultural Policy (CAP) emphasized the policy support for farmers' risk management and introduced new measures such as extended financial support for insurance schemes (e.g. Di Falco et al. 2014; Bardají et al. 2016; El Benni et al. 2016; European Commission 2017; Meuwissen et al. 2018; Popp et al. 2021).

The SURE-Farm (Towards SUsustainable and REsilient EU FARMing systems) project (see Chapter 1), inter alia, aimed to inform policy responses to the new risk environment by (i) documenting the state of play of risk and risk management in European agriculture and (ii) synthesizing policy-relevant pathways for risk management at the level of farms and farming systems. We used a wide range of methodological approaches (surveys, interviews to assess farmers' learning processes, biographical narratives, focus groups, digital co-creation platforms and empirical simulations) that consider different scales (farm, household, farming system) and a broad scope of risk management solutions (financial risk management, joint learning and knowledge sharing). In this chapter, we discuss the link between risk management and resilience and contribute to expanding the scope of risk management, underlining the key role of a farming system perspective.

We show that a diversity of risk management solutions should be enabled by policy and industry. Strategies to cope with risk often extend (and even more often *should* extend) beyond the level of the individual farm. Cooperation, learning and sharing of risks play a vital role in European agriculture and should be further strengthened. Risks can affect both up- and downstream operators with significant consequences for the farm sector. Thus, coordinated policies which target actors beyond the individual farm and consider all stakeholders that are involved in risk management strategies are needed to ensure effective implementation. Moreover, policies need to take full advantage of the novel technological opportunities and improved data availability (e.g. based on satellite imagery) to develop a wider set of risk management strategies.

The remainder of this chapter is structured as follows. First, we identify risk management at the farm and farming system levels. Second, we investigate behaviour and perceptions in the context of

risk and risk management in European agriculture. To this end, we identify the strategies of farmers and non-farm actors and consider a wide spectrum of risk management options. Third, we aim to sketch out exemplary pathways for improved risk management. We highlight the relevance of widening the focus beyond traditional financial risk management instruments and discuss the potential for novel insurance mechanisms, e.g. based on satellite data. Finally, we draw policy conclusions.

## **2.2 Farm-Level and Farming-System-Level Risk Management**

Farmers have various tools at their disposal to reduce the impact of risk exposure, e.g. from extreme weather or market shocks. They can adopt risk management strategies on their farms (on-farm risk management strategies) and share risks with others (risk-sharing strategies). On-farm risk management strategies aim, e.g., at reducing the impact of risks (e.g. in terms of production or profit). This can include measures to prevent weather risks, such as the establishment of irrigation equipment. Production and income diversification are other important on-farm risk management strategies (e.g. Meraner et al. 2015). Farm businesses also adjust investment decisions in response to risk exposure. For example, increasing risks often make investments less attractive and lead to their postponement (e.g. Spiegel et al. 2020a). Farm businesses also build up reserves (e.g. knowledge, financial and social capital, fodder, or production capacities such as labour and machinery) to be better able to cope with and respond to shocks and stresses. Along these lines, farm businesses also respond to risks by adjusting their capital structure. For example, an increasing exposure to risks often leads to a reduction in the use of loans (e.g. de Mey et al. 2014). This holds for both family and non-family farms. For family farms, risk management usually also has implications for the farm household as the intermingling of business finances with household finances is common in most family farms (Wauters and de Mey 2019).

Yet, these strategies increase the costs of production because they require expenditures (e.g. for an irrigation system) and/or induce opportunity costs – e.g. a diverse production range precludes specialization to realize efficiency gains (Vigani and Kathage 2019). Moreover, some risks may be beyond the capacity to cope on-farm and consequently spread to the landscape/farming system level.

Extreme weather events such as droughts and heat waves can have severe impacts on farms and farming systems as these risks can affect several activities simultaneously.

We highlight here crucial aspects in the field of risk management, such as the importance of considering interdependencies between actors and instruments, the dynamics of decisions at the farm and farm household levels and the relevance of learning. Thus, agricultural risk management goes beyond the level of individual farms. It also spans across all dimensions of resilience, i.e. robustness, adaptability and transformability.

Risk-coping strategies often require interaction between farms and other actors. For example, farmers can reduce uncertainty by learning and sharing experiences with other farms. Farmers can also share risks with other farmers or transfer risks to markets to complement on-farm risk management strategies (Vroege and Finger 2020). Moreover, farms are increasingly connected to other actors along the value chain that look to ensure the procurement of agricultural commodities through contractual agreements – a phenomenon referred to as contract farming (Bellemare 2018). These kinds of contract serve, among other purposes, as a partial insurance mechanism against price risks (Bellemare et al. 2021). This example shows how some risk management strategies develop from interactions of the farm with other actors of the farming system. More generally, farmers can share price risks with up- and downstream partners using forward contracts or transfer price risks using futures (e.g. Assefa et al. 2017). Other instruments and mechanisms such as cooperatives and mutual funds, for example, further facilitate risk pooling (e.g. Severini et al. 2019). Moreover, agricultural insurance schemes pool production risks and play an increasing role in European agriculture (e.g. Meuwissen et al. 2018). The uptake of all these measures and the optimal portfolios of on-farm risk management and risk-sharing measures is farm-specific and depends on the characteristics of the farm and on the preferences of the farmers (e.g. de Mey et al. 2016; Meraner and Finger 2019). In the SURE-Farm project, we highlight the dynamic nature of these allocation problems. It is not only the sources of risk that are changing over time (e.g. due to changing market or climate conditions) but also farmers' risk perception and risk preferences (e.g. Bozzola and Finger 2021).

### **2.3 Insights into Risk Perception and Current Risk Management**

The subjective perception of risk by farmers is crucial to explain observed behaviour and in particular to understand the adoption of risk management portfolios at the farm level. Three methodologies were employed in the SURE-Farm project to gain insights about the perception of risk and risk management by farmers: a farm survey, narrative interviews and learning interviews (see Chapter 1 for greater details on the methods adopted). The farm survey ( $n = 996$ ) was conducted in eleven farming systems and aimed to capture perceptions of challenges and applied risk management strategies using different question formats, including open questions, multiple-choice questions and Likert-type scales (see also Spiegel et al. 2019, 2020b; Slijper et al. 2020). Semi-structured interviews ( $n = 130$ ) sought to gain insights about influences on farmers' decision-making, as well as identify major learning strategies and their enabling and constraining factors. Biographical narratives were gathered in five farming systems (United Kingdom, Bulgaria, Belgium, Italy and Sweden) with early-, mid- and late-career farmers (Nicholas-Davies et al. 2020) to identify trigger points for change in risk management strategies.

In order to reveal the major challenges that European farmers expect in the future, in the survey (see also Chapter 1) we opted for a combination of closed and open questions. When assessing a predefined list of challenges (closed questions in the farm survey) based on their relevance for the future, farmers responded that they perceived institutional challenges (e.g. reduction of CAP direct payments and tighter regulations) and environmental challenges (e.g. extreme weather events and pest outbreak) as highly relevant in the future, with 39 per cent and 21 per cent of respondents, respectively, scoring them as the most challenging, while only 17 per cent of respondents perceived economic challenges (e.g. persistently low output prices and high input prices) as most challenging. In response to the open question in the farm survey, which asked respondents to name three major challenges they anticipate over the next twenty years, economic challenges, and in particular long-term pressures such as difficulty to improve profitability, were mentioned most frequently (Figure 2.1, left panel). From the open question we identified five categories, namely



**Figure 2.1** Fifty most frequent words and word combinations in response to open questions on major perceived challenges and risk management strategies in the next twenty years. The size of each word reflects how frequently it was mentioned.

institutional, environmental, economic and social challenges and challenges related to access to technology and innovations. Examples of the latter category were ‘lack of information about markets’; ‘lack of information about climate’; ‘keep on track with technologies’; ‘influence of new research results in terms of production and its ecological aspects, e.g. insects, groundwater, fertilization’; ‘introduce new technology’; or ‘access to technology’. In sum, results of the farm survey indicate that European farmers expect to face multiple challenges in the future.

Biographical narrative interviews confirmed that challenges perceived by farmers range across a spectrum from purely internal factors arising from within the farming family, to factors arising from within the farming system, through combinations of factors to uniquely external pressures. Internal factors, such as intergenerational change, family breakdown, illness and death were more prominent in the narratives than external factors. The narratives revealed different approaches to risk alleviation, both within and across regional agricultural systems. For example, in the Northeast Bulgarian case, family relations were a fundamental part of the management of the very large corporate arable farm systems, and narrators emphasized that this legal structure provided a means to reduce personal financial risk. In other examples, family deaths and breakdowns in relationships (e.g. divorce, sibling disagreement) posed significant threats to the resilience of the family farm business and often resulted in enforced adaptation. In an example in the Flemish case study, small farm sizes and price volatility resulted in risk aversion and a disinclination by the farmer to invest in the business. Whilst this was a robustness response at that point in time,



for the subsequent successor of the farm business it meant having to invest heavily to adapt the farm business in the early years of his farm management, thereby putting his business operation at greater risk. Factors that appear to be outside the control of the farm business (such as weather or price volatility) tended to be accommodated (robust response), rather than result in a considered, active change.

Addressing the manifold challenges perceived as relevant in the future requires adequate risk management portfolios. A combination of closed and open questions was used in the survey to reveal the most promising current and future risk management strategies (Spiegel et al. 2019). The closed question asked farmers to indicate which risk management strategies from a predefined list they had implemented in the past five years, while the open question asked farmers to list their three major risk management strategies they foresee as most relevant for the next twenty years (Spiegel et al. 2019; Slijper et al. 2020). Based on the responses to the closed question, we conclude that farms specializing in arable and perennial crops use more diverse risk management portfolios than livestock or mixed farms. For example, the risk-sharing strategies hedging and insurance were far less common in animal production compared to arable production. Yet, some risk management strategies were well adopted across all farm types. More specifically, cooperation between farms, such as membership of cooperatives and learning from others and their experiences, was an important risk management strategy. Results of the learning interviews add that a rather broad range of learning strategies were used by farmers to manage risk. Among on-farm risk management strategies, working harder to secure production in hard times and maintaining financial savings for hard times were found across all farm types. Our results further indicate that farmers elected highly specific risk management portfolios that were truly unique for each individual farmer in our sample. This finding underlines the importance of tailoring risk management efforts to the diversity of risks and challenges faced in the particular context of an individual farm (e.g. Meraner and Finger 2019; Vigani and Kathage 2019; Slijper et al. 2020). Understanding the adoption of different risk management strategies hence requires a holistic view on the diversity of risk management instruments available to farmers and how these interact in order to fully characterize how they allow managing multiple risks simultaneously, including the unknown (Spiegel et al. 2020b).

Responses to the open question in the survey are summarized in Figure 2.1 (right panel). In contrast to the existing literature, which mainly considers risk management in the context of short-term shocks for economic functions, farmers participating in the survey perceived risk management in a broader context. More specifically, their responses addressed also environmental and social functions of farms and targeted not only robustness, but also adaptive and transformative capacities. Likewise, examples from the biographical narratives of robustness in response to various challenges often appeared to relieve pressures in the short term and often forestalled opportunities for adaptation and transformation, as in the example of the Flemish farmer described earlier. Yet, sometimes this kind of long-term consideration was neglected by farmers. In an example from the Central Italian case, hazelnut farming was extremely profitable, and due to increased demand for land to establish hazelnut trees, the majority of new expansion was into more marginal land areas. Whilst this adaptation (expansion) ensured business resilience, it also came with the added risk of lower yield due to poorer growing conditions and greater prevalence of drought and heat waves (Zinnanti et al. 2019). The profits to be made clearly outweighed the risk in the short to medium term, but limited consideration was given to the potential long-term impacts of climate change on the sustainability of growing hazelnuts in these areas – perhaps a particularly pertinent issue given the long productive cycle of hazelnut trees. Results of the learning interviews provided further insights about the adoption of risk management strategies. More specifically, our analysis distinguishes between farmers who are ‘proactive learners’ and those who are ‘reactive learners’. Proactive learners anticipate risk and adopt risk management strategies in anticipation of expected challenges; they are often identified as innovators or early adopters (Rogers 1995; Diederer et al. 2003). They experiment with new technologies and new approaches on their farm and are open to new ideas, seeking out new knowledge and engaging across social networks. Conversely, reactive learners are risk averse and deal with the consequences as and when they occur (van Winsen et al. 2016). They often perceive themselves as lacking self-efficacy, adopt a business-as-usual model and hesitate to try out new approaches or technologies. Their lack of flexibility and their reluctance to engage in social networks can constrain their ability to learn about potentially more resilient ways of working.

Adopting risk management strategies to respond to both shocks and stresses, as outlined in this chapter, often requires learning both how to deal with new challenges and how to adapt to changing circumstances. In the SURE-Farm project, and in particular in the learning interviews, we distinguished between cognitive, experiential and relational learning. Cognitive learning includes the acquisition of new skills or knowledge, and may take the form of training or learning about new technologies that can mitigate risks (precision farming, hail nets, etc.) or actively seeking out new information (e.g. market prices, technology, inputs, cultivars, breeds and land management techniques). An illustrative example of well-developed cognitive learning can be found, among others, in the Veenkoloniën, the Netherlands (see Chapter 12). Experiential learning is the experience gained over time through trial and error, including experimentation. It may also involve working outside of the agricultural sector (as in some cases in France and the United Kingdom), bringing back transferable skills from other industries, or working on farms overseas, observing and trying out different farming techniques in different countries. Experiential learning builds slowly over time and increases farmers' autonomy in decision-making and the ability to learn from past mistakes or successes. Relational learning was a key strategy in all case studies, with farmers indicating that they learn from their peers. 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. In some case studies, such as the hazelnut production in Italy, shared learning occurred through involvement in cooperatives. As well as providing growers with stronger market power when dealing with wholesalers, the cooperatives also act as a forum for sharing information and experiences. Not all farmers in our interviews were open to learning from others, however. For instance, in the Spanish case study some farmers engaged in peer-to-peer learning, while others took a more individualistic approach to risk management. In this case, farmers who were involved in experimentation, social learning and sharing knowledge were more likely to innovate and improve their management systems. Individualistic farmers adopted more linear strategies such as cost reduction and intensification or transformed their business to a completely different activity.

## 2.4 Illustrative Opportunities towards Improved Risk Management

In this section, we aim to shed light on exemplary pathways of improved risk management. In particular, we highlight the relevance of widening the focus beyond traditional financial risk management instruments and demonstrate the potential for novel insurance mechanisms, e.g. based on satellite data, to cope with increasing production risk.

Several insights were identified from the biographical narratives, in particular. Structural issues, such as volatile prices, lack of available land and small farm size were highlighted as restricting the farmers' ability to adapt and evolve their farming businesses. Ensuring robustness was the dominant response to these challenges. Intergenerational transfer of farm businesses needs to be supported, e.g. in the form of vocational training and advisory support. Narrators considered this intergenerational transfer one of the greatest challenges facing a family farm business. Incremental change resulting in adaptation across time that was common in the narratives may be a better focus for policy support as it allows for experimentation and confidence building, perhaps resulting in more sustainable and resilient systems than radical transformation.

Our learning interviews identified reactive and proactive learner types that can strengthen resilience. Reactive learning-type farmers may facilitate farms to be robust in the short run, enabling their farm to recover from moderate shocks and stresses. However, 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. These farmers are more entrepreneurial and are able to anticipate and prepare for future challenges, suggesting that they are more resilient towards a broader range of 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 with the reactive learner type may struggle with this process 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 such farmers, to allow them to enhance their adaptive capacity.

To cope with increasing climatic risk exposure, existing risk management strategies have to be enriched with novel approaches. For example, agricultural insurance schemes are viable tools to manage weather risks, complementing other forms of risk management. Even though the current toolbox of insurance schemes offered to European farmers is rich (e.g. Meuwissen et al. 2018; Severini et al. 2019; Vroege and Finger 2020), the availability of insurance schemes to cover extreme weather risks, e.g. against droughts or heat waves, is currently limited. In this context, the SURE-Farm project investigated the potential of innovative insurance solutions such as weather index insurances. For example, we have shown that weather index insurance solutions based on different drought indices can be effective and efficient to cope with drought risk in crop production (Bucheli et al. 2021). We also found that these novel insurance solutions can complement traditional insurance arrangements for some farms because they specifically allow the establishment of efficient insurance mechanisms for previously uninsured crops (e.g. pastures and meadows) as well as under-insured risks such as droughts (Vroege et al. 2019). Ongoing technological developments such as remote sensing are expected to enable more effective, cheaper and more inclusive insurance mechanisms. The case study of crop production in Eastern Germany (Chapter 8) illustrates how drought insurance contracts that are based on satellite-retrieved soil moisture information could help farmers cope with drought risk (Vroege et al. 2021a,b). More generally, exploiting emerging opportunities of satellite data for crop insurance can reduce farmers' financial exposure to weather risks compared to a situation where no insurance option is available (Meuwissen et al. 2018; Vroege et al. 2021a,b).

## **2.5 Stakeholder Reflections and Insights in the Contribution of Risk Management to the Resilience Capacities at the Farming System Level**

During the SURE-Farm project, we reflected with stakeholders (e.g. farming associations, insurance companies, policy makers) in the eleven case studies (see Chapter 1) on the ways that risk management may enhance the resilience capacities – i.e. robustness, adaptability and transformability – of their respective farming systems (Soriano et al. 2020). Stakeholders identified the following risk management strategies which they considered to be most relevant for the challenges

threatening their farming systems: maintaining a strong financial base (financial savings and low debts), implementation of sanitary measures, diversification, risk-sharing strategies such as insurance, belonging to producer organizations, learning and information exchange, and diversifying the portfolio of suppliers. The stakeholders agreed that the selected risk management strategies may enhance all three resilience capacities, although robustness was perceived as the capacity most likely supported. Stakeholders saw a sound financial situation as the best alternative to be robust against shocks, since availability of funds usually helps to cope with unexpected losses. Low farm indebtedness increases the banks' confidence and credit scoring in credit/loan operations and farmers may find it easier to have access to financial resources to respond to challenges. This strategy also supports the adaptability and transformability capacities. Furthermore, stakeholders explained that farmers who build up financial savings have resources to support other adaptive/transformative on-farm strategies, such as production or income diversification. Also, the prevention of pests or diseases was emphasized by stakeholders as a key strategy to enhance robustness. Indeed, the stakeholders emphasized that the better the state of the natural resources, the higher the capacity of the system to face shocks. Insurances were also mentioned as a strategy that contributes to the robustness capacity to cope with weather shocks. Risk sharing strategies were seen by stakeholders as mainly contributing to adaptability and transformability. They explained that learning about challenges in agriculture gives farmers and other actors in the system the time to reflect on strategies for adaptation and/or transformation.

Stakeholders also reflected on ways how farmers and other actors implementing the risk management strategies in the farming system may enable the resilience capacities. A common perception was that the adoption of risk management strategies depends not only on farmers, but also on other actors in the farming system (Antón et al. 2011; Spiegel et al. 2020b). For example, according to stakeholders in the East German case study, when farmers diversify crops, other actors in the farming system also play relevant roles to implement this strategy. In this case these actors include: (i) local governments that provide funding programs and define the legal requirements; (ii) consultants who suggest new ideas, support strategy planning and monitoring; and (iii) financial institutions which provide funds, evaluate risks, provide

counselling and monitoring. Furthermore, the stakeholders' insights suggest that every actor involved in risk management contributes to resilience capacities in a different manner. For example, the stakeholders explained that farmers, producer associations, cooperatives and financial institutions were the actors who contribute the most to robustness. They were seen as the main source of human capital, networks and financial resources of the farming systems. Value chain actors primarily were described as contributing to adaptability as they were triggering changes by advancing knowledge exchange, innovation and cooperation. Agricultural Knowledge Innovation Systems (AKIS) were reported to contribute to transformability by providing adequate information for investments, qualified technical assistance, multi-sector knowledge and long-term innovation. NGOs, consumers, media and banks may also enhance the transformative capacity of the systems as they are the main triggers of changes. NGOs, consumers and media question farming practices and pressure actors in the farming systems to move towards more sustainable processes (i.e. animal welfare or nutrients and water usage) or new practices that better meet the consumers' expectations. Banks support transformability if they facilitate funds for investments in innovation.

## **2.6 Conclusion**

This chapter provides an overview of the risk and risk management practices in European agriculture and investigates opportunities for innovative and improved risk management strategies at the farm and farming system levels from a resilience perspective. Farmers need to deal with a diverse and volatile risk landscape that comprises short- and long-term risks. Consequently, risk management strategies differ across countries, farms, farm types and farming systems. The results of our analysis demonstrate the importance of tailoring risk management efforts to the diversity in the risks and challenges faced by a farm. Strategies to cope with risk often extend (and have to extend) beyond the level of the individual farm. Cooperation, learning and sharing of risks play a vital role in European agriculture and need to be strengthened. Risk management needs to go beyond instruments that focus on maintaining the status quo. For instance, setting up joint learning trajectories 'opens the door' for adaptability and transformability and thus for more resilient farming systems.

Coordinated actions and policies that target not only individual farms but consider all the stakeholders involved in the risk management strategies are needed to ensure their effective implementation. To this end, policies should define incentives specifically tailored to the different stakeholders in farming systems. For example, public collaterals that cover the increased credit risks of loans granted to small farmers for innovative projects could incentivize the banks' inclination to contribute to the adaptability and transformability of farming systems. Moreover, policies need to address long-term and diverse risk management strategies to account for the diversity of farming systems. Thus, policies need to enable long-term strategies, e.g. for dealing with intergenerational change, and need to address identified obstacles to change (e.g. cultural, legal, social welfare and policy). Finally, rapid technological progress and improved data availability enable the development of a wider set of risk management strategies. Pertinent examples are new insurance solutions which are based on satellite imagery and which will complement established approaches. Here policies should create an enabling environment in which a wide and diverse set of insurance solutions can be developed, e.g. by providing access to high-quality data.

Instead of a one-size-fits-all approach, more targeted and tailored policy mixes may be a sensible way to deal with the variegated and long-term risk landscape. At the same time, policy is often surpassed by new developments and needs to accommodate new realities. There are many unknowns out there, and policy mixes need to be designed in ways that are flexible and responsive to unforeseen events. Designing resilience-enhancing policies through improved risk management tools requires a holistic view on risk and risk management. More diverse risk management portfolios improve responses to risks, uncertainties and the unknown and help farmers to be better prepared for the future. To this end, we recommend agricultural policy makers to foster a more diverse risk management portfolio instead of focusing on optimizing a few risk management strategies which prolong a status quo situation that is not tenable in the long run.

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