Strengthening Agricultural Resilience in the Face of Multiple Risks

OECD

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Foreword

Managing risk is inherent in agriculture. Producers – and the sector as a whole – are confronted with production risk due to fluctuations in weather, market risk due to price volatility, financial risk resulting from the need to borrow funds to finance operations, and institutional or political risks from changes in policy. But even for a sector accustomed to risks and employing measures to manage them, farmers and other actors continue to be confronted with new and unknown risks that threaten farm businesses, supply chains, and even food security, eliciting emergency responses from governments and sector actors seemingly caught off-guard. At this writing, the largest global pandemic in more than a century, COVID-19, has disrupted the sector in unexpected ways, cutting off producers from seasonal labourers, affecting the wellbeing of workers in food processing plants, and even virtually shutting down certain supply chains as lockdowns severely curtailed restaurant and hospitality sectors.

As disruptive as the pandemic has been to lives and livelihoods, it has not occurred in a vacuum. Rather, it occurred amidst a myriad of other "unprecedented" shocks. Long established trade relationships are fraying, cutting off producers from their traditional markets and leaving them in search of new customers. Farmers are also dealing with production conditions affected by climate change, including prolonged and intensifying drought, torrential rainfall, and a warming spring that affects plant flowering. The economic impact of natural hazards continues to rise, including from powerful typhoons in Southeast Asia, more active Atlantic hurricane seasons, and historic wildfires in Australia and even the Arctic. Meanwhile, plant and animal disease risks have arisen that threaten whole sectors – African Swine Fever has decimated pig populations throughout Asia, orange producers in Florida face citrus greening, and olive growers in Italy are fighting the spread of *Xylella fastidiosa*. In response to these events, governments have marshalled emergency assistance packages, as traditional risk management tools seem to fall short. Given this environment, what is the way forward for risk management policy, and indeed, the sector as a whole?

In the face of this constantly shifting risk landscape, this report argues that a new approach to agricultural risk management is needed. Rather than relying only on tools that allow producers merely to deal with the impacts of risk, stakeholders need to implement measures and strategies that will make the sector more resilient to risk – by coping with the impacts of adverse events, adapting to changing circumstances, and transforming operations when the current system is no longer sustainable. This approach will require a reconceptualisation of agricultural risk management policy frameworks, with increased focus on both the manner in which risk management policies and approaches are developed, as well as expanded responsibilities for stakeholders and a prioritisation of investments that build resilience capacities both on-farm and for the sector as a whole.

The report is composed of two parts. Part I contains the background information exploring the concept of resilience, discusses the relevant bodies of literature, and uses the identified concepts to integrate resilience into agricultural risk management policy frameworks. The identified themes are explored further in Part II of this report, which contains four country case studies describing how these concepts are currently manifest in existing production systems and policy frameworks. In order to highlight concrete examples, each of these case studies focuses on a specific risk: drought in Australia, natural disasters in Canada, and animal and plant health risks in Italy and the Netherlands.

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Executive summary

The agricultural risk landscape is shifting, with producers increasingly confronting new sources of risk caused by a changing climate, unanticipated changes in policy, or the economy-wide effects of shocks external to the agricultural sector, such as the global COVID-19 pandemic. Confronting this landscape will require disciplined application of an holistic risk management strategy – specifically, ensuring that decisions are no longer made from a paradigm of reactivity, but from a more proactive "resilience" perspective instead. This implies focusing on preparedness, with the goal of either reducing the negative impact of events, or significantly reducing the likelihood that those events occur.

An agricultural risk management approach based on resilience – defined as the ability to prepare and plan for, absorb, recover from, and more successfully adapt and transform in response to adverse events – emphasises the importance of planning and prevention, while also ensuring that farming systems remain flexible enough to respond to future uncertainty. The approach also stresses the importance of considering systems and not just individuals, which means taking into account the impacts that the risk management strategies of individual farmers have on the resilience of the food system as a whole.

Turning to agricultural risk management at the farm level, resilience can be considered as a form of human capital – decision-makers are able to take into account the entire risk landscape, consider the array of potential responses, and be aware of how those responses will affect their operations at different points in time. Farmers are called on to not only bounce back from negative events, but also to prevent and mitigate the impacts of shocks, as well as learn from them in order to adjust their practices with a view toward enhancing long-term sustainability. At the policy level, a resilience perspective means holistically considering the long-term implications of policies for the sector, taking preventative actions to mitigate the impacts of systemic risks where possible, and ensuring that producers have the tools necessary to build on-farm resilience, while considering the possible implications and trade-offs for the sector at large from risk management policies.

Cultivating resilience requires the development of three core capacities in the sector: the capacity to absorb the impact of an adverse event, the capacity to adapt in response to risk, and the capacity to transform with the intent of eliminating the risk altogether. There is a range of measures and actions that farmers, the private sector and government actors can take to build these capacities. The capacity of the agricultural sector to absorb risk can be enhanced through measures and strategies that either reduce the initial impact of a shock or else shorten the time taken to recover from it. The capacity of the agricultural sector to adapt can be enhanced by measures that address information gaps that prevent farmers from making optimal decisions in the face of a changing risk environment; by support for investments in research and building human capital; and by facilitating networks for both vertical and horizontal knowledge exchange. The capacity of the agricultural sector to transform in response to a changing risk environment can be enhanced by many of the same measures that build the sector's capacity to adapt. However, it also requires stakeholders to engage in more long-term thinking, including placing additional emphasis on collaboratively planning and providing incentives for transformation.

The OECD has found that an efficient and effective policy approach for risk management in agriculture will take into account the interactions and trade-offs between different risks, on-farm strategies and government policies, and offer differentiated responses to different types of risk. It defines the broad areas of responsibility for governments and farmers, and the opportunity to transfer risk through market tools by distinguishing normal business risks (to be borne and managed by farmers) from larger but less frequent risks requiring market solutions (such as insurance systems and futures markets) and comparatively rarer catastrophic risks requiring public intervention.

Applying a resilience lens to this framework requires public and private actors to consider the risk landscape over the long term, place a greater emphasis on what can be done *ex ante* to reduce risk exposure and increase preparedness, and prioritise investments that build resilience capacities both on-farm and for the sector as a whole. It also places a greater emphasis on the processes through which agricultural risk management policies and strategies are developed. Specifically, five new dimensions are proposed to enhance the holistic framework for risk management in agriculture:

- *Time frame*: Public and private actors should consider the risk landscape over a long-term time frame, place a greater emphasis on what can be done *ex ante* to reduce risk exposure, and plan and prepare for possible risks. Consequently, risk management frameworks should place more focus on *ex ante* policies and prevention.
- *Trade-offs*: Different risk management strategies, policies and investments entail trade-offs both between the interests of different stakeholders, as well as between the capacities of the sector to absorb, adapt, and transform. Stakeholders should deliberately analyse and weigh potential future outcomes under different policy approaches.
- *Participatory collaborative processes*: Participatory processes involving a wide range of stakeholders are key to the development of new policy approaches and frameworks to ensure that all stakeholders share a common understanding of the risk landscape and their respective responsibilities for managing risk. As such, there should be greater emphasis on co-ordination and the use of a collaborative approach to define strategies and boundaries between the different risk layers, and to designate responsibilities for managing risk.
- *Investments in on-farm resilience capacity*: On-farm strategies, and the individual farmer's overall capacity to manage risk, can play a critical role in reducing risk exposure to catastrophic events, particularly over the long-term. For this reason, risk management frameworks should encourage farmers to develop entrepreneurial skills and their human capital more broadly, as well as promote or support the uptake of resilience-enhancing practices or technologies.
- *No-regret policies*: Public goods and no-regret policies are integral to agricultural risk management. Accordingly, more focus is needed on policies and investments in key capacities that build agricultural sector resilience to risk under a wide range of future scenarios and contribute to agricultural productivity and sustainability, which are of benefit even in the absence of a shock.

These ideas are already being mainstreamed into some countries' existing agricultural risk management policy frameworks, but are rarely considered together as part of a holistic strategy to improve sector resilience. Specific case studies on resilience to drought in Australia, natural disasters in Canada, and animal and plant health risks in Italy and the Netherlands, provide both concrete examples of how countries are conceptualising resilience, as well as illustrations of how existing policy frameworks continue to address the different capacities as unrelated components. Often, policy responses in these countries have provided disproportionate resources to enhancing the sector's capacity to absorb risks, to the detriment of its capacity to adapt and transform in response to those risks.

Part I
A resilience approach to risk management in agriculture

1 Conceptualising resilience for policymaking

This chapter examines the concept of resilience and explores how it applies to risk management in agriculture. It identifies three core capacities that are necessary to improve resilience in agriculture – the capacity to absorb the impacts of shocks, the capacity to adapt to an evolving risk environment, and the capacity to transform if the current system is no longer sustainable. Finally, it considers how to apply a resilience lens to agricultural risk management policies, including the need to define the target scale, source of risk and time frame.

1.1. Introduction

By its very nature, agriculture is an industry where uncertainty is the rule rather than the exception. Producers face many different forms of risk in their decision-making processes, including production risk as a result of fluctuations in weather, market risk due to price volatility, institutional or political risks from disadvantageous changes in policy, and financial risk resulting from the need to borrow funds to finance operations. In today's competitive market atmosphere, for many farmers, achieving success is highly dependent upon how well these risks are managed.

But the agricultural risk landscape is changing. Given likely projected climate change scenarios, farmers across the globe will have to adapt their operations to evolving physical circumstances, including higher average temperatures and the increased incidence of natural disasters that can be particularly devastating to the agricultural sector, such as droughts or more frequent high-intensity rain events (Hoegh-Guldberg et al., 2018[1]). Moreover, despite the support for improved risk management policies over the past few decades, the financial impact of natural disasters continues to rise (Bevere et al., 2018[2]). If this trend continues, some viable farmers may not be financially capable of dealing with the consequences of negative shocks, and governments will find themselves needing to intervene in order to prevent total market failure. Further on, the COVID-19 epidemic has reinforced that exogenous risks from outside the agriculture sphere can also cause substantial shocks to the sector, simultaneously impacting input markets, labour, logistics and consumer demand in unpredictable ways (Box 1.1).

Box 1.1. Agriculture and COVID-19

The COVID-19 pandemic provides a stark example of how adverse events outside of agriculture can affect the sector. Although COVID-19 is fundamentally a public health issue, the disease has caused devastating impacts on the world economy – both directly, and through measures to contain the spread of the disease. These consequences are increasingly spilling over to the agriculture sector.

A variety of shocks have been observed at different points of the food value chain. On the production side, limits on the mobility of people across borders and lockdowns have contributed to labour shortages for agricultural sectors characterised by periods of peak seasonal labour demand, such as fruits and vegetables, or labour-intensive production, such as processing of livestock products. A shortage of seasonal labour has implications not only for near-term food availability for fresh produce, but can also impact medium-term supplies, as farmers are now making planting decisions facing uncertain harvest-time marketing dynamics. There is also a potential risk that labour shortages upstream of production agriculture may also affect the availability of key farm inputs, from fertilizers to seeds.

Measures to contain the spread of COVID-19 have caused delays and disruptions to transport and logistics: border closures and additional procedures and checks have led to congestion and delays, affecting the transit of perishable products, and social distancing requirements have reduced the number of import and export inspectors at borders, further compounding congestion and delays. Value chains that are largely export-oriented have experienced the most serious disruptions, as border restrictions and port closures have reduced the availability of shipping capacity, resulting in drastically higher shipping costs and longer transport times. Labour impacts have also been felt downstream in the processing and distribution sectors, as processing plants have been either closed due to infected workers, or forced to reduce capacity to comply with social distancing requirements and ensure worker safety. These measures have increased costs and reduced processing capacity even as consumer demand in supermarkets increased. This in turn has increased the demand for on-farm or near-farm storage facilities.

Finally, there have been abrupt changes to food demand, with ripple effects for supply chain organisation. On the one hand, restaurants and open markets have closed in response to government mandates, resulting in both the overnight collapse of demand for some niche and high-value products (such as seafood or high-quality cuts of meat), but also challenging supply chains that are generally oriented toward restaurants, food service, or hospitality sectors. With these outlets closed, supermarket purchases have increased, and demand has shifted towards staple goods with long shelf lives. These shocks to demand may have further impacts on future supply, as some governments have moved to institute price freezes or export bans to ensure domestic food supplies are sufficient. In this context, public information on market conditions can help calm consumers otherwise prone to hoarding and panic-buying.

While the COVID-19 crisis has provided many examples of how farmers and firms have successfully adapted to the shifting circumstances, it has also provided an opportunity to critically assess chokepoints and vulnerabilities in agricultural and food systems, and subsequently inform needed investments or reforms that would strengthen the sector's resilience to future shocks (OECD, 2020[3]).

Confronting this reality will require disciplined application of an holistic risk management strategy – specifically, ensuring that decisions are no longer made from a paradigm of reactivity, but from a "resilience" perspective instead, with the goal of either reducing the impact of events, or significantly reducing the likelihood of certain risks. To accomplish this, the resilience approach emphasises the importance of *ex ante* strategies, including risk awareness, contingency planning, innovation and evolution The approach also stresses the importance of considering systems instead of individuals, both to ensure that the decisions of individual actors are placed in context for the resilience of the food system, as well as to ensure the consideration of linkages and potential knock-on effects for the sector at large.

The resilience approach is increasingly applied for policy development in a variety of sectors. However, given the unique exposure of agriculture to risk and the cascading effects of agricultural shocks on rural areas and the food chain, it is worth first exploring how the concept can be applied to the agricultural sector. Toward that end, this chapter defines resilience for the agricultural context, details the different capacities that contribute to resilience, and provides context on integrating resilience thinking into policymaking for risk management.

1.2. What is resilience?

Many countries aim to build the resilience of their farmers to a wide range of risks, from market volatility and more variable weather conditions, to pest and disease outbreaks and natural disasters. As a result, the concept of resilience is increasingly incorporated into agricultural policy frameworks. Despite this interest and the increasing use of the term, the concept lacks clarity. This ambiguity has various sources: the idea of resilience has been applied to and interpreted differently in various fields, such as ecology, engineering, and psychology (Keating et al., 2014[4]); resilient systems take many forms, and as such, resilience is highly contextual (Bahadur et al., 2015[5]); and resilience within even a single sector is multidimensional, with aspects of financial, social, cultural, and ecological resilience all relevant to agriculture. Even within the policy space, countries differ in their interpretations of the term, depending upon how the concept is positioned in their overall risk frameworks (OECD, 2014[6]). As such, definitions tend to be context specific (Box 1.2). The ambiguity of the term is also part of its attractiveness. The concept covers both the idea of preserving the system after a disturbance, and the idea of transforming the system into something new in response to disturbances and the evolving risk environment.

Box 1.2. Resilience definitions

Previous OECD work on resilience has noted that different countries (and even occasionally different agencies within the same country) have perceived the term "resilience" differently (OECD, 2014[6]). Moreover, even international bodies have put forward different definitions based on their own organisational objectives. For example, different definitions can be found depending on whether resilience is being considered in the agricultural development, climate change, and disaster risk reduction fields, or even in the context of governance of critical risks. Definitions from international actors in these areas include:

- *Food and Agriculture Organization of the United Nations*: The ability of individuals, households, communities, cities, institutions, systems and societies to prevent, resist, absorb, adapt, respond and recover positively, efficiently and effectively when faced with a wide range of risks, while maintaining an acceptable level of functioning and without compromising long-term prospects for sustainable development, peace and security, human rights and well-being for all (FAO et al., 2018[7]).
- *The Intergovernmental Panel on Climate Change*: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014[8]).
- *United Nations Office for Disaster Risk Reduction*: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (UNISDR, 2017[9]).
- *OECD Council Recommendation on the Governance of Critical Risks*: The ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions (OECD, 2014[10]).

Nevertheless, the different definitions have common features, emphasising the ability of systems to function, recover and transform in the face of risk and disturbances. Following Box 1.2, resilience can be understood as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt and transform in response to adverse events."[1] This definition is appropriate in the agricultural context, as it encompasses all possible adverse events (given that agricultural risk can come from production, market, or other sources), emphasises the multidimensional capacities needed to achieve resilience (in particular, absorbing the impacts of risks, recovering from them, and learning and adapting to them), and recognise that in the long-term, a system needs to be able to change in order to persist (through more successful adaptation or transformation).

In addition to being defined, resilience must also be placed in context – that is, in order to be a useful foundation for policymaking purposes, governments need to formulate a common understanding of resilience for *whom* (the target scale or unit of analysis), and resilience *to what* (the target source of risk), and recognise that in an operational sense, building resilience will likely involve targeted measures rather than a one-size-fits-all approach. With respect to agriculture, the relevant scale could be the field, farm, region, country, or even the global food system (Bullock et al., 2017[11]). When considering the target risk, policy makers will need to consider all disturbances, hazards and shocks that have potential negative impacts on the agricultural sector. These events should be deviations from a trend, and not trends themselves (for example, climate change is a trend, but not a risk, while more intense rainfall events as a result of climate change are a risk). Moreover, policy makers can consider resilience with respect to either

a single risk (referred to as "specified resilience", which would include, for example, resilience to floods or resilience to price volatility), or resilience to all risks (referred to as "general resilience") (Anderies et al., 2013[12]). Some specified risks are more likely to be associated with known probabilities than others, but may increasingly have uncertain risk distributions as the risk environment shifts due to climate change. Rare events tend to be more uncertain because there is less information about their frequency and severity.

Improving resilience requires actors to both manage the consequences of shocks, and to anticipate and prepare for their occurrence – including for shocks whose probability of occurrence are highly uncertain – by reducing or managing exposure and reducing vulnerability[2] through the building of resilience capacities. Exposure and vulnerability are important in this context because they will determine both the risk of a given event, and the magnitude of the impacts when the event occurs (IPCC, 2012[13]). To manage risk exposure and reduce vulnerability, the literature considers three capacities to be crucial for improved resilience: the capacity to absorb the impact of an adverse event; the capacity to adapt to an evolving risk landscape; and the capacity to transform – the type of farming system or even the agricultural sector itself – if the current system is no longer able to adapt to or recover from shocks (Box 1.3) (Béné et al., 2012[14]; Mitchell, 2013[15]; Douxchamps et al., 2017[16]; Tanner, Bahadur and Moench, 2017[17]; FAO et al., 2018[7]).[3]

Box 1.3. Key capacities for resilience in agriculture

The literature identifies three overarching capacities as crucial for resilience in agriculture.

- The capacity to *absorb* the impact of a shock reflects the ability to respond to and cope with an adverse event in the short-term. Previous OECD work defined this capacity as "the ability of a system to prepare for, mitigate or prevent the impacts of negative events using predetermined coping responses in order to preserve and restore essential basic structures and functions" (Mitchell, 2013[15]). In the context of agriculture, absorption is closely linked to traditional risk management strategies, including prevention strategies to reduce the exposure to an adverse event, mitigation strategies to reduce the potential impact of an adverse event, and coping strategies to reduce the impact of an adverse event on indirect losses once the risky event has occurred (OECD, 2009[18]; OECD, 2011[19]). Prevention and mitigation strategies focus on income smoothing, while coping strategies focus on consumption smoothing. For example, a relevant prevention or mitigation strategy for agriculture could be an early warning system that alerts tree crop farmers to take action when there is a high probability of frost. A coping strategy, in contrast, could be purchasing a crop insurance policy to allow farm operations to continue even in the face of a catastrophic crop loss.
- The capacity to *adapt* is characterised by the ability to make incremental changes to a system in response to current or expected future circumstances. OECD has previously defined adaptation as "the ability of a system to adjust, modify or change its characteristics and actions to moderate potential, future damage and to take advantage of opportunities, all in order to continue functioning without major qualitative changes in function or structural identity" (Mitchell, 2013[15]). In agriculture, adaptation often takes the form of adjustments to farm operations management, such as shifting planting dates, adjusting crop mix, adjusting the source of labour or reducing the need for labour through mechanisation, or investing in more efficient water use technologies or better quality seeds – flexibility is key. Particularly with respect to climate change, adaptation is often aligned with best agricultural practices and sustainable resource management, and as such does not require radical changes in behaviour (Ignaciuk, 2015[20]).
- In contrast to the absorptive and adaptive capacities, which seek to preserve the current system, the capacity to *transform* reflects "the ability to create a fundamentally new system when ecological, economic or social structures make the existing system untenable" (Mitchell, 2013[15]). While there is some discussion in the literature as to where to draw the line between

adaptation and transformation, for policymaking purposes, the two can largely be distinguished as capacity for change for the medium-term versus change focused on long-term viability. This is because, in some cases, incremental changes – adaptation – may not sufficiently reduce an agricultural system's exposure and vulnerability to a given shock, such that the system cannot continue in its current form, and must therefore transform. In agriculture, transformative changes can include technologies adopted at large scale, introducing new crops to a particular region or ecosystem, changes that transform places and shift locations (such as large scale irrigation projects that allow agriculture where it was before not possible), actions that reinvent the target business by taking advantage of demand for niche or high value-added products, the reorganisation of a value chain to better address current or future market opportunities, or even an exit from agriculture, see for example, (Kates, Travis and Wilbanks, 2012[21]). In addition, a transformation can be either deliberate and anticipatory, or forced and reactive (Tanner, Bahadur and Moench, 2017[17]). That is, actors can either take purposeful transformative actions in anticipation of future conditions, or else they can be forced to take transformative action due to the crossing of some sort of threshold (typically an ecological threshold) that renders the previous system infeasible. Because of this focus on completely reworking the present system, there is also an element of possibility in transformation – shocks can be viewed as negative events, or as opportunities for building something new. Taken further, the capacity for transformation implies that agricultural systems are stronger *because* they operate in an environment of uncertainty, not in spite of it.

These three capacities are needed for resilience, but there may be trade-offs between measures that absorb shocks to preserve the system, and measures to transform the system to address evolving realities of risks and uncertainties. For example, a farming operation that periodically floods could either take measures to reduce the impact of flooding (such as improved drainage), or could relocate entirely to another location. The two approaches have different costs and benefits, and will have different effects on the long-term risk profile of the farm. The risk environment of different countries (and individual farms) will influence the choice of which capacities need to be developed, and to what extent.

The three capacities are closely related. For a farm, the capacity to absorb the impact of a shock is the ability to better manage exposure to an adverse event, reducing either the event's probability and/or severity, or the farmer's vulnerability when coping with the event's impacts. The capacity to adapt means being able to change the farming system in response to current disturbances and in preparation for future events. The capacity to transform can be considered as an extension of the capacity to adapt, but implies a more extreme response in the form of deeper structural change (which may become increasingly necessary as systems approach biophysical thresholds under climate change) (Sinclair et al., 2014[22]). These three capacities are sometimes distinguished conceptually or temporally. For example, in the short-term, off-farm income may help a farmer to absorb the effects of a production shock caused by low rainfall in a given year and move forward without altering operations. However, faced with more variable climate conditions going forward, some type of change to the farming system may be called for in the medium-term (adaptation) or long-term (transformation) (Anderies et al., 2013[12]). All three capacities are needed for resilience, but the combination of measures that contribute to improved absorption, adaptation, or transformation will differ among farms, responding to the entrepreneurial allocation of their individual capacities and assets.

Applying a resilience lens to agricultural risk management implies an emphasis on planning and prevention to the extent possible, while also ensuring that farming systems remain flexible enough to respond to future uncertainty – a holistic management approach often referred to as "resilience thinking" (Folke, 2016[23]). At the farm level, resilience thinking can be considered as a form of human capital – decision-makers are able to take into account the entire risk landscape, consider the array of potential responses, and be aware of how those responses will affect operations at different points in time. Farmers are called on to not only

bounce back from negative events, but also to prevent, experience, and learn from shocks in order to adjust their practices with a view toward long-term sustainability. At the policy level, resilience thinking means holistically considering the long-term implications of policies for the sector, taking preventative actions to mitigate systemic risks where possible, and ensuring that producers have the tools necessary to engender on-farm resilience while considering the possible implications and trade-offs for the sector at large.

There is no one stable, desirable state for either a farm or a country's agricultural sector. But resilience thinking applied to policymaking means that the actions of today ensure that, although they may look different, the farm today and the farm of tomorrow will meet both individual and larger societal objectives.

1.3. Integrating resilience thinking into agricultural risk management policies

In order to achieve greater resilience and use this concept as a lens for formulating risk management policy, policy makers will need to evaluate the risk landscape in a holistic way, considering a range of options as well as the potential trade-offs in promoting one approach over another, depending upon the target objectives of their resilience policy frameworks. In this respect, three dimensions should be considered – scale, source of risk, and time frame – with potentially significant implications for the kinds of policies needed, their budgetary impacts and likely trade-offs.

When considering the scale for resilience policy, the systems approach is commonly advocated, wherein resilience is considered holistically for the entire food system, to better account for interactive effects and minimise negative externalities (Kuhl, 2018[24]; Tendall et al., 2015[25]). This is, for example, the focus of the EU SURE Farm approach (Meuwissen et al., 2018[26]). This holistic approach is advocated because focusing on a lower scale of a country's agro-food system may undermine resilience at a higher level, and may underestimate the importance of linkages to the sector's overall resilience (Walker et al., 2004[27]; Bahadur, Ibrahim and Tanner, 2013[28]). Although farmers are the target actor of most agricultural risk management policies, it is important to consider the potential trade-offs of how policies applied at the farm level will affect the resilience of the sector as a whole (and vice versa) (Walsh-Dilley and Wolford, 2015[29]). This is best illustrated in terms of utilisation of common pool resources – an individual farmer may improve his or her resilience to water scarcity risks by drawing on an aquifer for irrigation, but this action may reduce the resources available for other producers. When such actions improve the well-being of the individual but damage the long-term resilience of the system, they become maladaptations – the individual is better off, but the system is worse off. At the same time, there may be some risks that warrant a more targeted approach if their impacts are nonlinear, or if targeting prevents more widespread diffusion of impacts. As an example, this targeted approach (hotspot approach) has been advocated by OECD when dealing with water risks (OECD, 2017[30]).

With respect to source of risk, when evaluating whether to pursue a policy targeting specific or general resilience, policy makers should be mindful that improving resilience solely in one area can cause the system to be less resilient in other ways (Sinclair et al., 2014[22]; Adger et al., 2011[31]). Moreover, when actors concentrate on addressing only specific shocks, they may reduce their options for dealing with unanticipated future shocks. Similarly, focusing on one frequently occurring shock may reduce the capacity to deal with less frequent ones (Folke, 2016[23]). In contrast, a focus on general resilience also involves a wide degree of uncertainty about risks that are unknown or not well-known, and this can be costly. When focusing on specific resilience, the source of the shocks is better defined, and, if the events are frequent enough, typically their probabilities and likely financial impacts are easier to analyse. In cases of general resilience, there are events for which no probability can readily be offered to inform risk management policy, complicating the quantification of expected benefits. In this situation, policy makers will be called to choose their level of resilience given existing budgets, policy frameworks and the existing uncertainties. It may be the case that certain investments in general resilience are at present too great to justify their cost

(Carpenter et al., 2012[32]). In formulating plans for improved resilience, policy makers will have to prioritise and decide which risks are most relevant to their own agricultural sectors and more likely to generate market failures, and whether or not it is most cost-effective to promote strategies of general resilience or to instead target a more specific risk. This prioritisation is part of the holistic approach, and it should be re-evaluated over time when better information becomes available.

The final consideration required for resilience policymaking is the time frame. Implicit in the concept of resilience is the idea that systems should be able to persist or transform in the long-term despite repeated exposure to disturbances. However, improving resilience in the long-run may come at the expense of efficiencies in the short-run (Nelson, Adger and Brown, 2007[33]). Furthermore, it is possible that decisions taken to help cope with a risk in the short-term may increase exposure and vulnerability in the future (IPCC, 2012[13]; Carpenter et al., 2001[34]).

Even though resilience emphasises decision-making for the long-term, from a policy perspective this can be difficult to achieve – without proper incentives, decision-making processes tend to be biased toward the immediate future and neglect the long-term focus that resilience thinking implies (Carpenter et al., 2012[32]). These kinds of policy biases also apply to the scale and the source of risk. Governments tend to bias their policy responses in favour of risks that are better known or more visible in the media, and in favour of the actors and scales for which there is also more visibility. These behavioural biases apply as well to farmers and other actors, and they tend to favour baselines and trends from the past in risk perceptions, such that they can generate misalignments and maladaptations.

These biases can be somewhat ameliorated (and the possibility of implementing policies that increase future vulnerability can be reduced), by shifting towards *ex ante* thinking, including undergoing scenario analysis and implementing value-for-money policies that will have positive benefits over a wide range of potential futures. *Ex ante* thinking can be combined with an iterative assessment approach, which involves a periodic stocktaking of conditions to see if new information is available, and if practices or policies need to be adjusted as a result (Engle et al., 2014[35]). In this way, policy decisions can take into account both current conditions and the best and most cost-effective ways to ensure a viable future. A good resilience policy needs to be proactive in improving information and learning from experience. For example, scenario analysis can help to improve both policy analysis and design (Antón et al., 2012[36]; Antón et al., 2013[37]).

Based on this foundational understanding of resilience, its component dimensions, and the importance of context, the next chapter takes a deeper dive into the academic and policy literature for evidence of resilience-improving measures relevant to the OECD agricultural context.

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Notes

[1] Definition based on National Research Council (2012[39]).

[2] The IPCC defines exposure as, “The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected,” while vulnerability is, “The propensity or predisposition to be adversely affected,” (IPCC, 2012[13]).

[3] Different authors throughout the theoretical literature offer up their own suggestions for key resilience capacities. Even amongst authors that describe three capacities, the terminology can differ, with absorption sometimes referred to as “persistence” (Folke et al., 2010[38]) or “robustness” (Meuwissen et al., 2018[26]) instead, for example.

2 Literature on policies and strategies for resilience

This chapter reviews the literature on resilience to identify the attributes, strategies and policy instruments that can help to build the capacity of agricultural sector stakeholders to absorb the impacts of shocks, adapt to an evolving risk environment, and transform if the current system is no longer sustainable. It highlights the key policy implications that emerge from the literature, and identifies specific roles for governments in helping stakeholders to improve their resilience.

1.1. Introduction

The previous chapter defined resilience and explored what it means for agriculture and for agricultural policy makers. In particular, it identified three capacities that are key to resilience – the capacity to absorb the impact of an adverse event, the capacity to adapt in response to risk, and the capacity to transform with the intent of eliminating the risk altogether. This chapter reviews the literature to identify the attributes, strategies and policy instruments (collectively referred to as "resilience measures") that make farms more resilient by building these capacities.

The work covered here comes largely from the development field, the disaster risk management (DRM) sphere, and the climate change adaptation literature. Each of these fields is relevant to a broad review of agricultural resilience because resilience is highly contextual. For that reason, instruments identified in one of these settings could increase agricultural resilience more generally. Some perspective on each of these bodies of work is provided below.

- The development literature is drawn mostly from *ex post* evaluations of programme interventions that directly targeted farmers and rural residents in lower-income countries. Consequently, while this literature can be a source of information on farm-level resilience, its emphasis on poverty and food security might make its findings less relevant in the context of developed country agriculture.
- In contrast, the DRM literature covers all countries, but from a predominantly macro viewpoint related mostly to actions governments can take to be proactive in planning for and mitigating the impacts of disasters. Nevertheless, this body of work does provide some insights specific to agriculture.
- The literature on climate change adaptation focuses on mitigating the impacts of catastrophic events, incremental adaptations in response to slow variables (such as rising temperatures or erratic rainfall), and transformative adaptations that may be necessary as agricultural systems approach critical thresholds beyond which they may no longer be able to function. Much of this work comes from OECD countries.

This review sets aside the literature on both resilience theory and resilience measurement frameworks, and instead strives to provide an evidence base of the different measures that have been associated with improved resilience so that countries can consider which interventions might be relevant to their own policy contexts.[1] This review does not purport to be a comprehensive list of resilience measures, but rather seeks to highlight those that are frequently mentioned by a variety of sources. This work also draws heavily on previous OECD work in the context of risk management (OECD, 2009[1]), climate change adaptation (Ignaciuk, 2015[2]), and economic resilience (OECD, 2014[3]), uniting these concepts for a more holistic view of how resilience can be operationalised in the agricultural sector.

After reviewing the literature on resilience measures relevant to each of the capacities, the chapter closes by offering some policy implications of the literature review.

1.2. Evidence base on measures to improve resilience

This section describes the resilience measures that the literature suggests contribute to improved resilience by strengthening the core responsive capacities of stakeholders – absorptive, adaptive and transformative. It describes the core attributes needed to build each capacity, and how the resilience measures highlighted by the literature contribute to those attributes. In line with the risk management framework's optimal governance structure, the reviewed measures are grouped by actors. This construction emphasises the holistic and multi-dimensional nature of resilience – achieving improved resilience requires building multiple capacities to respond to risks in the short-, medium-, and long-run, with specific complementary measures relevant to the different actors.

1.2.1. Absorptive capacity

The capacity to absorb the impact of a shock, hazard, or adverse event (absorptive capacity) is characterised by the ability to prepare for, mitigate or prevent the event's attendant negative impacts, while also ensuring that essential system functions are re-established quickly in the aftermath. Improvements in absorptive capacity can be realised through measures that either reduce the initial impact of a shock or else shorten the amount of time it takes to recover from a shock. Broad categories of measures identified in the literature that reduce the initial impact of a shock include the following.

- *Providing information*, including detailed risk assessments and real-time information on potential risks, so that stakeholders can prepare appropriate responses.
- *Improving planning processes* – specifically, the collaborative drafting of contingency plans – to ensure that farms, private actors, and governments have a collective understanding of their responsibilities for managing risk and determine their optimal responses before shocks occur.
- *Investing in risk-mitigating technologies and risk reduction infrastructure*, including systems implemented at the farm level or on a regional/national basis.
- *Providing a risk minimising environment* to ensure that services are reliable and markets are functional, even in times of crisis.

Broad categories of measures identified in the literature that shorten the amount of time it takes to recover from a shock include the following.

- *Improving planning processes* (echoing reasoning from above).
- *Providing financial resources* to replace damaged assets and ensure that normal farm operations can be resumed as quickly as possible in order to minimise indirect impacts from adverse events, with relevant financial measures for farms, the private sector, and governments depending upon the impact of the event.
- *Social capital* at the household level to access resources and information in a timely manner.

Measures highlighted in the resilience literature for improving absorptive capacity are closely aligned with good risk management practices, with two additional caveats. First, for catastrophic events, the OECD has previously emphasised that governments have a role in responding to risks in this layer (OECD, 2011[4]). While recognising the role of government in catastrophes, the resilience literature puts greater emphasises on strategies that can be employed by all actors that will either mitigate impacts or facilitate a faster recovery. Second, the resilience perspective places greater emphasis on the role of government in facilitating risk reduction for potential future hazards rather than focusing solely on current risks (more in line with the climate change risk management literature). Keeping these caveats in mind, the following sections consider relevant measures for each of the different actors.

On-farm measures

Beginning at the farm level, a key finding from the literature is that several strategies for managing normal risks (that is, adverse events that are frequent, but that impart small damage) also improve farmers' resilience to catastrophic shocks by building their absorptive capacity. This is because risk management strategies such as diversification and savings accounts either reduce the financial impact of shocks, or else provide liquidity to help farmers to recover faster.

Regarding diversification, the literature highlighted this measure as a tool that helped households cope with adverse events in the short-term by ensuring that they have access to different income streams in the face of shocks (regardless of their magnitude). Various forms of diversification were found to positively affect resilience, including genetic diversity of a particular crop (Bullock et al., 2017[5]), overall crop mix (Darnhofer, 2010[6]; Gaudin et al., 2015[7]; Hansen et al., 2018[8]), the presence of multiple on-farm income-generating activities (Darnhofer, 2010[6]; Hansen et al., 2018[8]), or a mix of on- and off-farm income

sources (Nelson et al., 2016[9]; Smith and Frankenberger, 2018[10]; Darnhofer, 2010[6]; Jetté-Nantel et al., 2011[11]). For example, researchers in Canada found that by combining income from farm and off-farm activities, producers could improve their overall resilience (Jetté-Nantel et al., 2011[11]), while producers in Austria felt that diversifying their product offerings (growing niche crops such as herbs with predictable prices alongside more volatile crops like grains), expanding into other on-farm activities (engaging in tourism, composting, or on-farm processing along with crop production), and smoothing income through off-farm employment, were effective resilience-enhancing strategies (Darnhofer, 2010[6]).

The other most commonly-highlighted on-farm strategy found to improve absorptive capacity was more explicit access to financial resources – including assets, savings, or safety nets – that either allowed households to make repairs, or helped households to smooth consumption when productive assets were damaged. Previous OECD work has highlighted the potential role of savings as an effective agricultural risk management strategy (OECD, 2009[1]). Within the context of resilience, however, much of the evidence on the effectiveness of these tools comes from the development literature, so the evidence was based on the possession of assets such as livestock or land that can be liquidated as an emergency coping strategy (Smith and Frankenberger, 2018[10]). Safety net programmes were also found to be effective resilience-improving strategies, as they allowed households to bridge times of crisis without resorting to negative coping strategies. For example, both direct cash transfers and cash-for-work programmes were found to substantially reduce reliance on negative coping strategies in developing country settings (World Bank, 2016[12]; Bastagli et al., 2016[13]; Asian Development Bank, 2018[14]). Informal safety nets – social groups, savings groups, or other social support that can be accessed for financial needs – were also found to be associated with improved resilience (Smith and Frankenberger, 2018[10]). With respect to developed countries, the same type of income smoothing is commonly incorporated into the tax code (Antón et al., 2012[15]; OECD, 2020[16]). OECD's 2020 review of taxation in agriculture reported that income averaging measures for farmers were available in ten OECD countries,[2] while further tax deferral measures for exceptional circumstances were available in Australia, Canada, Ireland, Japan and the United Kingdom (OECD, 2020[16]). In one example, under Canada's "Livestock Tax Deferral" programme, livestock producers can defer proceeds from the sale of animals in stressed years to the following tax year in order to be able to better cover the costs of replacing livestock (Campbell et al., 2014[17]).

Aside from income and consumption smoothing strategies, the literature noted that *ex ante* investments in technologies at the farm level to monitor either climate or market conditions could help farms to avert or mitigate the effects of disasters by alerting them to the need to take preventative measures (OECD, 2014[18]; OECD, 2016[19]). An array of digital technologies can contributed to improved absorptive capacity in a variety of ways (Box 2.1).

Finally, particularly in the face of catastrophic events, the literature noted the importance of social capital to the absorptive capacity – particularly with respect to a household's ability to recover quickly from adverse events – because it allowed households to access either emergency financial resources or essential information necessary to coping with disaster (Woodson et al., 2016[20]; Smith and Frankenberger, 2018[10]), while tight-knit communities may also result in a more co-operative approach to hazard response that benefits affected parties (Murphy, 2007[21]). In fact, the literature even distinguished between several types of social capital that could be beneficial to resilience in these circumstances: bonding social capital (a sense of solidarity and trust amongst community or group members), bridging social capital (access to links outside of the immediate community or group), and linking social capital (vertical connections, typically to some form of authority). There are different reasons why these distinct types of capital could be important in times of crisis. For example, bridging capital allows communities to access new ideas or information, whereas bonding capital promotes co-operation in times of crisis (Newman and Dale, 2005[22]). Researchers noted that policy makers could consider using networks to strengthen implementation of resilience policy initiatives (Bernier and Meinzen-Dick, 2014[23]). For example, governments can utilise farmer groups, trade organisations or commodity organisations to leverage messaging targeting producers in the wake of a shock.

Box 2.1. Digital technologies to improve absorptive capacity

Farm-level resilience relies heavily on access to timely, accurate information to facilitate improved decision-making. Advances in digital technologies – including innovations in data collection, data analysis, data storage, data management, and data transfer and sharing – are contributing to improved resilience by helping farmers prepare for adverse events, mitigate their impacts, and recover more quickly. Some examples of how digital technologies can be used to further these aims include:

- *In situ* meteorological sensors can allow producers to access real-time granular weather data on their specific farms or areas, helping them to make more informed decisions without having to rely on satellite-based weather systems. Such systems have been found to reduce irrigation use, lower plant mortality, and increase grower profitability – effectively reducing the impact of an adverse production event (Wolfe et al., 2018[24]).
- Decision-support software that translates sensor and other farm data into actionable information, allowing producers to make informed, real-time decisions on the costs and benefits of different farm management actions.
- Financial management benchmarking databases and software allow farmer users to compare their farm business finances with their peers and identify optimal financial management decisions, improving their ability to cope with negative shocks to farm finances.

Source: (OECD, 2019[25]).

Market tools

Market tools were found to improve absorptive capacity by providing financial liquidity in the wake of adverse events to help actors avoid or reduce both direct and indirect losses. While insurance is the most frequently-cited of these tools, the resilience literature increasingly highlights the potential of other alternative mechanisms that can be used to transfer risk to the market, and consequently provide actors with more predictable finances in response to adverse events. These tools are utilised in conjunction with on-farm strategies for both income and consumption-smoothing purposes.

The value of insurance as a tool for absorbing the negative effects of adverse events is well-established (OECD, 2009[1]; OECD, 2011[4]), and there has been a concerted international policymaking effort to increase insurance utilisation as a means to improve resilience (Surminski, Bouwer and Linnerooth-Bayer, 2016[26]).[3] Despite rising interest in insurance for building resilience, there has been relatively little work devoted to the possible impacts of insurance on resilience objectives within OECD countries, with most of the work focused on the development of insurance products for farmers in low-income countries. Specifically, the literature largely examines the development of index insurance products for low-income countries, which have a mixed record of success in achieving resilience targets (Weingärtner, Simonet and Caravani, 2017[27]) (Box 2.2).

Box 2.2. Farmer index insurance and resilience

Index insurance is a concept that has been widely promoted in development circles as a possible market solution for disasters in developing country settings. In these cases, traditional crop insurance programmes are oftentimes unavailable or non-existent, due to problems of information asymmetry, moral hazard and adverse selection, and the high administrative costs of these programmes in developing country settings (Collier, Skees and Barnett, 2009[28]; Ceballos and Robles, 2014[29]; Carter

et al., 2017[30]). Index insurance programmes circumvent these problems by disbursing indemnities based on some publicly-observed index trigger rather than actual conditions on farms, providing catastrophic risk coverage for systemic events without requiring costly individual farm monitoring. Moreover, because no on-farm assessment is needed, funds can be disbursed rapidly in the wake of a disaster (Ceballos and Robles, 2014[29]).

Despite the widespread promotion of said programmes, index insurance in practice has had a mixed record of success:

- Research analysing the likely distributional effects of Kenya's index-based livestock insurance (IBLI) programme concluded that it would not be an effective risk management tool for the poorest households with small initial herd sizes. It would, however, be a valuable tool for households with mid-to-large sized herds (Chantarat et al., 2017[31]).
- An analysis of the outcomes of a similar ILBI programme in Mongolia found that households that purchased insurance recovered faster from a severe winter storm event. Indemnities smoothed household credit constraints and helped them to avoid negative coping strategies like selling or slaughtering remaining animals, allowing them to regrow their herds faster. Moreover, the positive effects of receiving an indemnity were still significant up to three years after the pay-out (Bertram-Huemmer and Kraehnert, 2018[32]).
- In their 2009 analysis, Collier, Skees and Barnett note that at least 30 weather index insurance programme pilots had been implemented from the early 2000s. But while pilot programme results were promising, the empirical evidence on the effectiveness of the programmes was inconclusive (Collier, Skees and Barnett, 2009[28]).
- A 2016 review of the available literature on index insurance programmes identified cases where index insurance improved income, but also a few instances where programmes led to a decline in household wealth or welfare. The authors concluded that more research was needed in order to make a more definitive assessment on whether or not index insurance could be an effective risk management tool for smallholder producers (Marr et al., 2016[33]).
- A 2018 meta-analysis found that index-based insurance did not have a discernible effect on either stabilising production or on household poverty, but it was strongly associated with increased uptake of capital and technology by participating households (Hansen et al., 2018[8]).

However, scholars note that with better data, more available information, and transparent programme quality standards, these programmes may be more likely to achieve their stated aims (Jensen and Barrett, 2016[34]).

There are a few examples of index insurance being used to build resilience in OECD countries, including several programmes that insure grassland-based farming systems in Austria, Canada, France, Germany, Spain, Switzerland and the United States. In OECD countries, these types of programmes generally do not face the same constraints that have been found to undermine their development more generally (including the lack of information or data on which to base an index, limited opportunities for reinsurance, and uneducated client pool), but they still suffer from basis risk,[4] which may limit widespread uptake. In grassland-based systems in particular, satellite-based index insurance products may become a more commonly available, cost-effective tool as data quality improves (Vroege, Dalhaus and Finger, 2019[35]). Two example programmes from OECD countries include:

- The US Department of Agriculture's Risk Management Agency offers an insurance product for pasture, rangeland and forage that uses a rainfall index for the indemnity payment trigger. In 2018, 98 million acres were insured under the programme (Belasco and Hungerford, 2018[36]).
- Mexico has been running an index insurance programme (CADENA) to insure the state governments' catastrophic insurance programmes since 2003. An independent analysis of the

programme's performance concluded that farmers that received payments through CADENA cultivated more land in the crop year subsequent to the weather shock, and that recipient households tended to have higher income in the subsequent year as well, indicating that the programme was effective at helping farm households absorb and bounce back from adverse events (De Janvry, Ritchie and Sadoulet, 2016[37]).

At the same time, some scholars have cautioned that insurance can also be counterproductive for resilience purposes – particularly in the case of subsidised insurance which does not accurately reflect the producer's risk profile. For example, programmes have been found to crowd out both on-farm risk management strategies and private insurance options (Antón et al., 2012[15]; Ignaciuk, 2015[2]; van Asseldonk et al., 2018[38]); incentivise maladaptive outcomes (for instance, insurance can allow producers to remain viable while eschewing the adoption of other long-term risk management practices, perversely jeopardising long-term sustainability) (Collier, Skees and Barnett, 2009[28]; Müller, Johnson and Kreuer, 2017[39]; OECD, 2014[18]; Annan and Schlenker, 2015[40]); or act as a disincentive to additional risk reduction (Surminski, Bouwer and Linnerooth-Bayer, 2016[26]). The challenge to using insurance as an effective tool to enhance resilience lies in ensuring that premiums reflect the actual risk faced by actors so that they have an incentive to take other risk-reducing measures (Kunreuther, 2015[41]). The overall conclusion of the literature in this area is that insurance can be useful as a potential resilience-enhancing strategy, but only if it is treated as a tool in a wider overall resilience strategy rather than as an alternative to adaptation (Surminski, Bouwer and Linnerooth-Bayer, 2016[26]; Weingärtner, Simonet and Caravani, 2017[27]). While the primary role of insurance in the resilience context is to provide financial resources for income smoothing purposes, the literature also noted that insurance could play a role in transmitting more accurate information about risks to stakeholders, and could also supply a mechanism for incentivising investments in disaster risk reduction (Weingärtner, Simonet and Caravani, 2017[27]).

Aside from insurance, the literature identifies non-traditional financing as a means through which resilience can be improved, by providing predictable financial resources quickly in the event of a catastrophe to minimise indirect losses. This emphasis on non-traditional tools grows out of the literature's finding that traditional risk financing mechanisms (including government reserve funds or *ex post* budget reallocations) have shortcomings in dealing with climate risks in the highest risk layer (Linnerooth-Bayer and Hochrainer-Stigler, 2015[42]). For example, funding disaster response through reserve funds has large opportunity costs, as governments must weigh the trade-offs between using funds for immediate purposes or for hypothetical future disasters (OECD, 2014[3]). Consequently, disaster funding tends not to be a budgetary priority (Kellett and Caravini, 2013[43]). In this context, non-traditional financing options are increasingly used to ensure that countries have an alternative mechanism in place prior to an event that allows for adequate financing for recovery. Among these instruments are catastrophe bonds (commonly referred to as "CAT bonds"), contingent financing, and catastrophic pooled insurance (Box 2.3).

The broader evidence base for these approaches remains thin since they are a relatively recent phenomenon (Kellett, Caravani and Pichon, 2014[44]; OECD, 2015[45]). However, a few OECD countries have long-running experience with these tools. Mexico has been using CAT bonds (in conjunction with their FONDEN disaster fund) since 2009 to insure against earthquakes and hurricanes (OECD, 2015[45]; Swiss Re, 2017[46]). Other OECD countries are also increasingly using these tools – as of 2018, the Artemis database for catastrophe bonds and insurance-linked securities had registered more than 280 CAT bond transactions, including for cyclones in Australia, earthquakes in Chile, floods in Europe, typhoons in Japan, and severe thunderstorms in Texas (Artemis, n.d.[47]).

Outside of insurance and non-traditional financing, the financial markets more generally contribute to improved resilience through the provision of access to normal banking services, such as credit and savings (Hallegatte, 2014[48]). Other market tools, such as futures markets, forward contracting, and value chain integration can also help farms to better absorb the impact of adverse events (OECD, 2011[4]), although these tools have not yet been widely considered in the resilience literature.

Box 2.3. Non-traditional mechanisms to finance disaster assistance

Although the resilience literature provides various examples of non-traditional financing options, three of the most often-cited include CAT bonds, contingent financing, and catastrophic pooled insurance. A brief description of each is provided below:

- *CAT bonds* are a high-yielding bond that is a type of insurance-linked security. These bonds transfer the risk of an insurance-related event to the capital markets through a provision that causes either a loss or delay of the pay-out of either principal or interest to investors if the specified event occurs (OECD, 2011[49]; Swiss Re, 2015[50]). CAT bonds have been used to cover anything from actual monetary losses to an index of weather conditions (for example, an earthquake of a certain magnitude or a recorded wind speed over a certain threshold). CAT bonds are typically raised by public sector actors as an insurance against specific designated catastrophes. These securities are attractive to investors because they are uncorrelated to other types of risks (Re:Focus Partners, 2015[51]). There are also increasingly calls to more explicitly tie catastrophe bonds to resilience, including through the possibility of using so-called "resilience bonds" (a catastrophe bond that is linked to projects certified to reduce the risk of said catastrophe using insurance rebates).
- *Contingent financing* in this context is a pre-approval for a line of credit to be accessed only in the event of disaster (OECD, 2015[45]). This instrument has the benefit of ensuring that countries are able to immediately access funds in the wake of disasters.
- *Insurance pools* are a means through which a group of small countries can pool their risk to achieve economies of scale in accessing international capital markets (OECD, 2015[45]). By pooling their risk, the premiums of individual countries are reduced. There are several regional insurance pools already in operation, but to date they have only been utilised by developing countries. Examples include the African Risk Capacity, Caribbean Catastrophe Risk Insurance Facility, and Pacific Disaster Risk Financing and Insurance.

Policy measures

The literature on the role of government in improving the absorptive capacity is extensive, as it covers both policies that can either reduce the initial impact of a shock or shorten the amount of time it takes to recover from a shock. Identified measures focus heavily on information provision and planning – both to identify and carry out *ex ante* risk reduction policy efforts, as well as to ensure that disaster response can be as organised and swift as possible – but also include *ex ante* investments in technology or infrastructure, and financial measures for *ex post* recovery. Mirroring the roles outlined in the risk management framework, this section is divided into *ex ante* and *ex post* actions to highlight aspects important to each level of government involvement.

***Ex ante* government actions**

Ex ante government actions advocated by the resilience literature are largely planning and investment measures that address information asymmetries and risk reduction and mitigation (in line with traditional risk management strategies). At the same time, the increased awareness of the importance of disaster risk reduction has put the focus of *ex ante* policies on mitigating not only immediate risks, but also future, potentially unknown shocks. In the context of the absorptive capacity, the literature identifies four main areas for *ex ante* government action: providing information to enable on-farm and more general sectoral risk management; improved planning and co-ordination for more effective disaster response; investment

in disaster risk reduction (including improving infrastructure); and the provision of an overall risk-minimising environment. A short overview of each of these areas is provided below.

Providing information for improved on-farm and sectoral risk management

The first mechanism through which governments can contribute to *ex ante* risk reduction is by providing information that helps farmers to implement their own strategies to better absorb shocks. In a general sense, governments can play a role in adequately communicating risks, strategies, and contingency plans to stakeholders well in advance of the onset of adverse events (Clarke and Dercon, 2016[52]). In the resilience literature, the most oft-cited example of how information contributes to absorptive capacity is through the use of early warning systems, because they allow farmers to reduce their exposure to adverse events. Both the Hyogo and the Sendai Frameworks stress the need for countries to set up early warning systems as part of their disaster risk management strategies (UNISDR, 2005[53]; UNISDR, 2015[54]), and experience on both the development front and in the DRM sphere provide support to this as a cost-effective action (Hallegatte, 2012[55]; Braimoh, Manyena and Obuya, 2018[56]). Monitoring of conditions is also necessary to inform stakeholders about when they should take mitigating actions (Fan et al., 2014[57]), but in addition to providing these early warning systems, there is a role for government in both providing the underpinning data and in devising new ways to use that data to improve early warning platforms. For example, researchers in the US state of Colorado have combined analysis of historical drought records and future climate predictions to inform their drought monitoring and scenario planning (Finnessey et al., 2016[58]).

Improved planning and co-ordination for more effective disaster response

In their detailed multi-country assessment of improving country response to natural disasters, Clarke and Dercon (2016[52]) argue that in order to ensure more resilient systems, the entire paradigm on disaster risk management needs to be reconceived with a decided emphasis on a co-ordinated pre-disaster action plan, an expedient and clear decision-making process during the onset of the disaster, and financing on standby to ensure the implementation of the pre-agreed plan. The planning phase is most effective if it brings together various stakeholders in a participatory approach (at a minimum, to include scientists to describe the scenarios, bureaucrats to plan the response, implementers to ensure the response is feasible, and financiers to offer estimates on how much the response will cost), and clearly delineates the responsibilities and actions of each, including who will be protected, under what conditions, and who will pay for said protection (Clarke and Dercon, 2016[52]). In this context, scenario planning – typically directed by the government, but involving actors from across the supply chain – has been shown to be a particularly useful exercise, as it encourages parties to think critically about different possible situations in a hypothetical, non-political setting. This process of brainstorming possible responses to the different scenarios leads to more flexible, better prepared systems (Finnessey et al., 2016[58]).

Aside from co-ordinated planning, the other key to ensuring the feasibility of *ex ante* planning is frontloading financing of disaster recovery. Particularly given evidence that the speed of recovery matters for improved resilience, this pre-planning of disaster funding can reduce post-disaster uncertainty and ensure that resources are available in a timely manner (Hallegatte, Rentschler and Walsh, 2018[59]). But governments – particularly in developing countries – typically do not keep access to sufficiently large disaster contingency funds to cover catastrophic events given the opportunity costs and implied trade-offs of holding such large amounts of money in reserve (Clarke and Dercon, 2016[52]). Furthermore, in the decade prior to 2015, only around 30% of catastrophe losses were covered by insurance, leaving individuals and governments extremely exposed (Swiss Re, 2015[50]). To avoid having to rely on ad hoc budgetary measures, governments have various *ex ante* options when it comes to financing disaster relief, including budgeting reserve funds or market-based tools like pre-approved contingent lines of credit, pooled insurance, and CAT bonds (detailed above) (OECD, 2015[45]). OECD countries have used these tools to ensure that recovery from adverse events is expedited and predictable. For example, Mexico established

a designated Natural Disaster Fund (FONDEN) in 1996, which each year specifies that at least 0.4% of the federal budget should be available for rehabilitation of federal infrastructure in the wake of disasters (OECD, 2015[45]). Since that time, FONDEN funds have been used to cover millions of dollars' worth of reconstruction. Researchers have estimated that FONDEN boosts economic activity in the areas that receive funds by 2-4% in the year following an adverse event, indicating that the funds are helping these areas weather shocks in support of improved resilience (World Bank, 2016[60]). Colombia has used instead a contingent line of credit, to be accessed only in the event of a natural disaster (World Bank, 2017[61]). In 2010, severe rains triggered the disbursement of the funds, which allowed the country to expedite its recovery (Hallegatte, Rentschler and Walsh, 2018[59]).

Investment in disaster risk reduction

In conjunction with improved risk management plans and strategies, both researchers and the international community are increasingly advocating a larger role for government in investing in disaster risk reduction as a more cost-effective approach to disaster management (Shyam, 2013[62]; Mechler, 2016[63]; Multihazard Mitigation Council (MMC), 2005[64]). These kinds of investments include large infrastructure projects like flood control or irrigation infrastructure, but can also cover soft things like institutional capacity and monitoring (Tanner, Bahadur and Moench, 2017[65]). Yet stocktaking efforts in preparation for the 2015 Sendai Framework found that countries continue to underfund risk reduction projects, leaving them unprepared for risks and more likely to need *ex post* disaster funds (Kellett, Caravani and Pichon, 2014[44]). The literature provides several suggestions for how this gap can be addressed in order to improve absorptive capacity.

One of the primary means through which governments can increase funding for risk reduction projects is by considering the way they value resilience-enhancing improvements in project evaluation cost/benefit calculations (Shyam, 2013[62]). Many of these projects require large up-front costs, while the benefits are uncertain and accrue over the long-term. As such, these projects may be perceived as poor investments, since the net present value of potential long-term benefits is close to zero at higher discount rates. The literature argues that in order to more adequately account for the benefits of such long-term actions, a much lower discount rate is needed. For example, the Stern Review used a rate of 1.4% in their report to assess the benefits of climate change actions (Levy, 2018[66]).

Another constraint impeding risk-reducing investments is the probability that such investments will not pay off in the long run – particularly given the uncertainty surrounding future conditions with respect to climate change. But this viewpoint could be overly simplistic, as there are investments that could pay off for farmers and agricultural sectors regardless of future conditions. These "no regret" options can include development of new irrigation or water storage infrastructure, increasing water use efficiency, the development of new crop varieties that are more tolerant of extreme conditions, adjusting planting dates, or devoting increased funding to agricultural research (Hallegatte, 2009[67]; IPCC, 2012[68]; ECONADAPT, 2015[69]). In an analysis of case studies covering Europe, for example, Tröltzch (2013[70]) concluded that various measures related to agriculture, including the development of adapted crops and pastureland restoration, would have greater benefits than costs.

Even outside the realm of no regret options, producers and countries can follow other strategies to minimise the riskiness of DRM investments. First of all, they can prioritise flexible or easily reversible investments. These options do not require large initial outlays and do not preclude further or different future adaptations. Some possibilities in this area would include the introduction of new crop insurance programmes, the establishment of a crop monitoring and early warning system, or farmer capacity building (Hallegatte, 2009[67]; IPCC, 2012[68]; ECONADAPT, 2015[69]). If none of these options are feasible, governments can concentrate instead on investments with reduced lifetime horizons, or they can focus on investments that will be robust across a large variety of possible future scenarios (Leclère et al., 2014[71]). Some authors suggest that investments should be designed using "safety margin" approaches, where

infrastructure or systems are designed not to function under most probable circumstances, but over a range of nearly all possible circumstances under current future climate projections (Hallegatte, 2009[67]).

Furthermore, the literature also notes that countries can consider investing in DRM as an opportunity that can unlock multiple layers of benefits for countries in terms of both avoided losses and wider economic gains and spillover effects. For example, Tanner et al. (2015[72]) argue that making investments in DRM can unlock three types of benefits for countries which they call a "triple dividend". This triple dividend is composed of avoided losses, development related to stimulated innovation and entrepreneurship, and social/environmental co-benefits from DRM investments, with two of the three identified benefits realised regardless of whether or not a disaster strikes. As such, the authors contend that choosing not to invest in these strategies is very much a missed opportunity.

Enabling environment

In addition to specific policy preparations targeting resilience, it's worth noting that countries can improve their resilience generally by providing an enabling environment, ensuring that producers have functioning access to services, credit, and markets in order to have the ability to implement their own risk management strategies (OECD, 2009[1]). For example, research from the developing world highlights the fact that more resilient households tend to have better access to services – including healthcare, schools, and local government offices (Smith and Frankenberger, 2018[10]).[5] Markets are another area in which governments can act to minimise the risks from adverse events. Research has indicated that open markets can play a role in stabilising food prices in times of crisis, ensuring that poor consumers continue to have economic access to food (Fan and Brzeska, 2014[73]; Dorosh, Kennedy and Torero, 2016[74]). Furthermore, the authors in these cases noted that distortionary trade policies in times of high food prices damage the resilience of the global food system.

Ex post government disaster response

While co-ordinated and well-planned pre-crisis government actions were found to be integral to resilience, the literature also noted that *ex post* disaster response could contribute to improved absorptive capacity through the provision of targeted financial resources that do not create disincentives to risk-reducing actions of other stakeholders. In this respect, several findings are relevant, including the importance of response speed, the necessity to consider incentives in the design of *ex post* assistance programmes, the opportunity to build back better, and the potential benefits of *ex post* analyses of disaster response.

With respect to the actual disaster response, the resilience literature from both the development and disaster spheres conclude that reaction time matters [see, for example, (Hallegatte, Rentschler and Walsh, 2018[59])]. Interventions and assistance that are delivered to producers immediately in the wake of a crisis (or even before a full-blown crisis develops) help households to better absorb shocks through the avoidance of negative coping strategies and the ability to resume productive, income-generating activities again sooner in order to reduce indirect adverse economic effects. One model from the World Bank stressed that indirect output losses would always be greater than a direct loss of productive assets, such that delayed reconstruction magnifies total disaster losses (Hallegatte, 2014[48]). Data from the 2005 Mumbai floods underscored this point – the authors estimated that if reconstruction time in the wake of the floods would have been cut by one-third, total welfare losses would have fallen by nearly 4% (Hallegatte, Bangalore and Vogt-Schilb, 2016[75]). The value of a quick response has also been noted elsewhere in the development literature. In their 2018 analysis of resilience in the face of drought in Ethiopia, Kenya, and Somalia, USAID used household data to estimate that an early response would save USD 1.6 billion in humanitarian response, and nearly USD 2.5 billion in additional avoided losses. Putting a similar plan into action, in 2017, FAO and partner organisations mobilised resources from their Special Fund for Emergency and Rehabilitation Activities (SFERA) in the Horn of Africa when monitoring systems indicated that a severe

drought was occurring. Livestock feed and other assistance was disbursed, leading to more productive herds, reduced livestock mortality, and improved household welfare (FAO, 2018[76]).

But the way in which support is provided may also affect farmers' resilience to risk in the long term. Farmers will decide on their risk management strategies based, in part, on how they expect governments to respond to 'catastrophes' in the sector (OECD, 2009[1]; European Commission, 2017[77]). For example, farmers in OECD countries may expect governments to provide relief after a disaster, potentially to support farm incomes and restore agricultural production and assets. Yet such assistance can reduce farmers' incentives to take responsibility for managing risks, which has the snowball effect of increasing their exposure to shocks, increasing losses, and necessitating further assistance (Barnett, 2014[78]; Clarke and Dercon, 2016[52]). Similarly, disaster relief that takes the form of tied grants – such as subsidies for freight or fodder, and support tied to the restoration of particular assets – can distort farmers' behaviour and favour some activities over others (Productivity Commission, 2014[79]).

In order to provide a foundation for improved resilience, disaster assistance should be structured in such a way that farmers and local authorities are incentivised to take mitigating actions. This may include cost-sharing between local and national governments, for example (Clarke and Dercon, 2016[52]). Another option in this space could be to shift from a paradigm of unlimited disaster assistance to a framework based instead on lifetime limits (Rogers, Bardenhagen and Lorente, 2016[80]). The idea behind such an approach is that central governments would set limits on federal disaster aid disbursed to local actors over a given period of time. As such, local actors would still have access to recovery funds, but they would in the meantime be incentivised to make investments to reduce their long-term vulnerability to adverse events. Such a system would not completely absolve the national government of responsibility for disasters, but it does allow for local control in deciding how best to allocate limited funds. This approach could be combined with additional actions, such as additional funding incentives for mitigating activities, requirements that actors carry insurance to privatise losses, or the establishment of endowment funds. Overall, governments should strive to ensure that this assistance is disciplined, rules-based, and predictable.

The final financial element of *ex post* disaster response relevant to governments is the idea of using disaster recovery as an opportunity to leverage improved system resilience through a structured programme to "Build Back Better": that is, stronger, faster, and more inclusively. The World Bank estimates that if countries were to build new infrastructure designed to withstand more powerful shocks, reduce post-disaster reconstruction time from five years to one year, and more effectively target the poor and vulnerable in crisis recovery, they could substantially reduce their losses to both assets and to post-disaster consumption and income, with significant implications for long-term resilience (Hallegatte, Rentschler and Walsh, 2018[59]). Although the model's estimated avoided losses tend to be highest in terms of percentage of GDP for poorer countries, the benefits to OECD countries of such an approach can also be substantial. For example, the authors estimated that reducing rebuilding time from natural disasters in the United States could reduce well-being losses by 24% (Hallegatte, Rentschler and Walsh, 2018[59]). Moreover, additional work from the group noted that the "productivity effect" of reconstructing in such a way that overall economic productivity is higher than prior to the crisis can more than compensate for disaster losses in the long-run (Hallegatte and Dumas, 2009[81]). In agriculture, farmers (and other actors in the value chain), can leverage disasters as opportunities to invest in new technologies, shift into production of different commodities, or improve the long-term sustainability of their operations.

Once the event has run its course, the literature suggested that policy makers engage in a an *ex post* analysis and learning process to identify lessons from the response to an individual disaster, learn from it, and evolve in such a way that the system is better prepared for future disasters (Munich Re, 2017[82]). Moreover, authors emphasised that planning, response, and learning should be an iterative process that incorporates new information after every disaster (Keating et al., 2014[83]). In one recent example, an *ex post* analysis of the drought experienced by the US state of New York in 2016 (in conjunction with modelling of future water use scenarios) revealed that the region does not have sufficient irrigation infrastructure to deal with increased agricultural water supply demands if climate change increases the

frequency of future droughts (Sweet et al., 2017[84]). Authors reported that this finding can inform the decision-making process for future regional investments, and can also be useful to producers in their farm management decisions.

1.2.2. Adaptive capacity

Although farmers routinely adapt their operations to changing circumstances, there has been an increased focus from the policy perspective on the importance of adaptation for the agricultural sector. Having the capacity to adapt means being able to either alter operations in response to an evolving risk landscape in the medium- to long-term, or to make adjustments in anticipation of future conditions. The resilience literature indicates that adaptive capacity can be improved through measures that:

- *Address information gaps* to ensure that farmers have both the background information needed to *make* farm management decisions to adapt to new risk environments (including adequately communicating risk probabilities and incentives), as well as to information *detailing* new strategies and farm management options appropriate to the circumstances.
- *Cultivate intangible human capital* to ensure that farmers are capable of and incentivised to implement new practices.
- *Recognise the contribution of social capital* as a means of enhancing knowledge exchange and creating new opportunities.
- *Increase investments* that permit the adoption of adaptation strategies.

Similar to absorptive strategies, the complementary actions of different actors act in concert to improve overall adaptive capacity. As such, this section is broken down into on-farm, private sector, and government measures.

On-farm measures

Much of the resilience literature related to adaptation focuses on the specific on-farm measures that producers can take to adapt to changing conditions, including the adoption of new seed varieties and technologies, adjustments in farm management strategies, or diversification – many of which build flexibility or contingencies into farm operations, and consequently mirror those measures that are important for absorptive capacity. While relevant adaptation strategies are very grounded in situational context (Box 2.4), building the *capacity* for on-farm adaptation relies on much more universal attributes, including human capital, social capital and networks.

Box 2.4. On-farm adaptation measures

On-farm adaptation measures are characterised by small adjustments to farm operations that can successfully transcend changed circumstances and help producers avoid suffering shocks in the first place. As such, all of these capacities require some sort of *ex ante* actions with a focus on a longer time horizon. Two areas highlighted by the literature are the adoption of improved seed varieties and adjustment of farm management practices.

For certain specific crops and areas, the adoption of improved seed varieties (and other technologies) has helped producers adapt to changing environmental conditions (Ignaciuk and Mason-D'Croz, 2014[85]; Ignaciuk, 2015[2]). For example, a 2018 meta-analysis including studies from India, the Philippines, Sub-Saharan Africa, and South Asia found strong evidence that stress-adapted germplasm was effective at improving household resilience through stabilising agricultural production (Hansen et al., 2018[8]).

At the same time, the literature provided ample examples of smaller adjustments in on-farm management that could also prove beneficial, and potentially at a lower cost. Commonly-cited strategies include increased farm diversification or changes to planting dates (Howden et al., 2007[86]; Ignaciuk, 2015[2]; World Bank, 2017[87]; Janowiak et al., 2016[88]). Numerous examples from the literature underscore the possibility of such practices to shore up farm resilience, for example:

- An analysis of adaptation measures in the Chinese rice sector concluded that adoption of certain improved farm management practices could be an effective means of adapting to extreme weather events. The researchers found that rice farmers who implemented management practices like reseeding, fixing, or cleaning seedlings had higher yields, lower yield variability, and less downside risk (i.e. fewer extreme yield losses) than producers who did not implement these adaptive measures (Huang, Wang and Wang, 2015[89]).
- An investigation of the Australian wine industry found widespread use of management practices to confront changing climate, including early harvesting of grapes, usage of more water efficient technologies, and the introduction of more drought tolerant root stocks (Park et al., 2012[90]).
- A review of studies on water harvesting in Sub-Saharan Africa concluded that this strategy could improve farm resilience by stabilising or improving yields and ensuring that the local agroecosystem maintained a productive state. Furthermore, the introduction of water harvesting was found to be associated with additional resilience strategies, as the increased income provided by water harvesting allowed farmers to invest in diversifying their farm operations (Dile et al., 2013[91]).
- Researchers noted that increasing precipitation volatility in the northeastern United States can be mitigated by the installation of deficit irrigation systems, improved farm ditch drainage systems to collect and store water, and increased organic matter in soil to improve water holding capacity (Wolfe et al., 2018[24]).

On-farm human capital – resourcefulness, self-initiated problem solving, and flexibility – was found to be a critical component of adaptive capacity. Different authors noted that farmers that successfully adapted to changing risk environments manifested this human capital in various ways, including as a capacity to learn from past events to adjust future operations (Adger et al., 2011[92]), as a paradigm shift from managing their operations for efficiency to managing them for flexibility (Carlisle, 2014[93]), through a process of continuous learning (Tendall et al., 2015[94]), or through adaptive management approaches that take into account new information to inform further decisions in an iterative cycle (Nelson, Adger and Brown, 2007[95]).

Building this human capital is a multifaceted process that may require addressing cultural and social barriers, confronting entrenched attitudes and belief systems, and ensuring that farmers are incentivised to develop these capacities (OECD, 2012[96]). Many of these mechanisms are external to the farm and will require some action on the part of governments, and as such are addressed in the following section.

The literature did point to at least one means through which farmers could improve their own human capital stock, while simultaneously devising useful adaptations for their own farm contexts – on-farm innovation and experimentation. This measure encourages problem-solving and discovery, while also building a site-specific knowledge base that will help farmers to adapt new outside technologies or methods to their own farm circumstances. Numerous instances of how on-farm innovation can contribute to improved resilience have also been documented:

- An analysis of climate change adaptation in New Zealand emphasised that on-farm research was a critical laboratory for early climate adaptation innovations, and should be supported (Kenny, 2011[97]).

- A qualitative analysis from Austria found that farmers' experiments in the region arguably enhanced resilience for both the target farms and the region as a whole (Kummer et al., 2012[98]).
- Also in Austria, on-farm experimentation with new crops was held up as a resilience strategy, as it allowed farmers to test potential new marketing opportunities that could prove to be more lucrative, or sustainable, in the future (Darnhofer, 2010[6]).
- Knowledge generation through farmer field schools was promoted as an effective way to co-ordinate between producers and researchers, with examples cited in Denmark, France, Italy and the United Kingdom (MacMillan and Benton, 2014[99]).
- Researchers found that farmer-initiated innovation in Ghana was correlated with improved resilience (Tambo and Wünscher, 2017[100]). In this instance, when researchers compared farmers who adopted any of a basket of innovations (developing new techniques, adding value to traditional practices, modifying or adapting existing techniques to local conditions, or conducting their own on-farm experiments) to farmers who did not, they found that the "innovators" scored higher on a calculated resilience index.

All of these examples indicate that resilient agricultural systems are characterised by experimentation, and embrace disturbances by innovating and approaching problems through novel approaches. In this way, new opportunities can arise, and new resources can be directed toward system development.

In conjunction with human capital development, the literature concluded that social capital (in the form of networks) can make an important contribution to a farmer's adaptive capacity (Wreford, Ignaciuk and Gruère, 2017[101]). Social networks were found to foster farmer-to-farmer knowledge exchange and innovation (Tompkins and Adger, 2004[102]), and were also found to play a role in the pooling of common resources for the development of new business opportunities. In one example from Austria, a group of producers was able to diversify their income-generating opportunities by co-operatively financing and operating a vegetable packing plant (Darnhofer, 2010[6]). Extended networks outside of the local social group were also found to be important, as they allow farmers to access external resources, opportunities, and information, which are all important for adaptation purposes (Newman and Dale, 2005[22]). In this area, stakeholders should be aware of and take steps to avoid relying too heavily on one type of social capital. For example, communities with strong linkages to others in their community (linking capital) tend to have poor external linkages (bridging capital), with the consequence that social networks may be highly entrenched and resistant to new ideas and exchanges (Harrison, Montgomery and Bliss, 2016[103]). Given these dynamics, commodity organisations or producer federations could have an important role in this process – for example, by linking producers to researchers, or identifying the most pressing issues facing their industry and advocating for solutions.

Private sector measures

The literature notes that the private sector can play a role in supporting adaptive capacity in several ways, including by addressing information gaps through insurance, by investing in larger infrastructure projects or technologies that allow farmers to adapt their operations, by promoting more sustainable practices throughout the value chain. With respect to insurance, numerous authors noted that the price of insurance signals the actual extent of a producer's risk exposure, and as such incentivises actions that help the farm better adapt to current circumstances (Collier, Skees and Barnett, 2009[28]; OECD, 2014[18]). Furthermore, insurance can also be leveraged to incentivise adaptation through premium reductions for the implementation of certain good agricultural practices (GIZ, 2015[104]; Linnerooth-Bayer and Hochrainer-Stigler, 2015[42]).

The literature also theorised that there could be a substantial market role in funding of both new technologies to facilitate farm-level adaptations, as well as larger-scale adaptation projects. With respect to larger-scale adaptation projects, there is presently a large investment gap in agricultural resilience due to various factors, including the difficulty in valuing an investment in agricultural adaptation by financial

markets (because the benefits are not necessarily accruing to the investor), the investment horizons in resilience are typically longer-term while financial markets tend to prefer short-term gains, and the returns from such investments are unpredictable due to the uncertainty surrounding climate change (World Bank, 2017[87]). Many of these issues can be overcome through the use of better data, reframing of the proposals, and the selection of projects that can produce returns over a wide range of potential future climates. In spite of the identified obstacles, the World Bank has already identified dozens of potential projects that could be attractive to commercial investors while also providing long-term resilience benefits in the agricultural sector. These include water treatment and reuse facilities in Australia, irrigation public-private-partnerships in Mexico, rainwater collection in Israel, and agroforestry opportunities in Colombia (World Bank, 2017[87]).

Outside of an informational and financial role, the private sector can contribute to improved adaptive capacity through global value chains and certifications (OECD, 2013[105]; OECD, 2017[106]). Value chains can incentivise farmers to implement adaptive measures and improve their overall adaptive capacity by either encouraging or requiring the utilisation of certain practices. In one example, Starbucks' Coffee and Farmer Equity Practices initiative sets standards for participating coffee growers on conserving water resources, soil quality, and biological diversity, leading to more stable natural habitats and higher overall incomes (Amado and Adams, 2012[107]). In the same vein, private certification schemes (such as Rainforest Alliance or 4 R's Nutrient Stewardship) are an additional market mechanism that can link consumer willingness to pay with producer willingness to adopt more sustainable production practices (Khanna, Swinton and Messer, 2018[108]).

Policy measures

As emphasised previously, building adaptive capacity above all requires flexibility in farm-level decision-making so that producers can shift their operations to respond to changing circumstances. There are numerous obstacles that prevent such shifts from occurring, including information or awareness gaps, lack of alternatives, or lack of infrastructure to support adaptive responses (Wreford, Ignaciuk and Gruère, 2017[101]). The literature identifies a clear role for government in addressing these obstacles, particularly in the areas of providing information and research, offering extension and capacity building to improve human capital, providing infrastructure that allows farmers to undertake adaptive actions, and ensuring that market signals incentivising adaptive measures are not distorted by policy frameworks that lock producers into maladaptive production systems.

First, the literature emphasises that one of the primary roles of the public sector in adaptation is the provision of information (Wreford, Ignaciuk and Gruère, 2017[101]). Researchers and policy makers need access to past and present information for analysis and policy-informing purposes, and producers need access to information about projected future conditions for planning and investment purposes (Ignaciuk, 2015[2]). Moreover, information flows and feedbacks are valuable in developing strategies and ensuring that all relevant stakeholders can contribute to the process (Howden et al., 2007[86]). The 2015 review of OECD member country adaptation activities found that most have already recognised that good information underpins national adaptation strategies, with a majority of countries reporting planned knowledge and information awareness activities (Ignaciuk, 2015[2]). One example of how improved access to information can further resilience objectives is the US Climate Resilience Toolkit online platform. Through the platform, users can access historical and projected climate data for all counties in the contiguous United States, learn about tools relevant to their particular region or sector, consult case studies on communities confronting climate challenges, locate regional experts who can advise them on their particular circumstances, identify potential resources to help fund climate adaptation efforts, and provide feedback to overseeing agencies (U.S. National Oceanic and Atmospheric Administration, n.d.[109]). Researchers analysing the effectiveness of the platform have found that the bi-directional flow of information has both improved the trust of users, as well as led to the co-production of knowledge (Gardiner, Herring and Fox, 2018[110]).

The literature also highlights the importance of information for guiding adaptive investments in the sector. For example, Antle and Capalbo (2010[111]) used a stylised agricultural sector model to show the importance of information on investment decisions in adaptation. They emphasised that both public and private actors need better information in order to support medium- and long-term investments in adaptation – private actors need information that helps them reduce the uncertainty around climate change and its impacts, while public actors need information to help them adequately assess the benefits of uncertainty-reducing investments (Antle and Capalbo, 2010[111]). With respect to catastrophes in particular, governments can use advanced modelling techniques to analyse large-scale investments in infrastructure projects that will allow producers to implement adaptive actions (Re:Focus Partners, 2015[51]).

With respect to knowledge systems in general, the literature indicated that farm-level adaptive capacity was somewhat constrained by the availability of feasible technologies or management strategies. To address this gap, the literature highlighted the potential role of publicly funded research. While authors noted that investments in agricultural research can pay large dividends and enhance livelihood resiliency (Dorosh, Kennedy and Torero, 2016[74]), there is particularly a role for government in ensuring that research is downscaled to local conditions (Ignaciuk, 2015[2]). In this space, there is an increasing emphasis on the potential for integrated participatory research approaches, where the research community collaborates with farmers, industry, and local stakeholders to both ensure that solutions are feasible in the real-world context, and to facilitate the uptake of promising practices (Vogel et al., 2007[112]; Nettle et al., 2015[113]). One particular area of research that is relevant to adaptation is the development of more drought and flood tolerant crop varieties (Howden et al., 2007[86]), which will often have to be further tailored to local environments (Collier, Skees and Barnett, 2009[28]). Researchers from Australia, for example, found that the development of an ultra-early variety of peanuts that required fewer growing days helped the industry there to adapt to increasingly dry conditions (Jakku et al., 2016[114]).

Integral to this process of improving awareness to improve adaptive capacity is the diffusion of information and strategies through extension efforts. Particularly as climates change, the literature noted that extension and technology diffusion will become increasingly important to ensure that farmers have information about effective local adaptation options (Collier, Skees and Barnett, 2009[28]). Moreover, extension services can affect resilience through multiple pathways, including through the provision of information and decision-making tools, via the introduction of new packages of technological and management advice, or by acting as conduits of information to cultivate on-farm human capital (Davis, Babu and Blom, 2014[115]). For example, researchers from Australia noted that extension could contribute to improved farm resilience by informing producers about adaptation strategies, learning from farmers about their adaptation decisions, and acting as a broker between policy makers and producers striving to improve farm resilience (Nettle and Paine, 2009[116]).

The literature also noted that the government could contribute to improved adaptive capacity by developing infrastructure for shifting climate scenarios (Nelson, Adger and Brown, 2007[95]; Ignaciuk, 2015[2]; Mathijs, 2017[117]). Although interventions in this area are context-specific, particularly in the area of water and irrigation management, the scale of projects may be such that government investment is needed (Howden et al., 2007[86]; Ignaciuk, 2015[2]).

The final role of government in improving adaptive capacity noted in the literature is ensuring that producers are properly incentivised to improve their own individual adaptive capacities. Farmers generally have been observed to adopt resilience-enhancing behaviours if there is an economic incentive to do so (Wreford, Moran and Adger, 2010[118]; Ignaciuk, 2015[2]; Wreford, Ignaciuk and Gruère, 2017[101]). For many farmers, then, incentivising action may just be a matter of communicating the concept to producers in such a way that they are more likely to take actions. Above all, farmers need to be aware of changing risk profiles and the probability of permanently altered climate circumstances (Howden et al., 2007[86]). For example, in an analysis of groundwater use, Li et al. (2014[119]) analysed whether or not giving information about groundwater resource quality influenced individual withdrawals. They found that communicating

information about the threat of groundwater contamination was sufficient to incentivise reduced usage, even in the absence of any other regulatory framework or economic incentives (Li et al., 2014[119]).

However, even if there are economic incentives in favour of adaptation, governments may have a role in addressing other barriers that can prevent adaptation from taking place, including policy barriers, hidden costs, and access to credit (Wreford, Ignaciuk and Gruère, 2017[101]). For example, subsidisation of crop insurance programmes disconnect farmers from the actual risk profile of their operations, incentivising risky behaviour and reducing the likelihood of investments in long-term adaptive measures (Ignaciuk, 2015[2]). As such, governments could support adaptive capacity by phasing out insurance subsidies to ensure that farmers make production decisions in response to market incentives.

1.2.3. Transformative capacity

The resilience literature increasingly notes that in some cases, incremental adaptations in agriculture may not be enough to confront the realities of a changing climate or increasing natural resource constraints (Kates, Travis and Wilbanks, 2012[120]; Mushtaq, 2018[121]). The potential for reaching critical thresholds beyond which recovery is not possible and the evolving risk environment suggest that critical thinking about possible new opportunities may be the key to the continuity of the sector. In these cases, transformation may be the optimal strategy. Transformation can be a difficult and politically fraught process because it challenges producers, governments and other actors to confront difficult questions about the trade-offs of agricultural activities, and can even require that actors reconcile a need to relocate activities against a strong place attachment (Fleming, Park and Marshall, 2015[122]). But looked at through the lens of possibility for the future, transformation can instead be framed as an opportunity for reinvention.

Unfortunately, there is little empirical work that can contribute to the evidence base to guide the successful development of the transformative capacity, since policy frameworks to date tend to avoid transformative approaches and instead focus on adaptation for reasons of cost, uncertainty, and even political sensitivity (Jakku et al., 2016[114]; Panda, 2018[123]). However, historical examples can offer some useful insights, and modelling work and the growing theoretical literature on the topic provides both guidance and cautionary advice that can inform policy makers in this regard. In these reflections, it is important to distinguish between proactive, directed transformations in response to current conditions and in anticipation of the future, and forced transformations resulting from the crossing of biophysical thresholds, because the policy responses are different. In order to inform future transformations, this section focuses on proactive transformation strategies, which require deliberate choices and purposeful decision-making (Park et al., 2012[90]).

Because the transformative capacity is related to the adaptive capacity, the literature identifies many of the same factors as relevant to transformation at the farm level, including human capital and social capital. The role for government in transformation, however, is much more focused on not only providing information, but in driving the collaborative planning processes necessary for successful transformation. The literature indicates that transformative capacity can be enhanced through measures that:

- *Provide or improve information* to assist actors in their long-term decision-making processes.
- *Develop human capital* so that producers have a forward-looking decision-making outlook and the capabilities necessary to carry out transformative changes.
- *Leverage social capital* as a means to generate new ideas and ensure farmers are supported in their transformations.
- *Establish deliberate collaborative planning processes* to ensure that all stakeholders are both aware of likely changes in the risk landscape, and can contribute to the planning of the sector's future.
- *Provide financial resources* to support transformative actions.

How these measures are relevant to the different actors is detailed below.

On-farm measures

As with adaptive capacity, one of the factors for success highlighted by the literature on transformation is intangible human capital – farmers need to employ a forward-looking decision-making process that incorporates management flexibility and on-farm experimentation. This is partly because the process of transformation is not a one-off type of occurrence. Rather, transformation is typically accompanied by many smaller accommodations and adaptations, as general strategies must be customised to local conditions. A recent example from the Australian dairy industry illustrates this point. When the sector deregulated in 2000, although farmers were fully aware that this specific shock would be occurring well in advance, the initial actions taken by producers led to negative unanticipated consequences that required further management decisions (Sinclair et al., 2014[124]). Similarly, in their *ex post* analysis of the Peanut Company of Australia's attempt to relocate a large portion of their production to a new area, researchers stressed that there was definitely a need for a good business plan, and sufficient time and resources to implement and adjust it as needed (Jakku et al., 2016[114]).

Various authors noted that the attitudes and beliefs regarding long-term agroecosystem health was also an important human capital dimension that was necessary for improved transformative capacity (Carlisle, 2014[93]; Rickards and Howden, 2012[125]; Sinclair et al., 2014[124]; Walker et al., 2004[126]). For example, interviews with farmers in Finland and Sweden revealed that although they acknowledged climate change was occurring, capitalising on it as an opportunity through transformative change was not a priority, since their decision-making processes were more focused on short-term risk coping (Juhola et al., 2017[127]). Similarly, in their analysis comparing adaptive and transformative tendencies amongst Australian wine grape producers, Park et al. (2012[90]) noted that the main difference between transformers and adapters seemed to be psychological, in that the two groups approached the problem of climate change differently. Transformative producers tended to absorb and analyse a large quantity of data and information in order to drive their proactive management approach, whereas adapters tended to consume less data and confront problems in a more reactive manner (Park et al., 2012[90]).

As with both the absorptive and adaptive capacities, social capital in the form of networks was found to be important for transformative producers as well. However, the focus was found to be different. For example, in their analysis of Australian producers, Dowd et al. (2014[128]) found that transformative producers tended to have extensive knowledge and information networks but smaller social networks of family, friends, and colleagues. In this way, transformers were receiving outside information and knowledge of new practices without being constrained by existing social norms of peer groups, freeing them to experiment and move into new directions (Dowd et al., 2014[128]).

Private sector

There is potentially a substantial role for the private sector in transformation, as this capacity relates to creating or taking advantage of new opportunities in the course of altering the production system. In this context, agribusiness firms can provide the vision and leadership to harness these new market opportunities, including by mobilising financial resources, organising adjustments throughout the value chain, and ensuring that products meet evolving consumer demands (Amado and Adams, 2012[107]). Some authors note that the interruptive nature of transformational change implies that greater co-ordination along the entire value chain is necessary as compared to incremental adaptations, putting private sector firms in a position to orchestrate industry transformations. For example, they can incentivise farmers to relocate or otherwise transform their operations by offering higher prices or more lucrative contracts (Fleming, Park and Marshall, 2015[122]). The private sector can also play a role in funding new initiatives, or can collaborate with other actors in public-private partnerships to develop new technologies or seed varieties (Kates, Travis and Wilbanks, 2012[120]).

Policy measures

With respect to improving transformative capacity, the overarching role of government is to ameliorate the primary obstacles to transformation: uncertainty about future climate conditions, institutional or behavioural barriers that impede change, and high costs associated with transformative actions (Kates, Travis and Wilbanks, 2012[120]; Jakku et al., 2016[114]). In order to confront these barriers, the literature suggests that governments should increase efforts to provide or improve data to inform decision-making efforts, engage in collaborative planning processes with the intent of identifying barriers and facilitating transformative actions, and potentially provide financial resources to allow producers to make transformative changes.

The literature notes that one of the primary means of improving transformative capacity is by resolving information gaps through research, on several fronts. First, more research is necessary to improve and refine climate models in order to better inform transformative decision-making (Leclère et al., 2014[71]). Currently, climate models estimate a wide range of potential effects, such that there could be considerable risk in investing in a transformative strategy now since there is little certainty on what the actual effects may be in a given area. In fact, several examples are noted in the literature where although producers acknowledge that climate change is occurring and affecting their operations, it is not yet considered sufficiently severe for them to entertain the notion of transforming their operations – other problems such as market prices and policy changes are, as yet, of greater concern (Fleming, Park and Marshall, 2015[122]; Juhola et al., 2017[127]).

Indeed, scholars from the theoretical literature argue that more research considering transformation in the context of resilience is useful to help policy makers and producers take critical decisions about where resources should be invested (Park et al., 2012[90]; Anderies et al., 2013[129]; Wolfe et al., 2018[24]). This should include not only work on refining modelling approaches, but also investigating the historical record for examples of cost-effective transformation strategies. Second, there is a need to direct further resources toward research into more interdisciplinary strategies to confront long-term resource constraint issues (Rickards and Howden, 2012[125]).

Researchers noted that it may be necessary for knowledge systems themselves to reorganise in order to better contribute to transformative capacity. Cornell et al. (2013[130]), Rickards and Howden (2012[125]), Park et al. (2012[90]) and others argue that a radical change in knowledge systems is needed, emphasising the necessity of more participatory approaches, transdisciplinary interactions, and bridging the gap between knowledge and action though capacity building and extension. They noted that knowledge systems should function from the premise that the system may not be able to retain its current form if solutions cannot be found for more systemic underlying problems or drivers (Colloff et al., 2017[131]). In these cases, technological solutions only serve to entrench an already unsustainable pathway (e.g. path dependency). Indeed, various scholars expressed concern that necessary systems transformations are being sidelined in favour of promoting adaptation of entrenched interests, distorting the intention of resilience thinking and frameworks (Tanner et al., 2014[132]). In fact, one of the reasons transformation is so difficult is that it may require changing some existing power structures in order to succeed (Bahadur et al., 2015[133]).

An additional role for government in the realm of transformation noted in the literature is the need to act as a facilitator for deliberate, collaborative scenario planning. Such an exercise would consist of the government convening a body of all affected actors in a given area and setting out contingency plans for various hypothetical scenarios. Various sources reported that interactions of these types could help actors to confront possible future circumstances without the pressure of actually having crossed the critical thresholds necessitating change, permitting them to begin a process of planning how to move toward – or away from – those “worse-case” scenarios and possibly undergo transformative change (Walker et al., 2004[126]; Colloff et al., 2017[131]). In their *ex post* analysis of the Australian dairy sector deregulation, for example, Sinclair et al. (2014[124]) note that such an action was missing from the transformation planning process, and while it is impossible to know for certain, just such an initiative may have helped to predict some of the outcomes that the individual actors failed to anticipate. Planning processes could also help

identify institutional barriers impeding wider system transformations. For example, in a case involving the relocation of the Peanut Company of Australia's production to another part of the country, participatory planning between stakeholders and local government officials could have identified a regulatory barrier preventing firms from acquiring water rights for more than one year at a time one, which acted as a disincentive to the company for making long-term investments (Jakku et al., 2016[114]).

Beyond supporting research and acting as a facilitator for scenario planning, governments may also have a role in providing financial resources to support transformation – either in the form of grants or loans, or even buyouts if the chosen transformative action is relocation. As noted above, cost was one of the primary barriers the literature identified with respect to transformation. At the farm level, transformations may be very costly, and may not be reversible, resulting in a conundrum for individual farm decision makers – on the one hand, farmers run the risk of foregoing transformative action and staying in a production system that ultimately may become unsustainable, while on the other hand they risk transforming and locking themselves into a new production system that could turn out to be maladaptive to future conditions. Moreover, the costs involved may be multi-dimensional. Not only are there the direct transaction costs of the particular transformation, but also opportunity costs, costs of unintended consequences of the transformation, and residual losses costs arising from incomplete adaptation (Rickards and Howden, 2012[125]). In these cases, there may be some scope for government involvement in the form of credit support or other funding, but efforts must be carefully considered in their particular context in order to avoid crowding out of private sector financing (Ignaciuk, 2015[2]).

Governments may also need to consider providing transitional financial support in areas where existing agricultural systems may no longer be viable, or where certain activities can be targeted for phasing out based on potential benefits to the greater public good (Sesmero, Ricker-Gilbert and Cook, 2018[134]). The North Carolina Swine Floodplain Buyout Program provides one example in this respect. The programme was created in 1999 as a way to provide financial support to pork producers in the 100-year floodplain in the US state of North Carolina, to allow them to close down their hog operations and transition the land to conservation easements. An analysis by the state's Department of Agriculture indicated that, had the farms not been bought out, many would have flooded during subsequent hurricanes (National Pork Council, 2018[135]).

1.2.4. Gaps in the literature and contribution of this review

This review has identified several gaps in the literature that, if addressed, would better inform future agricultural policymaking for improved resilience. First, the literature is overwhelmingly composed of case studies, which provide some useful experience, but little empirical evidence on the impact of resilience.[6] Although cases can be useful as far as generating ideas, the contextual nature of resilience means that certain measures and predicted outcomes may not be applicable to all countries (Keating et al., 2014[83]; Hansen et al., 2018[8]; Hallegatte, Bangalore and Vogt-Schilb, 2016[75]). Additionally, because the concept of resilience has been in use in the development community for a longer period of time, some of the evidence accumulated in that context and covered in this review may be less relevant for OECD countries. This review has attempted to examine a large swath of the literature for common themes and strategies that are highlighted in multiple instances in order to minimise this possibility, but additional strategies may be useful in other contexts.

The second limiting factor is that most analyses focus on a single intervention, with few attempts to consider those effects in a more holistic context. The risk management literature, however, emphasises that there are typically interactions between different instruments and strategies, such that it may not be appropriate to attribute improved resilience outcomes solely to the stated resilience measure (OECD, 2009[1]). Some work reviewed here was able to measure the relative contributions of different interventions in a development context, while others pointed to the importance of a risk layering approach (for example, adopting stress-tolerant germplasm to guard against moderate fluctuation in conditions, while also

purchasing insurance to cover cases of more severe climate stress) (Hansen et al., 2018[8]). More evidence that takes into account these interactions is needed to better inform resilience policymaking efforts.

Thirdly, only a small number of studies evaluated the impact of policy interventions in the medium- to long-term. This is because the focus on resilience as a policy objective is relatively recent, so there have been few opportunities for countries to take action in an attempt to improve resilience and subsequently analyse the effectiveness of the measure in the medium- to long-term. Even in the agricultural development sphere (where donors require evaluations and impact assessments on project interventions), the literature covering measurement frameworks concludes that no tool has a sufficiently robust history to demonstrate that a given approach has positively influenced outcomes over time (Douxchamps et al., 2017[136]). There remain either recent cases highlighting mostly policies that target short-term absorptive capacity improvement, or else a reliance on historical examples that may hold limited relevance for today's agricultural sector. The current moment, then, is characterised by experimentation on strategies that can be helpful in the medium- to long-term, but widely applicable results and conclusions to inform policymaking may not be available for some time.

Finally, there is no set of generally agreed measures of good resilience outcomes. As such, it is difficult to compare the assessment of the different policy instruments with respect to the three resilience capacities. Further investment on methods to characterise and quantify resilience would help to have more comparable results and prioritise resilience areas, levels and policy responses.

In spite of these limitations, the literature consistently emphasises common themes that can guide policy makers as they further develop their resilience policy frameworks. Moreover, most of the strategies, approaches, or instruments identified in the review have previously been identified as best practice for risk management, or as actions that are likely to lead to improved sustainability in a climate change context. The contribution of this review, then, is to raise awareness of how strategies for improved risk management or sustainability have been found to also contribute to improved sector resilience.

1.3. Policy implications of the literature review

The literature review has provided evidence that there is room for resilience-enhancing tools and strategies from the farm sector, the private sector, and government. Although the review focused on identifying factors essential to improving resilience capacities, several overarching themes emerged that are relevant to how policy makers can integrate resilience into policy frameworks:

- *Taking ex ante measures against possible shocks over a long-term time frame is key to improved resilience*: Applying a resilience lens means making decisions and policies with a long-term focus in mind. In terms of the absorptive capacity, this means planning for a range of possible scenarios and a variety of adverse events under long-term time horizons, and investing in infrastructure that will continue to function under a range of shocks. By planning for adverse events, farmers are better positioned to either mitigate or absorb their impacts, and recover more quickly. With respect to adaptive and transformative capacity, decision makers need to be aware of possible future scenarios and take those potential conditions into account in their decision-making processes, supporting measures to reduce the risk.
- *There are trade-offs and interactions between the different risk management tools and policies*: Because resilience implies a holistic systems focus, there will necessarily be trade-offs and interactions between certain policies or actions. The combined effect of individual farms' actions to improve resilience could be to the detriment of the sector as a whole. Conversely, actions to improve the resilience of the sector as a whole could make some farming operations unviable. Policymakers must consider these trade-offs and interactions in their decision-making processes, and set clear, transparent objectives for what resilience objectives they intend to achieve.

- *Participatory processes involving a wide range of stakeholders are key to the development of new policy approaches and frameworks*: Setting the policy agenda in a collaborative participatory setting will allow all actors to consider relevant information on risks and evaluate the trade-offs in the various approaches. The process also helps stakeholders to better define the boundaries between the risk layers. With this improved understanding of risk ownership, individual actors are better positioned to make appropriate adjustments in their own behaviour. Furthermore, a periodic re-assessment allows stakeholders to evaluate the effectiveness of their approach and redirect resources if necessary.
- *On-farm strategies, and the individual farmer's overall capacity to manage risk, can play a critical role in reducing risk exposure to catastrophic events, particularly over the long-term*: Farmers are better able to confront and cope with risks in all of the layers if they make proactive investments in resilience capacity. This may require the utilisation of specific tools or measures, but also involves the development of human capital and entrepreneurial thinking to be prepared to confront changing circumstances with a creative, problem-solving approach.
- *Public goods and no-regret policies are integral to agricultural risk management*: The role of government in improving sector resilience is not limited to providing financial assistance in the wake of adverse events. Rather, even in cases where the relevant actor is the farm or the private sector, there is a "behind-the-scenes" role for government in providing information, supporting knowledge systems, and engendering an overall enabling environment to support informed on-farm decision-making.
- *The concept of general resilience emphasises a system's ability to respond to any risk, which translates to a capacity to be flexible in the face of uncertainty*: By ensuring that production systems and supply chains have in place contingencies (potentially including diversified production strategies, alternative suppliers, and diversified sales outlets), they will be better positioned to respond to all types of adverse events, including unknown risks.

Given these broad themes, several specific roles for government can be identified with a view toward enhancing sector resilience. First, governments have a role to play in planning and co-ordination processes. In part due to international processes such as the Hyogo and Sendai Frameworks or the UN Framework Convention on Climate Change, there is already increasing awareness on the necessity of planning and preparing for catastrophic events, general downturns, and medium- to longer-term shifts in climatic conditions (OECD, 2014[3]). In most countries, policy makers are already well-advanced in their planning processes for disasters and climate change adaptation. At the same time, these issues continue to be dealt with under different mechanisms. If countries are to truly improve resilience to adverse events, greater policy coherence on these topics is needed, with a view toward the effectiveness of policies in the long-term (FAO et al., 2018[137]). In particular, disaster risk reduction plans need to be mainstreamed into agricultural policy, where they can be combined with climate change adaptation plans to form the basis for a more holistic resilience policy framework (Trujillo and Baas, 2014[138]). This will likely necessitate the evaluation of the trade-offs and interaction effects of any given policy with respect to the different scales, the time frame, and the ability to confront specific or general risks. As a result of this planning and co-ordination role, a well-accepted *ex ante* plan of action is required that defines the risk and resilience framework, incentives and responsibilities, and the process to be followed when adverse events occur.

Second, because the resilience literature stresses that the most effective research and policy frameworks are likely to emerge from collaborative processes and participatory approaches (Tompkins and Adger, 2004[102]; Ignaciuk, 2015[2]; Bizikova, Waldick and Larkin, 2017[139]; Averyt et al., 2018[140]; Steiner et al., 2014[141]; Colloff et al., 2017[131]), there is a key role for the government to act as the facilitator, to both seek out and manage these collaborations (Webb and Beh, 2013[142]; Eyzaguirre and Warren, 2014[143]). Efforts of these types are already underway in multiple OECD countries (including Canada and the United States), and the outcomes of these processes could provide valuable guidance for other countries as they seek to implement similar systems. Moreover, these collaborations can best be leveraged for purposes of

resilience if they are iterative processes (Bahadur, Ibrahim and Tanner, 2013[144]; Darnhofer, 2010[6]; Engle et al., 2014[145]; Keating et al., 2014[83]; Tendall et al., 2015[94]). That is, in contrast to one-off events, they will be most effective if the groups meet periodically to consider new information, evaluate the effectiveness of ongoing initiatives, and make adjustments as necessary.

Third, particularly with respect to the absorptive capacity and disaster risk reduction, there may be a need for countries to re-examine their disaster response systems with respect to agriculture. It has long been reported that investment in risk reduction is typically more cost-effective than *ex post* assistance, suggesting that there are other cognitive or institutional barriers that are preventing countries from making these investments now (Mochizuki et al., 2016[146]). In cases where traditional cost/benefit assessments have not seemed to be effective in drawing attention to the problem, participatory "serious gaming" (where different stakeholders collaboratively brainstorm potential solutions for risk management issues in a virtual setting) can be one approach to discussing potential disasters and elucidating potential solutions. This approach has been used in various developing countries, and was found to help stakeholders identify stumbling blocks, propose innovative solutions for the local context, and design risk management plans for future events instead of repeating the mistakes of past ones (Mochizuki et al., 2016[146]). The concept of "stress testing", as commonly applied to the financial sector, could also provide useful insights to the system's ability to withstand certain shocks. These approaches could be integrated with the more long-term participatory planning processes outlined above.

Fourth, governments should make a critical holistic assessment of their current risk management and climate change adaptation policy structure to ensure that there are no misaligned incentives or policies that run counter to resilience objectives (Wreford, Ignaciuk and Gruère, 2017[101]). This should include consideration of available market instruments to deal with medium-impact adverse events, and if there is a role for government in increasing access to or uptake of these tools.

Finally, perhaps the most challenging role for government is in assisting farmers in developing the necessary human capital to autonomously integrate resilience thinking into their individual farm management approaches. Specifically, more emphasis should be placed on the cultivation of entrepreneurship and holistic risk assessment, combined with improved access to data and technologies that allow farmers to better absorb the impacts of adverse events and make informed decisions about the future of their farm. Despite the rising policy focus on farm resilience (particularly with respect to climate change adaptation), change has in many cases been hampered by a multitude of factors, including lack of awareness, lack of motivation to act, general uncertainty, or institutional problems like crowdedness (too many institutions have overlapping authority, hindering policy development) or fragmentation (relevant institutions don't communicate, so policy response is incomplete) (Eisenack et al., 2014[147]).

This chapter has reviewed the literature on the resilience measures that are most relevant for the agricultural sectors of OECD countries, focusing on measures that can improve the ability and capacity of farmers (and the sector more broadly) to respond to shocks and stresses via three key capacities – absorption, adaptation, and transformation. Despite this section's focus on how single measures contribute to improving these capacities, the optimal resilience framework will be composed of a combination of strategies (OECD, 2014[3]). A holistic approach is necessary for the success of the resilience perspective, because it forces actors and policy makers to consider that their actions may have trade-offs, interaction effects, and unintended consequences.

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Notes

[1] While both of these bodies of work may be relevant to policymakers depending upon their given interests, each addresses the topic in a level of detail that is considered beyond the scope of the current review. For stakeholders seeking more information on measurement in particular, there is ongoing OECD work in this area [see, for example, (Figueiredo, Honiden and Schumann, 2018[148])], and there is also a wider "Resilience Measurement Evidence & Learning Community of Practice" run by the Rockefeller Foundation. This initiative, launched in 2016, brings together more than 200 researchers with the goal of advancing the resilience research agenda. For further information, see (Measuringresilience.org, n.d.[149]).

[2] These were Australia, Canada, France, Germany, Ireland, the Netherlands, New Zealand, Norway, the United Kingdom, and the United States. In the Netherlands, the provision is not specific to agriculture, and is instead available for all sectors. In Norway, the provision is available only for furskin production, which will be banned from 2025.

[3] See, for example, the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions, launched at the 2017 UN Climate Conference, https://www.insuresilience.org/.

[4] Basis risk is the risk that the individual farmer will suffer a loss but the overall weather index threshold will not be triggered, such that the farmer will not receive a payout (OECD, 2016[19]).

[5] The causal factor behind this finding is perhaps a bit more difficult to interpret, as it may indicate a higher base level of well-being, or location in an area that is better connected and thus more likely to offer households access to wider resources.

[6] As noted earlier in this review, this lack of empirical evaluation is partly due to the fact that there is as yet no agreed-upon method of measuring resilience.

3 Resilience and the OECD Framework for Risk Management in Agriculture

This chapter revisits the OECD holistic framework for risk management in agriculture and offers a proposal for how it can be refined to better mainstream resilience objectives into existing risk management policy frameworks. It proposes five new dimensions: three ways to improve the "process" through which risk management policies and approaches are developed; and two additions to the "content" of the framework, which expand on the responsibilities of stakeholders. Finally, it provides guidance on how to apply this "resilience lens" to risk management policymaking.

3.1. Introduction

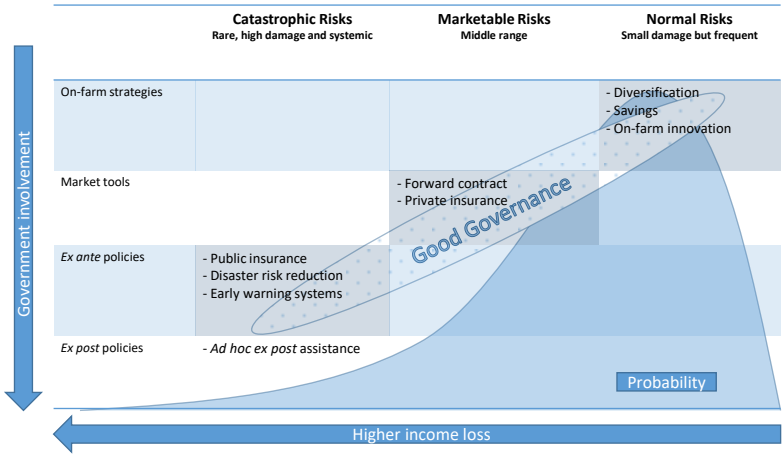
The previous chapters explored the concept of resilience and how it relates to agriculture, and identified a range of policies, practices, and strategies that have been linked to improved resilience. Many of the resilience-enhancing measures identified in the literature review are also best practices for farm risk management generally (OECD, 2011[1]). In fact, there is increasing awareness that risk management is a natural entry point for the mainstreaming of resilience strategies (Howden et al., 2007[2]; Keating et al., 2014[3]; Braimoh et al., 2018[4]). Risk management strategies and techniques are powerful tools to enhance resilience, and resilience principles can also enrich traditional risk management approaches by integrating a long-term focus, prioritising improved risk managing capacities, and recognising policy trade-offs.

This chapter seeks to orient this work within the context of the OECD risk management framework as a way for countries to streamline resilience into their already-existing risk management programmes. To this end, the OECD risk management framework is briefly reviewed before describing how it can be adapted to inform resilience policy.

3.2. The OECD framework for risk management in agriculture

The OECD has found that an efficient and effective policy approach to risk management in agriculture will take into account the interactions and trade-offs between different risks, on-farm strategies and policies, and offer differentiated responses to different types of risk. Specifically, the OECD holistic framework for analysing risk management policies in agriculture – hereafter risk management framework – distinguishes normal business risks (to be borne and managed by farmers) from larger risks permitting efficient market solutions (such as insurance systems and futures markets) and catastrophic risks requiring public engagement (OECD, 2009[5]; OECD, 2011[1]).These ideas are represented in Figure 3.1. Given the frequency and magnitude of income losses of different risks, different policies or strategies are more appropriate for responding to each of three categories of risks. These optimal policies and strategies are indicated along the “good governance” diagonal.

Figure 3.1. Optimal pattern of risk management strategies and policies



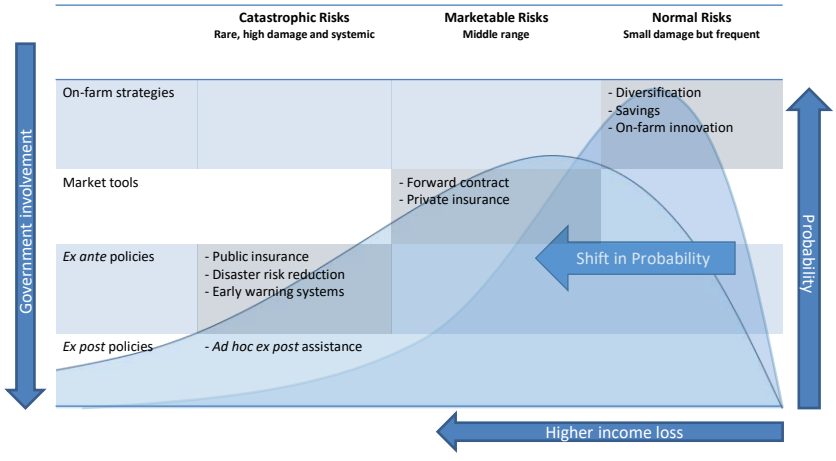
Note: Moving from right to left, the magnitude of the income loss associated with a risk increases, while the probability that it occurs decreases. This makes it possible to segment risks into different layers that are defined in terms of the probability of occurrence and the magnitude of the associated income losses, as outlined above (OECD, 2009[5]).
Source: (OECD, 2011[1]).

3.3. Resilience in the risk management framework

The holistic framework for managing risk in agriculture recommends that specific risks be segmented into different layers in order to determine the optimal risk management strategy. However, if this approach is adopted in a way that does not consider trade-offs and interactions, then it risks both biasing decision-making toward the short-term, and also short-sightedly focusing on managing well-known risks at the expense of new risks and uncertainties: farmers and policy makers may consider only specific risks, and take measures that only consider the *next* occurrence of a given event. Moreover, interpreting the framework's layers too rigidly risks creating the impression that farmers or government bear sole responsibility for managing risks within a given layer, when there may be complementary measures all agents can implement to reduce vulnerability and exposure to risk.

A number of factors suggest that the risk profile faced by farmers is shifting, which has implications for "good" risk governance. Farmers are operating in an increasingly uncertain environment. Despite having access to risk management tools and better information on risk profiles, the economic impact of disasters has continued on an upward trend, with high-impact events occurring more frequently (Bevere et al., 2018[6]; OECD, 2014[7]). Moreover, the frequency and intensity of extreme events is projected to increase under climate change scenarios (Hoegh-Guldberg et al., 2018[8]; OECD, 2014[9]). These circumstances can be represented by a shift in the distribution of the impacts of adverse events, with high impact events occurring more frequently, implying higher costs in terms of direct impacts to the sector, as well as the cascading effects of business interruption (Figure 3.2). If countries continue with a "business-as-usual" approach to risk management, a greater share of the risk management burden will likely shift on to governments.

Figure 3.2. "Business as usual" agricultural risk management will shift more responsibility to governments in the long run



Source: Authors' elaboration, based on (OECD, 2011[1]).

The challenge lies in ensuring that risk management frameworks do not transfer responsibility for losses that should be managed by farmers (through on-farm strategies or market tools) to government. Instead, risk management frameworks should recognise the need to manage risks for the long-term. Farms must be able to cope with the next adverse event, but also the subsequent one, as well as concurrent shocks. At the same time, as has already been highlighted, the strategies that target improved resilience largely overlap with best practices for risk management purposes, suggesting not that the framework itself is inappropriate, but that the manner in which it is applied needs to be adjusted. The gaps in the framework

as a tool for resilience analysis are reviewed below, before proposing a revised application of the framework that addresses these gaps.

3.3.1. Gaps analysis

Although the resilience literature review touched on many aspects that are relevant in the risk management context, some of the key conclusions were:

- Taking *ex ante* measures against possible shocks over a long-term time frame is key to improved resilience.
- There are trade-offs and interactions between the different risk management tools and policies that should be acknowledged.
- Participatory processes involving a wide range of stakeholders are key to the development of new policy approaches and frameworks.
- On-farm strategies, and the individual farmer's overall capacity to manage risk, can play a critical role in reducing risk exposure to catastrophic events, particularly over the long-term.
- Public goods and no-regret policies are integral to agricultural risk management.
- The concept of general resilience emphasises a system's ability to respond to any risk, which translates to a capacity to be flexible in the face of uncertainty.

These findings inform a gaps analysis of the current framework:

- The framework could place greater emphasis on preventative or *ex ante* actions (such as risk mitigation efforts, risk assessment, and research on potential adaptation and transformation measures).
- The framework should place a greater emphasis on potential trade-offs and how to assess them. This includes intertemporal trade-offs, for example, between current outcomes (reducing farm income variability via measures that reduce/mitigate risk) and future outcomes (resilient farmers with better – and more diversified – stocks of natural and physical capital, as well as greater financial reserves), and trade-offs between measures that help producers to manage risks (e.g. by reducing risk exposure) and policies to support a more resilient sector (e.g. facilitating normal structural change and adaptation to a changing climate).
- The framework does not provide guidance for how stakeholders within countries can develop a common understanding to define the boundaries between the different risk layers.
- The framework needs to be more explicit in outlining the potential role of government in facilitating risk reduction in all the layers, while simultaneously emphasising the necessity of increased farmer responsibility for risk management decision-making.
- The current framework does not explicitly recognise the need to inform responses for unknown risks.

Thus, while the current framework is a valuable starting point for risk management policymaking and analysis, it is in need of a reorientation if it is to be used for purposes of improving resilience.

3.3.2. Revised approach

To address these gaps, a revised "Risk Management for Resilience" framework should include considerations for both the *processes* through which risk management policies and approaches are developed, and additions to the *content* of that framework that place more emphasis on the roles of both farmers and governments in preventing and mitigating risk, and in building the capacity to manage risk across all layers. Accordingly, five new dimensions for conceptualising risk management for resilience are

proposed, comprised of three considerations for improved “Processes” and two “Content” additions to the responsibilities of stakeholders.

Process dimensions

Time frame: More focus on *ex ante* policies and prevention

Although a given policy option may be effective in helping farmers to manage the next occurrence of a given adverse event, it may actually worsen their ability to cope with other kinds of shocks, or else it may not enhance their capacity to cope with repeated exposure to shocks. In order to make decisions that will position farms to respond under conditions of general uncertainty, the decision-making framework should be shifted toward *ex ante* thinking for the medium- or long-term. By making decisions for longer time horizons, actors are more likely to consider any “knock-on” effects from their immediate actions, and also take into account both the potential occurrence of events currently considered to be unlikely in the short-term and the possibility of successive or concurrent shocks. This shift implies a greater focus on prevention, including a serious consideration of the potential need to *ex ante* adapt or transform farming systems. At the farm level, this means reducing exposure to repeated events, diversifying income streams, developing human capital to be able to respond to any risk, planning for multiple possible future contingencies, and cultivating a talent for entrepreneurship to take advantage of the opportunities that future conditions may bring. At the policy level, this means making investments today that can withstand projected future conditions, taking a proactive approach to risk management by reducing exposure and vulnerability, and enacting supportive policies with a view toward the future of the sector.

Decision-making for the long-term requires a careful assessment of the costs, benefits, and trade-offs of any given policy or approach. This means that additional planning and *ex ante* efforts may be required – risk assessments (including about potential unknown risks) should be carried out periodically, risks should be communicated to stakeholders, actors should make contingency plans, and research into risk management strategies or tools should consider future, as well as current, risks.

Trade-offs: More focus on analysing and weighing the potential future outcomes under different policy approaches

Because resilience thinking focuses on managing risk for the medium- and long-term, each policy or decision clearly implies trade-offs in time, scale, target risk, and even outcome. With respect to time, certain approaches may be appropriate for the short-term, but actually reduce the long-term viability of farms or the sector as a whole (for example, as a consequence of common resource decline). Considering scale, certain initiatives may strengthen farm resilience, but not address vulnerabilities at other stages of the value chain, resulting in bottlenecks and negative feedbacks. For target risks, it may be the case that emphasising management of a particular risk may lock farms into a particular response path and limit their ability to respond flexibly to future, unforeseen risks. Looking at outcomes, governments face budgetary constraints that limit the amount of resources that can be spent on building resilience – is there better value for money in focusing on helping farms absorb risks, adapt to them, or transform their operations entirely? This focus on trade-offs is particularly relevant when stakeholders consider potential paths toward confronting the future – that is, whether to adapt or transform in response to future risks. A decision to continue down one path or the other will require a careful assessment of the costs involved, as well as the potential benefits or future opportunities that may arise, keeping in mind the possible need to make irreversible investments. In assessing these trade-offs, actors should consider that certain investments or policies may imply foregoing efficiencies or revenues in the short-run for the sake of improved outcomes in future time periods. An important challenge for government is to create the incentives to balance this trade-off, giving more weight to long-term resilience.

The decisions taken will depend on the context, and there are bound to be drawbacks and clear winners and losers regardless of the path chosen. The point is to acknowledge these trade-offs and then determine if the most resilience-enhancing policy is worth the costs at that point in time (and then to reassess in future iterations). Moreover, in cases where there are clear losers, it may be more cost-effective to consider compensating them rather than to continue in an undesirable state.

Participatory collaborative process: More focus on co-ordination and the use of a collaborative approach to define strategies and responsibilities

A key challenge for governments is to ensure that all stakeholders clearly understand and take responsibility for managing risks to their assets. The literature suggests that an iterative and participatory approach can help to achieve this outcome by allowing all actors to contribute to the process, assess available information, consider the likely consequences of certain actions, suggest possible alternative strategies and accept the outcomes of those decision-making processes. Under such an approach, policy makers, researchers, farmers, other industry leaders, and financiers would meet and analyse the probabilities and likely consequences of various adverse events. Potential mitigating responses could be analysed, and the costs and benefits would be communicated to all stakeholders. Risks and responses could be ranked and compared to find places where synergies might exist, or to demonstrate that certain responses are not cost-effective or are counter-productive in an environment of general uncertainty. This approach also helps stakeholders come to a common understanding of the risk environment and a collaborative definition of the boundaries between the different risk layers – the thresholds defining instances when governments will intervene should be clearly defined and communicated, and farmers can use this knowledge to better prepare their own risk responses. Furthermore, because the risk landscape shifts over time (and new information periodically becomes available), this process should be ongoing. With periodic re-assessments, actors will be able to analyse the effectiveness of past actions, make adjustments and head off actions that seem to lock in particular response paths, analyse new information on developing risks, share findings on new approaches to confront risks, and reallocate resources as needed.

Content dimensions

Investments in on-farm resilience capacity: More focus on developing entrepreneurship and human capital, and increasing uptake of resilience-enhancing practices or technologies

The optimal risk response in the original framework is based on the probability distribution of income losses, with small but frequent risks dealt with at the farm level, rare and catastrophic events managed through public policies, and risks falling between these two layers covered by market tools. While this segmentation is still relevant for resilience objectives, it should not be interpreted too rigidly – different stakeholders can play a role in managing a given risk. In particular, farmers can take proactive actions to either avoid or mitigate both catastrophic and marketable risks. At the most basic level, there are certain strategies that have been shown to enhance resilience to all risks, such as income or crop diversification, improved contingency planning and increased savings or financial safety nets. Beyond these, however, there should be a greater emphasis on farmer entrepreneurship and human capital development. Farmers need to be able to access information, interpret it, and use it to make farm management decisions under risk and uncertainty. Similarly, farmers need technical, financial and management skills – to identify and integrate resilience-enhancing innovations into their operations, manage risk, and build their capacities to respond to and adapt to adverse events. Soft skills are also important – flexibility and entrepreneurial skills to try out new approaches and take advantage of opportunities to adapt and transform their operations in response to risk.

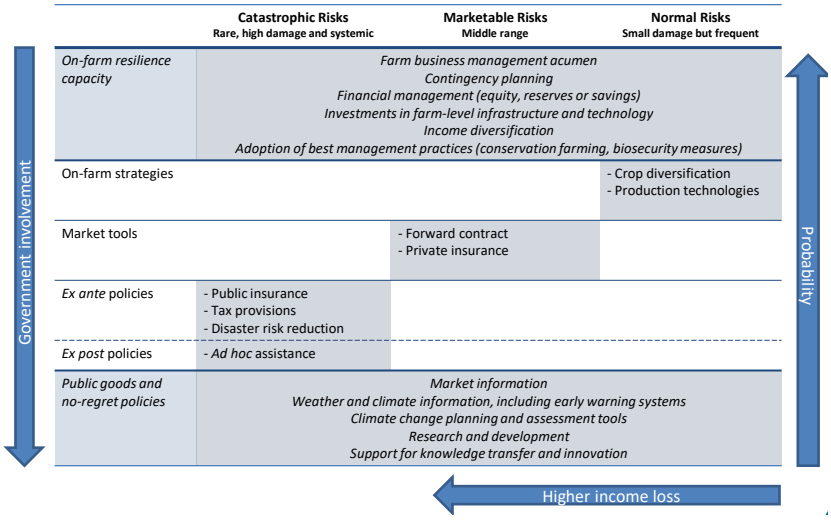
No-regret policies: **More focus on policies and investments in key sectoral capacities that build agricultural sector resilience to risk – and contribute to agricultural productivity and sustainability – under a wide range of future scenarios, including even in the absence of a shock**

In order for farmers to build their resilience to risk, they need an enabling environment where they can access information and acquire the necessary capabilities and skills. Public investments in general services for the sector should build resilience and farmers' capacities to absorb, adapt and transform in response to risk – and contribute to productivity and sustainability – under a wide range of future scenarios, including through research about risks and innovations in new technologies or risk management strategies, or extension and capacity building efforts. Governments can also help farmers make informed decisions about how to manage risk. For example, government-run early warning systems can help producers to make decisions based on the latest-available information, and ongoing research can give insights into optimal farm decisions for the medium- and long-term. Periodically updated risk assessments are particularly vital in this sphere, as the circumstances surrounding farming are not static, and new contingency plans, investment strategies, and research programmes will be needed as the risks inherent in a changing climate become better understood. Government-run web portals could play a role in facilitating farmer-to-farmer exchanges and acting as collection points for best practices, enabling both bottom-up and top-down knowledge dissemination. All of these policies must be underscored by an overall enabling environment – farmers need to be able to count on the provision of basic services and functioning markets as a foundation for their holistic risk management strategy.

Taken altogether, the "Risk Management for Resilience" framework encompasses the original risk management framework, but with these additional dimensions that: encourage stakeholders to take a long-term focus, recognise the trade-offs inherent in certain policy choices, emphasise a participative policymaking process, encourage farmers to build their resilience capacities, and highlight the role for "no-regret" policies.

Adding the content dimensions (on-farm resilience capacity and no-regret policies) to the three-layer framework gives a visual representation of how these ideas should be considered as all contributing to the risk management system (Figure 3.3). While the good governance actions are retained along the diagonal, the cross-cutting farm level and public good actions represented in the top and bottom rows indicate that these activities are relevant to effectively manage risk at all levels. By considering the role of these actions in conjunction with current risk management strategies under a process that considers time frame, trade-offs, and participatory approaches, a more resilient sector can be achieved.

Figure 3.3. Risk management for resilience



Source: Authors' elaboration, based on (OECD, 2011[1]).

3.4. Moving toward a resilience approach

Although the framework offered here represents an extension of existing approaches to risk management, implementing this approach may require substantial revisions in relevant policy frameworks. As countries move to make these adjustments, findings from previous OECD work on water policy reform and climate change mitigation and adaptation may provide useful insights.

First, policy makers and sector actors should introduce such reform initiatives when the confluence of exogenous conditions creates a unique window of opportunity, as timing has been found to be a critical factor in the success of previous reform efforts. These factors include the recent experience of a crisis or emergency (such as a flood or severe drought), a stable economy, a political environment conducive to the reform, and advances of past reform efforts (Gruère, Ashley and Cadilhon, 2018[10]).

Aside from taking advantage of a window of opportunity, previous reform efforts also highlighted the importance of three key elements underpinning success: (i) developing a knowledge base in anticipation of a window of opportunity for the reform, (ii) the need to set evidence-based goals while ensuring that any new policy can be adjusted as needed; and (iii) the importance of working with stakeholders and government officers to facilitate policy changes (Gruère and Le Boëdec, 2019[11]). In addition, effective reform processes were characterised by five essential conditions:

- Support evidence-based problem definition, reform objective setting and impact evaluations; diagnose the current situation and the direction of change. In this case, the target objectives could include an evidence based risk assessment and a more cost-effective approach to disaster risk management with greater emphasis on prevention, or identifying actions needed to implement potential adaptations or transformations likely necessitated under future climate change scenarios.
- Ensure that governance and institutions are aligned with the policy change; adapt the governance system and the institutions to ensure that they will be able to manage the policy change. This may encompass reviewing how long-term risks are considered in current risk management policy frameworks, how unknown risks are continuously updated in the risk assessment and considering how existing institutions may need to be better aligned to incorporate the management of trade-offs in the resilience approach.

- Engage stakeholders strategically and build trust between local policy authorities and farmers, and to foster dialogue at key stages of the reform process. Governments could engage early with farmers to discuss the necessary evolution of polices in response to more diverse and increasing risks, and arrive at a common understanding of the sets of risks and the risk management responsibilities and thresholds for intervention.
- Rebalance economic incentives to enable policy change. This would include possible compensation mechanisms to cope with short-term economic losses resulting from policy changes, while balancing efficiency and distributional concerns. Due to parabolic discounting in particular, farmers may need some encouragement to adopt a longer-term perspective. In addition, greater emphasis on *ex ante* risk management approaches may require further consideration of distribution challenges.
- Define an adjustable smart reform sequencing. This could combine, for instance, a long-term performance objective, flexible implementation options for the reform at local levels, and credible sanctions. In this case, a transition period could be offered with flexibility for farmers, allow a progressive shift towards the revised set of instruments.

Early on in the policy reform process, it may also be necessary for policy makers to devote some additional efforts to identifying and removing or accounting for existing barriers to adopting resilience-enhancing management practices at the farm-level. These barriers could relate to a lack of access to information or low levels of awareness, actual or perceived effects of new practices on performance, cost of adoption, local practices or production context (such as land tenure arrangements where the primary operator does not own the land in question and as such has little incentive to make investments to improve the operation's long-term resilience), or to existing policies or regulations that may be working at cross purposes (Wreford, Ignaciuk and Gruère, 2017[12]). Producer age, income, and education level may also constrain willingness or capacity to make resilience-enhancing investments or adjust farm management practices.

Finally, in combination with refocusing the dialogue and reforming the policy environment, a crucial component of improving resilience is the adjustment of planning and management practices at the farm level. Consequently, adjustments in policy frameworks will likely need to include efforts to shift farm-level decision-making toward a resilience approach. Behavioural economics offers several insights that can aid policy makers and sector actors in facilitating this transition at the farm level (Box 3.1).

Box 3.1. The role of behavioural economics in changing farm management paradigms

Farmers' decisions are driven by a range of factors including income, attitudes, risk aversion, available information, stress and problem-solving ability. As such, while financial incentives (in the form of tax concessions or subsidised loans, for example) may contribute to behavioural change, they are unlikely to be sufficient in meeting policy goals unless they are accompanied by a change in attitude and motivation. Previous OECD work has found that policy could more successfully contribute to changing farmer behaviour if four key factors were considered:

- *A holistic approach is needed:* A wide range of factors must be taken into consideration to understand what motivates behavioural change amongst different groups of farmers. While financial incentives are important (as farmers will not adopt new practices or approaches if they are not profitable), profitability alone will probably not be sufficient to motivate change. Instead, a combination of market-based instruments and other measures designed to influence farmer behaviour (including community engagement, education campaigns, or emotional appeals) will likely be needed.
- *Behavioural change should be understood at the local level:* Attitudes, motivating factors, and decisions are heavily influenced by local conditions and farm-specific characteristics. The

heterogeneity of farms should be reflected in the policy package available, such that producers can access a variety of tools to achieve target objectives based on their individual circumstances.

- *"Nudging" could be a useful approach to guide policy:* Policy instruments are typically designed on the assumption that farmers make rational decisions to maximise expected returns. However, this assumption may not hold in the real world. Parabolic discounting (wherein actors heavily discount the present value of future gains) may be particularly widespread. That is, because potential benefits will not be realised for some years while costs are incurred in the present, farmers are reluctant to change behaviour. In response, policy makers must consider means to correct both market failures and behavioural biases. These objectives can be partially achieved through the use of signals to farmers as to the optimal policy choice without imposing a mandate – a "nudge". Nudges can take a variety of forms, including default settings (opt-out versus opt-in) or labelling initiatives that convey messages to consumers (for example, through "climate smart" or "soil stewardship" certifications).
- *Forming networks of farmers or working collectively can play an important role:* For collective action problems like adapting to climate change and more variable weather patterns, collective solutions can play a role. For example, network building initiatives can help groups of farmers to collectively plan for likely future conditions, or to create contingency plans for hypothetical events. Collective actions can be aided by benchmarking exercises (whereby producers receive information on their own actions relative to that of their peers) to provide group context and incentivise co-operation. All of these actions can be aided by advisory and extension systems that help to shape perceptions and attitudes around the need for the advocated adjustments in farm management decisions.

Source: OECD (2012[13]).

3.5. Conclusions

This chapter has revisited the OECD holistic framework for risk management in agriculture and offered a proposal for how it can be refined to better mainstream resilience objectives into existing risk management policy frameworks. This "resilience lens" includes a prescribed approach for analysing, considering and managing risk (process dimensions), and also highlights the importance of complementary strategies and measures on-farm and in the public sector (content dimensions) in reducing the impact of adverse events across all layers. Specifically, this resilience approach to agricultural risk management requires public and private actors to consider the risk landscape over the long term, and to place a greater emphasis on what can be done *ex ante* to reduce risk exposure and increase preparedness. It highlights the trade-offs inherent in agricultural risk management, including between the interests of different stakeholders and between different measures to manage risk, such as investing in risk prevention and mitigation *ex ante* and providing *ex post* disaster assistance. It recommends that governments adopt participatory approaches to define disaster risk frameworks and ensure that all stakeholders are aware of risks and understand their responsibilities for managing risk. It also identifies a role for no-regret (or win-win) policies and appropriate investments in public goods that build the capacities of farmers to manage current risks, as well as to adapt and transform in response to uncertainty and a changing risk environment in the future. Finally, it argues that farmers need to invest in their own capacities to manage risk – for example, entrepreneurship and human capital, and on-farm strategies such as diversifying production and income sources, and savings – to increase their resilience to all types of risks, including catastrophic events. Considerations for adjusting existing policy frameworks and securing buy-in from producers were then provided.

Practical examples of how these ideas are already being mainstreamed into existing risk management policy frameworks follow in Part II.

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Part II
Case studies

4 Case study synthesis

1.1. This chapter synthesises the findings from the four country case studies according to the five dimensions in the revised framework on Risk Management for Resilience. It identifies how the four case study countries are incorporating resilience thinking into their agricultural risk management policies, as well as common challenges they face in doing so.

4.1. Introduction

The shifting risk environment and rising uncertainty faced by farmers and other actors in the agricultural sector has put renewed emphasis on the importance of risk management in agricultural policy frameworks: known risks are changing in hard-to-predict ways, long-held mechanisms of responding to known risks are becoming either more costly – including for governments – or less effective, and new unknown risks are threatening producers and value chains every day. At the same time, there is rising awareness that the challenges of the future – particularly due to the uncertain effects of climate change and the associated shift in the frequency and intensity of weather-related extreme events, combined with renewed awareness of the potential knock-on effects of crises external to the sector, such as COVID-19 – are such that policy measures to reduce the effects of adverse events on farmers' incomes alone will not be sufficient. Indeed, the policy principles agreed upon by OECD Ministers in 2016 emphasise the need to foster greater resilience of farmers to risk, to enable them to cope with more frequent, unpredictable events (OECD, 2016[1]).

As outlined in Part I of this report, resilience principles can be mainstreamed into agricultural risk management policy frameworks by adjusting risk management processes (i.e. the way in which risks are considered and policies are developed) and considering a wider toolbox of measures and policies to achieve risk management objectives (emphasis on the contribution of farmer capacity and no-regret policies to effective risk management frameworks). This can be accomplished through the application of five dimensions to the OECD holistic framework for risk management in agriculture (OECD, 2009[2]):

- Process dimensions
  - Time frame
  - Trade-offs
  - Participatory collaborative process
- Content dimensions
  - Investments in on-farm resilience capacity
  - No-regret policies

Each of these five dimensions is composed of key considerations, related to capacities, tools, incentives, processes and systems.

In order to explore these ideas in greater depth, four case studies from OECD countries – Australia, Canada, Italy, and the Netherlands – were prepared to analyse the extent to which countries' policy environments strengthen the resilience of the agricultural sector to multiple risks. These case studies were developed using country responses to a questionnaire (the revised version of which is included in Annex A), along with relevant literature and findings from previous OECD work.

Each of the four case studies focuses on a specific risk, in order to provide more concrete examples. The Australian case study focuses on how the policy environment strengthens resilience to droughts. The Canadian case study looks at how the country's policy framework addresses natural disaster preparation and response. In both Italy and the Netherlands, animal and plant disease management frameworks – and their relationship to the national context of each country's agricultural sectors – are explored.

Policy frameworks, priorities, and sector conditions vary considerably across the four case study countries. Nevertheless, common themes emerge from each of the cases that may prove instructive for other countries as they make efforts to improve the resilience of their agricultural sectors. This chapter synthesises the overall findings of the case studies according to the five dimensions described in the revised framework on Risk Management for Resilience: time frame, trade-offs, participatory collective process, investment in on-farm resilience capacity and no regret policies.

4.2. Time frame: Countries have made significant progress towards *ex ante* policies and prevention

In all four case study countries, agricultural risk management policies are placing a greater emphasis on *ex ante* approaches – that is, each country recognises the value of establishing risk management policies and frameworks well in advance of adverse events to reduce the reliance on *ad hoc* assistance. Furthermore, countries increasingly recognise the need to anticipate risky events that may seem remotely possible now in order to develop an appropriate *ex ante* strategy. These adjustments are motivated, in part, by the reality that existing assistance mechanisms can discourage producers from adopting strategies to manage risk over the long term, and in many cases may actually reduce farmers' capacity to cope with, or respond to, future adverse events. These changes in the policy approach are also likely motivated by rising uncertainty due to more direct exposure to commodity price volatility and climate change, with potentially large implications for national budgets. While the shift has reduced the role of *ad hoc ex post* assistance, such assistance has not been wholly eliminated in any case study country.

Case study countries are all making efforts to reduce their dependence on *ad hoc* assistance as a means to respond to catastrophic risks that are beyond the farmers' and markets capacity to cope. Progress has been observed in all of the studied countries. In Australia, most *ex post* assistance programmes are limited to households shown to be in financial hardship. In Italy, assistance available through the National Solidarity Fund (FSN) is limited to damage from events not outlined in the National Risk Management Plan. In Canada, assistance provided under the AgriRecovery Framework is limited to exceptional recovery costs beyond what is covered through other Business Risk Management (BRM) programmes. Finally, in the Netherlands, the government shares the cost of animal disease prevention and response up to a certain well-defined ceiling, but it is responsible for costs above the ceiling.

At the same time, the case studies suggest that the challenge to making this shift to *ex ante* approaches and a longer-term focus lies in defining stakeholders' responsibilities for risk management. Depending upon where the "catastrophic" risk layer threshold falls, government assistance can still be large, even if delivered through *ex ante* means. Further refinement of tools may be needed by governments to ensure that their risk management toolkits provide risk coping solutions only in the case of systemic, rare and devastating catastrophic events. Nonetheless, the cases examined here demonstrated some approaches that governments can take to strike a balance in this area, including through participatory approaches (discussed below) and cost-sharing frameworks, as in the case of the Dutch Animal Health Fund.

A related finding from the case studies is that the shift to *ex ante* approaches often requires stakeholders to reconsider how disasters themselves are defined and managed. In Canada, for instance, the government has clarified which events qualify as disasters, and also developed a predictable framework for dealing with these types of events. In Australia, drought risk was determined to be a part of normal business risk rather than a natural disaster.

In their efforts to reduce *ad hoc ex post* assistance, some countries are moving toward a mostly crop insurance coverage model. As noted in OECD (2011[3]), the principal rationale for providing subsidies to agricultural insurance is due to the role of these policies as *ex ante* measures to make disaster assistance more efficient. Insurance has several advantages over *ex post* disaster relief, including that farmers typically participate financially,[1] damages are evaluated by experts, and indemnities are paid out relatively rapidly.[2] However, the challenge is to ensure that insurance subsidies do not crowd out farmers' risk management strategies and use of market tools, and are effective in limiting *ex post ad hoc* assistance. In practice – and as seen in the case studies – insurance does not fully replace *ad hoc* assistance, nor does it clearly differentiate catastrophic from marketable risks. Even in cases where insurance mostly replaces *ad hoc* assistance, the case studies suggest that insurance subsidies can incentivise farmers to take riskier production decisions, which can negatively effect on-farm resilience in the long-term, contrary to the policy's aim.

Finally, all four countries recognise the need to consider risks over the long-term. Countries are carrying out horizon-scanning exercises and assessing the appropriateness of their policy frameworks to help farmers prepare for and cope with increasing risk and uncertainty. However, the extent to which these analyses influence policy frameworks remains unclear. At the same time, all of the case studies provide examples of how existing programmes are being adjusted (including revisions to policies in Canada subsequent to the recommendations of programme audits, or changes to the design of the annual National Risk Management Plan in Italy following consultations with a technical committee of sector stakeholders) to improve effectiveness following evaluations. Accordingly, countries could consider combining horizon-scanning exercises with programme evaluations as a way to integrate long-term planning into policy frameworks.

4.3. Trade-offs: Analysis of trade-offs can lead to more effective allocation of resources across risk management measures, and ensure that the effects of measures on incentives to build resilience are taken into account

It is important for policy makers to consider the trade-offs inherent in different measures or approaches in order to develop risk management frameworks that will make the agricultural sector more resilient – that is, there will be costs and benefits, along with winners and losers, regardless of the policies and frameworks put into place. The trade-off that may be most relevant for policy makers is the question of where government resources should be allocated in order to most effectively strengthen the long-term resilience of the sector. In particular, governments are becoming more aware that providing assistance to help producers cope with production and market risks *now* may not be sufficient to strengthen resilience to *future* risks. Instead, more investments in risk prevention may be warranted, along with more focus on ensuring that the sector can adapt and transform, rather than just cope with existing and future risks.

This trade-off between risk prevention and risk coping exists across all potential threats and hazards, but is particularly prominent in the realm of animal and plant diseases. Proactive efforts to establish good biosecurity practices and incentives for optimal disease risk management can slow the spread of disease and reduce the need for *ex post* response measures. The Dutch effort to link prevention and response with their Animal Health Fund has helped to discipline the cost of responding to outbreaks, both by ensuring that there is adequate funding for prevention activities, but also by mandating biosecurity practices that have been shown to reduce the impacts of disease events.

The value of linking prevention and response is also increasingly recognised when dealing with natural hazards as well. For example, feedback from Canada's AgriRecovery framework identifies areas where proactive investments are needed in order to avert similar losses in future. Moreover, the linking of these two activities will become more important as governments move to implement climate change initiatives. Specifically, governments will need to critically analyse the costs and benefits of a policy response that balances managing financial losses from adverse events in combination with supporting activities that help the sector to better adapt to changing conditions.

In addition, existing risk coping tools may need to be further refined to improve their effectiveness and better take into account the incentives faced by farmers from the wider agricultural policy environment. As it currently stands, incentive structures to invest in building resilience on-farm may be skewed by other policies that address risks outside of the catastrophic layer or support income. This spread of policies across other risk layers is partly because there is still some ambiguity, in some countries, around where to define the catastrophic risk layer. In addition, programmes historically operating in the marketable or normal risk layer may be politically challenging to remove.

At the farm level, these trade-offs often manifest in issues of profitability versus long-term sustainability. For example, there is some evidence that in providing a safety net against adverse events in the present,

Canada's crop insurance programme may reduce the incentive to invest in longer-term sustainability and lead to negative environmental outcomes. Similarly, EU direct payments provide an income stream that largely covers producer variable costs in Italy, reducing the incentive for producers to adjust their operations according to market signals and individual risk exposure. Moreover, they may incentivise farmers to make more risky production decisions, to the detriment of improved long-term resilience.

Countries generally seem to struggle with balancing the trade-offs between absorption, adaptation and transformation. While countries recognise the need to invest in activities or examine policy frameworks that support adaptation and transformation, at present, such measures are not integrated into overall risk management frameworks. Many of these efforts focus instead on sustainability, productivity or competitiveness goals. However, linking them with risk management in the long-term may help farmers to better consider how their actions in the present are related to their long-term ability to manage risks.

At the same time, countries should consider that not all activities can or should be supported. In particular, stakeholders should be aware that transformation and structural change may in some cases be necessary to the long-term competitiveness and sustainability of the sector – particularly in areas with serious environmental constraints. In this vein, government actors should acknowledge that support (whether in the form of prevention and mitigation activities, or delivered through *ex post* assistance) can affect resource allocation decisions and distort the market incentives driving long-term change. In the worst case scenario, support can act as a barrier to change and prevent new opportunities from advancing. Oftentimes, the trade-off between providing support or allowing transformative change to take place entails reaching politically difficult decisions. In some cases, these decisions can have far-reaching consequences for the viability of certain industries and the rural communities that depend on them. Nonetheless, policy makers should at the very least be aware of this trade-off, and consider "no support" scenarios in their cost and benefit analyses.

4.4. A participatory and collaborative process: More focus on co-ordination and the use of collaborative approaches to define strategies and responsibilities

Recent OECD work has established that two elements that are crucial to facilitate agricultural policy reforms are a lengthy preparation time in advance of reforms (including first iterations of frameworks, consultations and discussions), and building a coalition of the willing to support the proposed reforms (Gruère, Ashley and Cadilhon, 2018[4]). In the realm of agricultural risk management, this preparation and coalition building should take place across all stages, including analysis of the risk environment and evaluating the effectiveness of available tools and measures managing both known and unknown risks. These activities should be carried out in conjunction with farmers and other stakeholders, both to increase awareness of the risk environment, and to solicit feedback on the feasibility of proposed measures.

To some degree, all case study countries involve farmers, producer interest groups, and other agricultural sector stakeholders in their policy development processes, which contributes to a better understanding of the respective risk management responsibilities of each stakeholder. This process also contributes to improved overall communication on evolving risks, creates a sense of common ownership and improved acceptance of policy tools, and is key to ensuring acceptance of the boundaries between the risk layers and consequently reducing the political pressure to provide *ad hoc* assistance. These processes can be very successful, leading to jointly established risk management tools like cost-shared public-private-partnerships (as in the Netherlands), or to realise significant changes in how risk is managed through consistent long-term communication about policy direction (as in Australia). At the same time, these processes can be more challenging in instances where sector stakeholders are very diverse, as illustrated by the Italian case study.

One important factor for gaining stakeholder support is ensuring that reforms and general policy designs are underpinned by research and evidence-based analysis (Tompson, 2009[5]). In this vein, advances in

technology, computing power, and data availability are providing new tools that both governments and producers can use to analyse the risk environment and consider the likely future impacts of adverse events (OECD, 2019[6]). In the Netherlands, for example, stochastic models are used to simulate the impacts of both animal and plant disease outbreaks. These types of exercises can help governments test the cost-effectiveness of certain policies and interventions well in advance of their implementation, and as such contribute to cost-benefit analysis to inform resource allocation.

At the same time, improved management of certain risks could require additional outreach and engagement with stakeholders not typically included in these processes. In particular, better prevention and control of animal and plant disease could be achieved by ensuring that non-commercial farmers or other actors are aware of good biosecurity practices and are incentivised to implement them. Previous OECD work analysing farmer behaviour related to climate change identified several potential approaches that could be utilised in this instance as well, including information and awareness-raising campaigns undertaken by advisory and extension systems; schemes or initiatives targeting groups of farmers instead of individuals in order to take advantage of social capital to bring about collective action; and making available information on how a farmer's individual actions compare with their peers through benchmarking (OECD, 2012[7]). Even with respect to interactions regarding the risk environment more generally, there could be greater scope to involve producers and other stakeholders in the supply chain in a more systematic way to better identify potential risks and appropriate responses.

Finally, all case study countries have demonstrated a willingness to evaluate the effectiveness of their policy toolboxes and frameworks, and to adjust them where necessary. At present, however, there is little evidence as to the effectiveness of many of these programmes and how they affect risk management incentives, profitability, and sustainability over an extended timeframe. Countries should make efforts to establish strong monitoring and evaluation programmes alongside the implementation of new policy tools. This process will continue to be important to ensure effective frameworks in an environment of increased uncertainty.

4.5. On-farm resilience capacity: Policy reforms and structural adjustment in the sector have led to increased farm management capacity, which can be supported by complementary policies

In order to strengthen on-farm resilience to multiple risks, farmers need to have the capacity to absorb the impact of adverse events, adapt to an evolving risk landscape, and transform their operations if the current system is no longer viable. Evidence from the case study countries suggests that farmers are making investments in these capacities, though the exact manner in which they are doing so varies by country and by context. For example, one of the core components of the capacity to absorb the impact of adverse events is having sufficient financial reserves to cope with shocks. Different strategies or tools can contribute to this capacity (including income diversification, savings, or ability to liquidate assets), and a variety of strategies were identified in the four case study countries. In Australia, for instance, producers can take advantage of tax-deductible Farm Management Deposits (FMD) scheme savings accounts that can be used to help cope with short-term contractions in income. A similar savings vehicle is available in Canada. In Australia and the Netherlands, income tax smoothing provisions are available for farmers. In Italy, farmers are moving to diversify on-farm income-generating activities, with significant growth in agritourism operations in particular.

Farmers are also investing in improving their knowledge and entrepreneurship skills, primarily through education, training, and by harnessing new technologies or production practices that could help them improve their resilience and long-term sustainability. Farmers in all of the countries examined are on average more educated than previous generations, and are accessing both privately-provided farm management advice, as well as publicly-offered training courses. In Italy, for example, 169 000 farmers

participated in training courses and 32 000 farmers received advisory services funded through the 2007-13 CAP.

The case study countries also provided examples of producers demonstrating their capacities for adaptation and transformation – some of which could prove useful to policy makers as templates to inform future initiatives. For example, farmers in Italy sought out collaborations with researchers to find *Xylella*-resistant olive cultivars. In contrast, in Australia farmers are transforming their operations in response to changing climate conditions, as seen by the shifting of the cultivation of certain crops out of lower-rainfall areas.

The policy environment can continue to support improvements in human capital by investing – where appropriate – in training and education, research that generates innovations that support more sustainable farming systems, and extension and advisory services that deliver innovations into the hands of producers. There are numerous examples of this in the countries examined, including Rural Development initiatives in Italy and the Netherlands, or Canada's Living Laboratories Initiative (which employs a collaborative experimentation model to co-develop, test and refine new practices and technologies on-farm). Increasing the availability of training that targets improved risk management could be beneficial, as this type of programme may encourage producers to draft contingency plans for different scenarios.

While there are examples of farmers investing in skills and improving their capacity to absorb the financial impacts of adverse events, governments could do more to facilitate these types of behaviours by ensuring that current policies do not disincentivise these activities. For example, *ex post* financial assistance should concentrate on the catastrophic risk layer, and policy makers should take care to ensure that programmes do not crowd out private sector initiatives.

4.6. No-regret policies: More focus on policies that will enable farmers to respond to uncertainty and a changing risk environment

Appropriate investments in general services for the sector and other no-regret policies, including investments in the provision of information, education, infrastructure, and research and development, can help support farmers' capacity to manage risks across all layers. There is scope to ensure that these investments take into account the long-term needs of the sector. Research priorities need to consider likely future conditions (as well as potential constraints that farmers may face under different scenarios); infrastructure investments should be executed only after considering long-term structural trends in the sector and ensuring that investments are climate-resilient, according to appropriate technical standards; and governments should provide an enabling environment that allows farmers to make investments and business decisions for the long-term. These investments and adoptions of innovation will move in the direction of resilience if other policies do not remove the incentives of farmers and the private sector to build on-farm resilience.

This work identified various instances of how the government's role in the provision of information – including the monitoring of crop progress, pest presence, disease incidence, and weather conditions – can contribute to improved resilience by notifying producers of current conditions and allowing them to take preventative measures when necessary. These initiatives are increasingly facilitated by digital technologies. These technologies have a role to play in refining risk management programmes, and can be used to facilitate monitoring and control activities as well (Langemeyer, 2018[8]).

Research and development activities have a potentially large role to play in ensuring the long-term resilience of the agricultural sector. Indeed, previous OECD work has explicitly discussed the link between innovation and productivity (OECD, 2019[9]). In order to ensure future productivity and long-term resilience, countries should foster an innovation system that responds to sector needs, and helps to orient agricultural policies towards long-term threats and priorities.

Innovation extends to new approaches to planning policies, interacting with private stakeholders, and finding new ways to harness data and information and communication technologies that lead to new and better-adapted risk management tools. For example, a substantial proportion of Australia's government expenditures on agriculture are spent on research and development. In Canada, research covers tools and strategies that will improve the long-term viability of the sector, with several provincial governments developing initiatives that embody the *ex ante* preparedness approach to catastrophic risks.

All of the countries profiled in these case studies carry out these types of activities. For example, Italy mobilises 13% of its national rural development programme (RDP) budget on R&D measures, while Canadian stakeholders increasingly recognise the value of preparedness and *ex ante* approaches, with strategies like improved farm-level management and investments in knowledge systems prioritised over *ex post* assistance. At the same time, the intensity of investment in public research and development is low, representing less than 2% of agricultural value added in all four countries in this study, with research intensity declining between 1996 and 2016 for each country, with the exception of Italy (OECD, 2017[10]).

An additional constraining factor is that research efforts within countries remain fragmented by policy systems that devolve research responsibilities to the regional or local level. Although there are benefits to tailoring research findings to local conditions, issues of catastrophic risk are relevant at a national level, with catastrophic events in one area potentially impacting economic activity outside of the region – particularly in cases of animal and plant disease, where trade restrictions are often applied at the country level. In addition, there is also a continued role for private research, and greater co-ordination and the planning of national research strategies would help to ensure that public initiatives do not crowd out private ones.

While countries have made substantial strides in these areas, some projects or initiatives would benefit from being better linked with risk management outcomes. That is, while these initiatives on their own have merit, country risk management frameworks would benefit from monitoring and evaluation programmes of no-regret policies to show benefits of risk prevention and mitigation. Such evaluations could also be used to support the adoption of more coherent research agendas, which would reduce the research fragmentation problem identified above.

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Notes

[1] Although this is not the case when subsidies cover much of the policy premium.

[2] Note that this is not typically the case with whole farm income policies, which are typically paid out with a substantial delay, and can even have a pro-cyclical rather than counter-cyclical effect.

5 Resilience to drought in Australia

This chapter examines resilience to drought in Australia. Relevant agricultural policy frameworks are first presented, including an outline of drought risk governance according to the three-layer framework. This is followed by a discussion of how the country's agricultural sector stakeholders consider the five resilience dimensions in their approach to managing drought risk.

5.1. Introduction

Australia has a diverse and export-oriented agricultural sector. The country is a major world supplier of a variety of products, including beef, cotton, sheep meat, sugar, wheat, wine and wool. At the same time, the farming system in any given area is highly dependent upon the natural resource base. Given the arid conditions that prevail over much of the country, the majority of farms are broadacre operations (essentially, farms raising non-irrigated crops, cattle and sheep) (OECD, 2015[1]). Additionally, the overall policy environment is based upon a market-oriented approach. Consequently, agricultural producers are expected to be self-reliant in the face of multiple risks.

Scarce and variable rainfall is a feature of the Australian farming environment. Indeed, previous OECD work has shown that due to variable rainfall and other climatic conditions, Australian farmers are more exposed to systemic yield risk than producers in a number of other OECD member countries (Kimura and Antón, 2011[2]). This is largely driven by the near constant threat or presence of drought, which is a recurring feature of Australia's landscape (OECD, 2016[3]).

The agricultural policy approach to drought has shifted over time, just as droughts have become more frequent, and projected effects from climate change indicate that they will become more severe in the future (Hughes, Lawson and Valle, 2017[4]). In fact, drought is such a frequent event that it is considered the responsibility of farmers to manage as a normal business risk. Accordingly, the broader agricultural policy emphasis with respect to drought is largely one of self-reliance, through preparedness and risk management – ensuring that farmers have similar access to welfare services as other Australians, and have the necessary business management skills to respond to these circumstances and adapt or transform their operations to become more resilient to this risk.[1] This approach to drought policy has developed over many years, including through policy experiments involving farm groups, and in collaboration with Australian state and territory governments (Commonwealth of Australia, 2018[5]). This same emphasis on preparedness to better manage drought risk is also applied to other risks facing the sector. While this general approach remains in force, recent severe drought conditions have motivated additional emergency government support measures, and provisions of existing programmes have in some cases been adjusted.

At the same time, the continued development of comprehensive water policies, largely in response to increasingly intense droughts, has played a major role in the management of risks by irrigating farmers, especially in the Murray Darling Basin (OECD, 2016[3]; Gruère, Ashley and Cadilhon, 2018[6]). The Basin is an important agricultural region, accounting for 46% of the country's irrigated agricultural production value in 2014-15 (MDBA, 2017[7]). The development of the market-based water allocation regime in the Basin has enabled farmers to anticipate and adjust to drought risks according to variable supplies, decreasing the overall costs of droughts for farmers (Mallawaarachchi and Foster, 2009[8]; Holley and Sinclair, 2016[9]). This may have lowered the need for complementary approaches to cope with droughts in those areas.

Although evolutions in water policy have implications for how farmers manage resources in response to drought risk, the role of Australian water policies will not be developed in this case study.[2] Instead, this case study will focus on how agricultural policy development can help strengthen the resilience of farmers to risks. These policies are particularly important for broadacre farms that are outside of the Murray Darling Basin.

This case study will first examine Australia's agricultural policy landscape as it pertains to drought, including an elaboration of the relevant policies and strategies in the context of the framework for risk management and resilience. It will then explore how the five dimensions of resilience are manifested in the country's approach to managing risk for resilience to drought before offering some final concluding remarks.

5.2. Current agricultural policy landscape

The Australian agricultural sector is strongly market-oriented, with domestic and international prices largely aligned for most products. The country's approach to agricultural policy reinforces this orientation – direct support to producers is low, the country has no permanent farm subsidy scheme, and investments in research and development constitute a substantial portion of overall support to agriculture. Australia's agricultural risk management framework mirrors this market-oriented approach. Government involvement is largely limited to providing support that encourages risk management and preparedness, welfare and other services to alleviate personal hardship, and *ad hoc* financial assistance in response to catastrophic risks (infrequent events that have severe impacts) such as natural disasters and animal or plant disease outbreaks.

Drought is just one of a number of hardships that can adversely impact farming businesses, but it is considered to be part of farmers' normal operating environment in Australia's agricultural risk policy framework. As a result, farmers are expected to manage this risk. Accordingly, there are now few risk management policies that are explicitly designed to help producers prepare for or cope with this risk alone. Instead, the majority of agriculture policies and measures that help producers to absorb the impacts of drought or adapt to its effects are contained within a policy toolbox that is designed to help producers manage all types of risks. This approach ensures that risk management decisions are made by producers themselves, since they have the greatest knowledge about the individual risks they face. At the same time, some (state-level) measures that could encourage risk-taking behaviour have persisted, and the scale of the most recent drought event motivated some additional *ad hoc* measures as well.

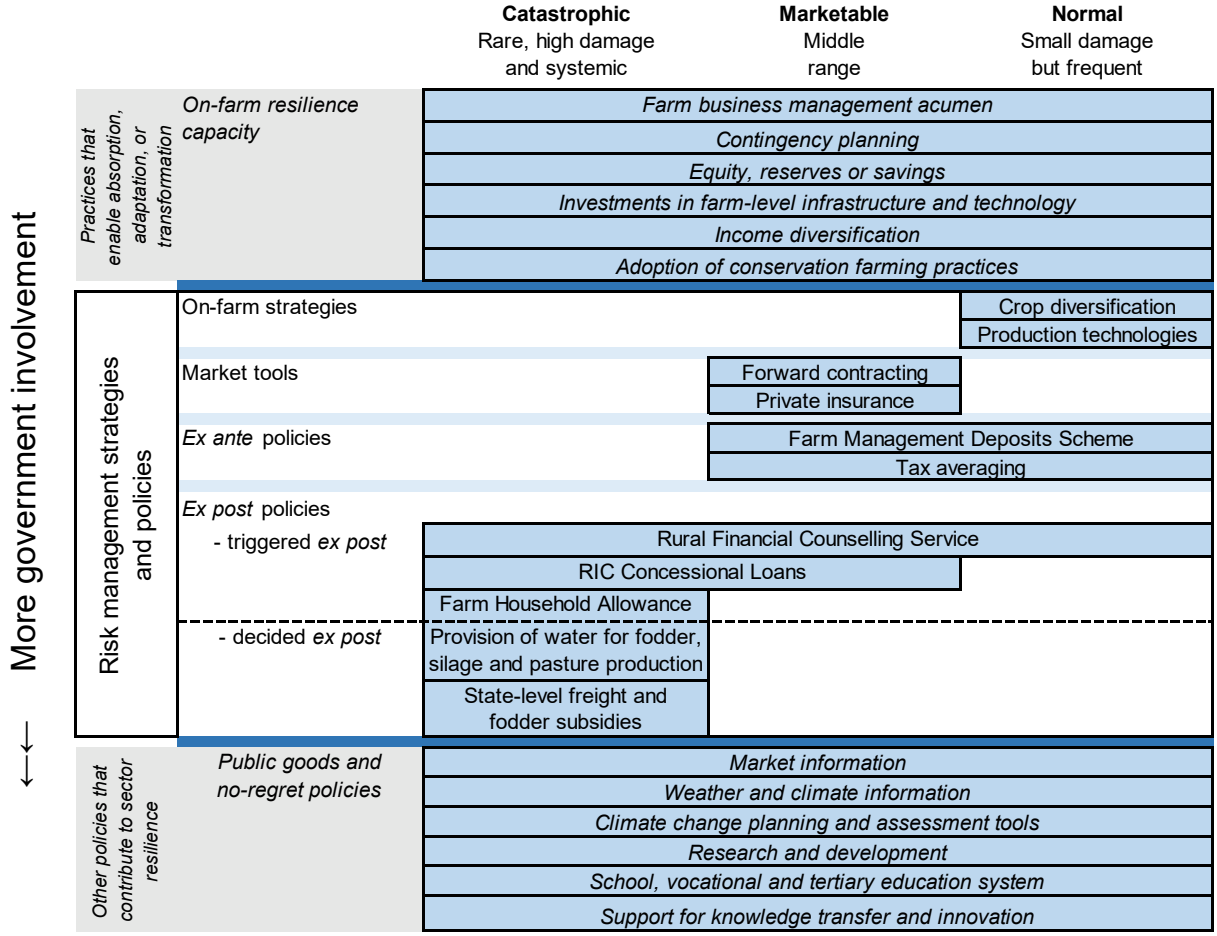
Consideration of drought as a part of normal business risk reflects a substantial realignment of the country's agricultural risk management framework over the past few decades. The most consequential revision was a significant reduction in the use of measures that provide *ad hoc*, *ex post* support to farm businesses, combined with an increasing emphasis on measures that aim to build risk management skills and provide support to farm households. This shift came about through a gradual evolution of the policy framework. Prior to the 1990s, the government considered drought to be a natural disaster. In 1989, drought was removed from the joint Commonwealth-State Natural Disaster Relief and Recovery Arrangements, after an analysis of the framework indicated that drought policy was poorly targeted, distorted farm input prices, and disincentivised farmers from preparing for drought. At that time, policy makers determined that a risk management approach, rather than a crisis management approach, was more appropriate to effectively confront drought. This view was formalised in the 1992 National Drought Policy (NDP), which encouraged producers to adopt self-reliant approaches to manage climate variability. However, the policy framework put into place as a result of the NDP still operated on the premise that some droughts were beyond the scope of producers to handle. Accordingly, the NDP included provisions for *ad hoc*, *ex post* assistance if producers were located in areas experiencing an "exceptional circumstances" (EC) drought event.

Periodic reviews of drought policy in the ensuing years concluded that assistance based on these EC declarations was preventing farmers from achieving the objective of self-reliance and also undermining climate change adaptation. The system of EC declarations finally ended in 2013 with the implementation of the Intergovernmental Agreement on National Drought Program Reform. The policy framework that resulted from the 2013 agreement significantly reduced the use of measures that provided *ad hoc, ex post* support to farm businesses based solely on the occurrence of drought, and placed increasing emphasis on measures that aim to build risk management skills and provide support to farm households (although some *ex post* assistance to farm businesses was still available). The recent signing of the 2018 National Drought Agreement (NDA) continues reforms in this direction, laying out a joint governance approach between the Commonwealth and the states and territories that emphasises preparedness, responsiveness and recovery, with a focus on accountability and transparency. This agreement emphasises better co-ordination across all jurisdictions with the goals of bolstering risk management practices and enhancing long-term preparedness and resilience. While the 2018 NDA remains in force, drought conditions in 2019

motivated some additional actions to assist farmers and communities in drought preparedness and response, including revisions to some existing farm-level assistance programmes, additional support for drought-affected communities, and continued support for investments in longer-term resilience-building initiatives. These actions were detailed in the government's November 2019 Drought Response, Resilience and Preparedness Plan (Department of Agriculture, 2019[10]).

The policy emphasis on preparedness is also evident when visualising the different risk management strategies and policies in the context of the framework for risk management and resilience. The top three levels (on-farm resilience capacity, on-farm risk management strategies, and market tools) indicate the skills, strategies, and instruments employed at the farm level with minimal intervention from the government, while the bottom three levels (*ex ante* policies, *ex post* policies, and public goods and no-regret policies) detail the policies or government activities that either help producers manage farm risk or enable overall sector resilience more generally (Figure 5.1).

Figure 5.1. Strategies and policies employed in Australia for risk management and resilience



Source: Author's own elaboration.

On-farm resilience capacities increase the ability of producers to cope with, respond to, and adapt to all levels of risk. Australian farmers use a number of strategies that enhance their resilience capacity. For example, off-farm income has become increasingly relevant for producers. On average, off-farm sources accounted for around one-third of net cash income for broadacre farms in 2018 (ABARES, 2019[11]), increasing to over 50% for small broadacre farms with a total value of sales of less than AUD 500 000

(representing about 66% of all broadacre farms) (Martin and Topp, 2019[12]). Australian farmers also keep cash reserves in the form of farm liquid assets, which can be used to cope with financial shocks. In 2018, average farm liquid assets were estimated at nearly AUD 250 000, or around 5% of average total farm business equity (ABARES, 2019[11]). In addition to the importance of diversified income and equity reserves, previous OECD work indicated that producers employed specific farm management strategies to cope with drought situations, including storing fodder, reducing farm maintenance, or planting a different type of crop (Kimura and Antón, 2011[2]).

There are some market tools available for producers to manage middle-range risks that may have implications for management of drought risk as well. The development of multi-peril crop insurance policies has long been considered in the context of the Australian market, but recent reviews have found such programmes are likely infeasible without substantial government subsidisation (National Rural Advisory Council, 2012[13]). Nonetheless, some relatively new, privately-operated multi-peril insurance products are currently available to grain farmers in Australia, although take-up is very low. Additionally, weather derivatives are also being developed for certain industries (Laurie et al., 2019[14]). Forward contracting and single-peril insurance policies are well-established for some products, but their uptake is generally quite limited.

The policy measures in place can be classified into three categories: *ex ante* tools to manage business risk; *ex post* programmes that offer temporary support for farmers in financial difficulties; and the provision of public goods or the implementation of no-regret policies that contribute to building agricultural sector resilience.

Australia's *ex ante* agricultural policies mostly focus on providing farmers with the tools necessary to prepare for drought and other adverse events, helping them to either mitigate the effects of shocks, or adapt to changing climatic conditions. One of the most widely-used tools in this area is the Farm Management Deposits (FMD) Scheme (National Rural Advisory Council, 2012[15]). This programme allows farmers to set aside pre-tax income from primary production in a good year, which can then be drawn upon during later years as needed. First implemented in 1999, the programme was intended to help producers manage financial risks in preparing for future challenges due to climate variability or market fluctuations. As of July 2019, there were around 50 000 active FMD accounts holding AUD 5.9 billion in deposits (Department of Agriculture and Water Resources, 2019[16]).

Various tax measures also assist producers in managing fluctuating income (OECD, 2020[17]). Tax averaging[3] is widely used. Data from the Australian Taxation Office in 2011 indicated that 97% of individuals who earned income from primary production had accessed the income averaging system (National Rural Advisory Council, 2012[15]). Other provisions of the tax code – including accelerated depreciation for investments in water facilities, fodder storage infrastructure and fencing – incentivise investments in assets that improve drought resilience by allowing these assets to be written off over shorter time frames.

Ex post agricultural risk management policies are mostly intended to help farm households cope with the impacts of adverse events and improve risk management. For Australia, most programmes in this space are available to all farms experiencing hardship, regardless of the underlying reason. The first of these measures is temporary farm household income support through the Farm Household Allowance (FHA) programme.[4] Under the FHA, qualifying farm households[5] receive assistance every two weeks to help cover basic household needs, for up to four cumulative years. It is paid at the same rate as other welfare payments, so a partnered person could receive a little over AUD 500 each fortnight. Aside from the payments, participating households are also entitled to a financial assessment of their business, as well as assistance to develop new skills or attend training (Department of Agriculture, 2019[18]). In October 2019, legislation was introduced to provide an additional Drought Relief Payment to producers that had exhausted their four years of FHA eligibility (Department of Agriculture, 2019[10]).

The government also funds the Rural Financial Counselling Service (RFCS) (around AUD 17 million annually), which provides free financial counselling services for farmers, fishing enterprises, forestry growers, and small related businesses in – or at imminent risk of – financial hardship.[6] Counsellors assist clients to understand their financial position and the viability of their enterprise, and to develop and implement plans to become financially self-sufficient. This assistance is expected to help businesses become more resilient to risks, or to take steps to exit the industry with dignity if long-term viability is not achievable (Department of Agriculture, 2019[19]).

Finally, the government provides concessional business loans to farmers and agricultural businesses that demonstrate financial hardship, although the programme under which this assistance is delivered has also evolved. In 2018, the Regional Investment Corporation (RIC) was established, with part of its mandate to deliver and manage government-supported concessional loans intended to help farmers and small businesses prepare for, cope with and recover from drought. Loans offered through the RIC include Drought loans, AgBiz Drought loans, and Farm Investment Loans.[7] The Drought and Farm Investment loans are structurally similar (producers can borrow up to AUD 2 million at subsidised interest rates, and applicant farm businesses must be in financial hardship), but drought loan eligibility requires farmers demonstrate that their income has been affected as a result of drought. In addition, from 1 January 2020, the RIC offered amended Drought loans whose terms included two years interest free.[8] In contrast to products targeting farms, the AgBiz Drought loans offered loans of up to AUD 500 000 to small non-farm businesses that directly provide primary production-related goods and services to farm businesses in affected areas, that had experienced a reduction in turnover as a consequence of drought.[9]

Beyond policies and strategies to manage drought risks, the government also makes *ad hoc*, *ex post* interventions. In the context of the most recent drought, an *ad hoc* initiative was undertaken with the goal of improving short-term fodder availability. In 2019, the government secured access to 100 gigalitres of water in the MDB at AUD 100 per megalitre to increase the production of fodder, silage and pasture (Department of Agriculture, 2019[10]). Outside of federal initiatives, some state governments provide *ad hoc, ex post* drought measures to assist farmers with specific activities, including subsidies for freight and fodder.

Outside of specific risk management strategies and policies, the government also funds a variety of public goods and has enacted no-regret policies that help to facilitate on-farm resilience capacity. First, the government invests in a range of general services for the sector that help farmers to prepare for and mitigate risk, or adapt and transform to confront a changing risk landscape, including market information, weather and climate information, climate change planning and assessment tools, and support for research, development and extension. In the public sphere with respect to market information, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) produces quarterly crop updates as well as short- and medium-term commodity outlook reports that help producers make informed short-term production decisions.

With respect to weather and climate information, the Bureau of Meteorology (BoM) provides a variety of reports that are useful to producers. In addition to releasing near-term forecasts, the BoM publishes a monthly drought statement, bi-weekly climate and water resource projections for the ensuing three months, and a bi-annual “State of the Climate” report detailing long-term trends informed by historical data. The BoM also publishes periodic “Special Climate Statement” reports that examine in detail specific significant weather and climate events, including with respect to drought [see, for example, (Bureau of Meteorology, 2019[20])]. The development of additional drought indicators, including improved forecasts and local information on emerging impacts, is also foreseen (Department of Agriculture, 2019[10]). Additional efforts have also been undertaken to improve the availability and quality of actionable climate information for decision-making. To further support the agriculture sector in adapting to climate change and managing emissions, Agriculture Ministers from all Australian jurisdictions agree to a co-ordinated national approach to agriculture and climate change in 2019. The co-ordinated national approach will drive collaboration between jurisdictions focused on four priorities: deliver information and tools for better decisions and

climate risk management, drive research and innovation to support adaptation and mitigation, strengthen market opportunities and business models to build resilience, and prepare for increasing biosecurity risks.

In addition to providing information on climatic conditions, the Australian Government also provides a wider set of planning and assessment tools, learning resources, data and projections to aid producers in making business decisions to prepare for possible future conditions under climate change.[10] These tools include guidance and information on best practices for adapting to changing climate conditions, as well as managing climate change risks. As a specific example, the Australian Government is working to improve the accessibility of practical weather and climate information for farm-level decision-making through the BoM's publication of 58 "Regional Weather and Climate Guides". These guides" are designed to provide accessible, user-friendly information on weather and climate trends in local areas to help farmers understand and manage their climate risk (Bureau of Meteorology, 2019[21]). Producer planning and farm business management capacities are further strengthened through financial literacy programmes in the country's school, vocational and tertiary education system.

Australia also places great emphasis on the importance of research, development and extension (RD&E), with total public and private RD&E investment in primary production, sustainable resource use, agricultural inputs and the processing sector reaching AUD 3.3 billion in 2014-15 (Millist, Chancellor and Jackson, 2017[22]). One component of Australia's RD&E system is the co-investment principle between public research and private industry that funds the network of rural research and development corporations (RDCs). These RDCs invest in research agendas aligned with industry priorities (Productivity Commission, 2011[23]), and several RDCs publish specific advice on drought (Rural R&D Corporations, 2018[24]). In addition to research, the other notable public good that contributes to a farmer's capacity to manage drought risk is extension services. Extension activities are carried out by various organisations and private providers, with state governments and universities also funding RD&E activities.

5.3. Australia's experience in managing agricultural risks for resilience to drought

Australia's current agricultural policy framework treats drought as a part of normal business risk. This represents a shift from historical frameworks, which treated drought as a natural disaster, and then continued to offer *ad hoc* assistance in cases defined as exceptional to historical averages (using drought declarations). But subsequent reviews of those frameworks questioned their effectiveness in helping producers to improve self-reliance and preparedness for drought. This move to redefine drought as a normal business risk also shifted the policy focus to an *ex ante* framework focused on preparation. The shift has helped to largely discipline *ad hoc, ex post* assistance, but some measures that distort producer incentives to manage risks persist, such as freight and fodder subsidies. The following section examines how the policy framework has affected producer incentives and decision-making, with wider implications for the resilience of the sector.

5.3.1. Emphasis on ex ante policies and prevention encourages farm-level action, but potentially distorting ad hoc, ex post assistance remains

The bulk of the agricultural policies that Australia has in place to help producers manage drought emphasise *ex ante* strategies and encourage producers to take a long-term view. Consequently, much of the assistance available today from the government for managing drought risk are *ex ante* measures, such as FMDs, tax measures, research and knowledge generation and adoption. While some *ex post* assistance is available (the FHA, for example), these programmes are largely not specific to a single event, most are targeted to the farm households with the greatest need (by means-testing), and programmes also include provisions that help farmers make adjustments to their business in ways that reduce their likelihood of needing to access the programme in the future.

At the same time, *ad hoc* drought assistance persists, and efforts to disentangle drought-specific support from needs-based assistance have proven difficult. *Ad hoc* measures continue to be offered, largely in the form of freight and fodder support or subsidies at both the national and state level [although one state government has recently announced that they intend to phase out these particular subsidies – see Queensland Cabinet and Ministerial Directory (2019[25])]. Additionally, recent relief packages included drought-specific supplementary payments for FHA recipients, in spite of the programme's general availability. Furthermore, some programmes that were previously found to perversely encourage poor management practices and disincentivise autonomous preventative actions have persisted as well. Drought-contingent financing in particular has remained in the policy framework. Although EC-based interest rate subsidies ended in 2012 after having been determined to be counterproductive in terms of drought preparedness (Gray, Oss-Emer and Sheng, 2014[26]; Productivity Commission, 2009[27]), concessional loans that are contingent upon having experienced drought were subsequently put in place under the 2014/15 drought package (OECD, 2015[1]). While not all new loans available through RIC are predicated upon the applicant having experienced drought, farmers are only eligible for "Drought Loans" if they can demonstrate that their income has been affected as a result of drought (RIC, 2020[28]).

In spite of these recent *ad hoc* assistance measures, previous analyses have indicated that the support measures outlined in the *ex ante* preparedness framework are working, in that a significant share of farmers are adapting to producing in drier circumstances or transforming their operations entirely. At the enterprise level, for example, the government's 2009 Drought Review reported that from 2002-08, about 70% of dairy and broadacre farms in drought declared areas (as defined by EC declarations) did not receive any drought assistance, suggesting that a sizeable majority of producers were able to cope with the hazard using their own management strategies (Productivity Commission, 2009[27]). Further evidence for the effectiveness of the *ex ante* framework can be found in research from ABARES, which indicates that during the 1990s, farm productivity fluctuated significantly between good and bad years, with producers focusing on maximising performance in good years to offset the bad. Since 2005-06, however, farm productivity has fallen less in poor years, indicating that farmers are adapting to drier conditions by adopting technologies or management practices that maintain productivity in drier years (Hughes, Lawson and Valle, 2017[4]). Other evidence suggests that even greater transformational change may be underway, with Australia's cropping farms moving out of lower-rainfall areas and into zones with higher average rainfall (Hughes, 2017[29]). The growth of the wine sector in Tasmania is another notable example.

Although recent policy packages have reverted to providing more drought-specific assistance, they have also recognised the need to support research and investment for longer-term structural change as climates shift. This priority is embodied by the Future Drought Fund (FDF), which establishes a secure revenue stream to finance AUD 100 million-worth of drought resilience projects annually, with projects funded beginning in July 2020. FDF spending is obliged to target projects that enhance the drought resilience of all farms and communities as a public good, and do not solely benefit individual farm entities. Funds can be used for different types of projects, including research and innovation, extension, technology adoption, improved natural resource management, infrastructure, and community initiatives.

Government agencies and industry organisations – including the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), Commonwealth Scientific and Industrial Research Organisation (CSIRO), state and territory governments, farming organisations and industry groups – also undertake long-term foresighting exercises to estimate the likely impacts of the evolving risk landscape. While valuable in evaluating the risk landscape holistically, these exercises may not hold many insights for drought occurrence, given that drought is already acknowledged as a perennial risk.

5.3.2. Ex ante policy focus largely developed from an analysis of the trade-offs between potential future outcomes under different policy approaches

Over time, *ad hoc* assistance has been reduced and agricultural policies reformed to support the long-term competitiveness of the sector. This occurred through a process where stakeholders weighed the potential costs and benefits of different policy options, with the knowledge that the path of continuing to provide *ad hoc* assistance would be costly, impede normal structural change, and perversely undermine the long-term sustainability of the sector. Faced with these potential future outcomes, policy makers chose to largely focus on designing tools and initiatives to support the sector's preparedness to manage risks and mitigate their effects, while continuing to provide farmers with health and wellbeing support, along with limited access to financial support in cases of hardship. This approach to drought risk also has greater ripple effects on other stakeholders both up- and down-stream from farmers in the value chain – namely, it ensures that markets and incentives are not overly distorted by policy. Nevertheless, although the policy toolkit continues to focus on prevention and long-term sustainability, completely eliminating *ad hoc* programmes has proven difficult. Even as the policy paradigm is oriented toward long-term competitiveness, there remains a tension between allowing structural change and transformation due to ecological constraints, and providing assistance to the producers who would likely exit the industry – with negative cascading effects for surrounding rural areas – as a consequence of that transformation.

5.3.3. Iterative participatory processes and policy evaluations are key to responding to evolving conditions

While drought is considered a normal farm business risk, drought response frameworks continue to be periodically assessed (in both dedicated consultative sessions and as a factor in wider policy development processes) to help ensure that policies are accomplishing their objectives without creating unintended effects. Evaluations typically take place during or in the aftermath of a major drought event in order to inform evolutions of policy frameworks, and involve consultation with a wide range of stakeholders. Recent evaluations during the development of the National Drought Agreement 2018 included public consultations, roundtable discussions, and summits with relevant stakeholders (including the general public, industry bodies, state and national farming organisations, and state and territory governments). For example, the National Drought Summit held in October 2018 brought together leaders from all levels of government, along with experts from the agricultural, charity, community, banking and finance sectors, with a view toward helping both farmers and communities cope with the current drought and improve their resilience to future events.

The Future Drought Fund referenced earlier was one initiative unveiled at the 2018 summit, and it too will be developed using participatory approaches. Work is now well advanced on developing a Drought Resilience Funding Plan – a high level framework to guide the approach for supporting future projects and activities. The draft Funding Plan is being informed by public consultation and independent advice from a committee of diverse experts in fields relevant to farming, agricultural economics, natural resource management, research and innovation, climate risk and rural and regional development. Public consultation on the Plan began on 29 October 2019 and closed on 13 December 2019. The Funding Plan will be reviewed every four years to ensure emerging priorities are appropriately captured and the Fund remains future-focused. To help inform these reviews, the Productivity Commission will conduct an assessment of each Funding Plan before it expires, including having regard to the economic, social and environmental outcomes.

One of the key outcomes of these types of collaborative processes is a mutual understanding of thresholds and responsibilities when it comes to managing risks. Since the first iteration of the NDP in 1992, the Australian Government's policy objective has been to encourage primary producers to adopt self-reliant approaches. Although the measures and tools have evolved in the ensuing years, this message has driven

the policy dialogue – farmers are responsible for managing their drought risk, but there are a number of tools that can be used if farms are facing hardship.

Policy reforms should be accompanied by clear messaging to inform stakeholders of the change, but even so, it may take some time to fully communicate new thresholds and responsibilities that result from shifting away from an *ex post* assistance framework to one based on self-reliance (in this case, away from the EC model of the past), since producers form expectations of support from earlier experiences. For example, during the 2019 independent review of the FHA, the panel of experts found that many producers held the viewpoint that the FHA was a drought relief payment, and they expressed frustration that they were not able to access it if they were experiencing drought but did not otherwise qualify (Lawrence, Somerset and Slonim, 2019[30]). Recent drought-specific supplementary payments offered to FHA recipients who have exhausted their four years of eligibility may further entrench this belief.

In addition, governments should be consistent in policy responses deployed at times of crisis in order for farmers to credibly believe that the policy position has changed in practice, and not just in principle. The Australian government has largely succeeded in this space by offering most assistance through means-tested interventions (such as the FHA or concessional loans), but changes to programmes in the midst of a crisis may confuse the message. The reinstatement of drought-contingent financing products during the 2014-15 drought referenced above is one such example.

Many of the individual agricultural support measures that farmers rely on during drought and other hardships have also undergone periodic independent reviews. For example, the FHA was reviewed in 2018, and a performance audit report of the FMD scheme was released in June 2019. These evaluations tend to be qualitative, and do not typically include a quantitative assessment of whether the policies are meeting their objectives in a cost-effective way.

5.3.4. Clear boundaries and market signals provide incentives for preparation and adaptation, and are supported by measures to build farmers' resilience capacities

The Australian approach to drought risk encourages on-farm investments to improve resilience by clearly delineating the boundary on responsibility for responding to normal business risks, including drought – that is, the Australian government has a relatively limited role in responding to drought risk alone (instead providing welfare and business support in the form of concessional loans, and tools and information to improve farm decision-making), so producers must formulate their own management strategies. Further on, competitive markets for inputs and outputs ensure that prices provide the market signals necessary for producers to make their own decisions regarding resource allocations given their own individual risk profile.

At the same time, the policy framework also provides an array of tools that enable producers to take a proactive approach to on-farm risk management, and to improve their operation's long-term sustainability. With respect to improved on-farm risk management, for example, the FHA and RFCS include provisions that help farmers make adjustments to their business in ways that reduce their likelihood of needing to access these programmes again in the future. Outside of programmes designed to support on-farm innovation and adaptation, the suite of tools that helps farmers manage fluctuating farm business cycles makes producers more resilient in the face of all magnitudes of adverse events. These tools include FMDs that allow producers to set aside cash reserves during high income years to draw on in low income years, tax averaging to smooth annual variation in tax liability, and accelerated depreciation for investments in water facilities and other on-farm infrastructure. Exposure to competition in domestic and world markets also plays a fundamental role in encouraging on-farm innovation.

On the sustainability front, initiatives such as the National Landcare Program allocates resources to farmers to improve their environmental performance. Additionally, there are some programmes that encourage farm-level innovations, including support from the RDCs, or initiatives such as the Smart Farms Small Grants programme, which funds the adoption of best practices in natural resource management.

Despite changing farmer demographics and variable skillsets across producers, programmes designed to improve farmer capacity for business management, entrepreneurship, or adaptation are not specifically targeted toward young farmers, who may have less financial capacity to deal with downside risk. At the same time, evidence from a pilot initiative on strategic farm planning with a view toward improved business management indicated that farmers who participated in such initiatives were disproportionately younger, suggesting that there could be some scope for targeting these types of initiatives to younger producers in future (Keogh, Granger and Middleton, 2011[31]).

The Australian Government has designed their overall policy toolkit with the intent of ensuring that programmes would not crowd out other farm-level risk management strategies. There is no evidence that widespread crowding out has occurred, but there also has been no explicit analysis of this possibility. At the same time, some products could have that potential. For example, low-interest government loans could drive down commercial loan interest rates as lenders seek to attract business in competition with government lenders – potentially crowding out private sector credit and limiting the overall availability of credit.

5.3.5. Substantial investments in public goods provide critical information and technologies to support long-term decision-making key to sector resilience

Given that self-reliance is the core underlying theme for drought management in Australia, no regret policies and the provision of public goods form a substantial part of the government's role in ensuring resilience to drought. This is most evident in the generation of research on both the effects of climate change and new strategies to adapt to or manage its effects. In general, the Australian Government prioritises spending on general services support, with a large share of that spending directed toward agricultural knowledge and innovation systems, including various projects dedicated to improving resilience of farmers to medium- and long-term risks (particularly climate change) (OECD, 2019[32]).

The country's current research programme is attuned to the need to strengthen approaches to managing climate risk for the industry and support adaptation and transformation. Research undertaken by CSIRO, ABARES and state governments, as well as projects commissioned by the RDCs, all investigate the impact of climate change on Australian agriculture. For example, CSIRO and the Bureau of Meteorology jointly developed Australia's next generation climate model: the Australian Community Climate and Earth System Simulator (ACCESS), which provides weather forecasts, cyclone tracking, fire weather forecasting, flood warning and climate information (CSIRO, n.d.[33]). CSIRO has also carried out research specifically targeting enhanced drought response capacity, including research into precision agriculture, development of drought tolerant plants, and development of new cropping practices. One highlighted tool is the "Pastures from Space" project, which uses satellite data to estimate pasture biomass, facilitating farm-level decision-making regarding sustainable management of feed resources (CSIRO, 2019[34]). ABARES reports have also contributed to the national dialogue, including by highlighting how climate affects the productivity of broadacre farms (Hughes, Lawson and Valle, 2017[4]). State governments are also funding climate change research, identifying possible localised impacts in their own regions. Work underway through the RDCs has analysed the effect of climate change on various industries. One initiative targeting improved resilience is the Rural R&D for Profit programme, which provides AUD 154.4 million in funding over eight years for RDCs to co-ordinate national-level research for the benefit of all producers Box 5.1. All of these research initiatives, in conjunction with other programmes, help producers to improve their resource management with a view toward adapting to volatile climate conditions.

Box 5.1. Improved farmer resilience under the Rural R&D for Profit programme

Two example projects under the Rural R&D for Profit programme illustrate the kinds of research investments underway in Australia to improve long-term resilience. The first, "Forewarned is Forearmed", equips farmers and agricultural value chains with the necessary tools to proactively manage the impacts of extreme climate events by delivering improved seasonal forecasts of extreme climate events to adjust their management practices accordingly.

The second, "Mitigation of Climate Change Impacts on the National Wine Industry by Reduction in Losses from Controlled Burns and Wildfires and Improvement in Public Land Management", seeks to reduce the impact of major fires on the wine industry. The project accomplishes this task by generating knowledge and new technologies to better manage bushfire risk, while also developing tools and techniques to remediate affected grapes and wine.

Public extension also addresses outreach and education on risk management. Extension services in Australia are funded under both public and private mechanisms, with total rural extension funding estimated at AUD 316 million (about half of that coming from the private sector) in 2014-15 (Millist, Chancellor and Jackson, 2017[22]). For example, in 2016 the Australian Government helped to fund the "Tactics for Tight Times" programme developed by Dairy Australia and the Regional Development programmes to increase farmer resilience and the business management capacity of producers in the dairy sector. The programme included technical extension advice and appropriate management strategies, along with advice on the financial implications of management decisions and various farm business planning scenarios.

Other public goods that contribute to drought resilience include early warning systems and general market information. Early warning information for drought covers a wide range of products, since drought is considered to be a slow-onset event. As noted above, the Bureau of Meteorology publishes seasonal outlook weather forecasts that provide information on drought conditions. In conjunction, ABARES publishes periodic commodity forecast reports, which are forward-looking and cover a range of potential risks – drought included.

Finally, the general policy environment is also relevant to strengthening sector resilience against drought. Other programmes that target long-term sustainability and land improvement likely have additional co-benefits for drought resilience. Many of these projects are funded through phase two of the National Landcare Program, which provides AUD 1 billion in funding from 2018/19 to mid-2023 for partnerships with governments, industry, communities and individuals to support natural resource management and sustainable agriculture. Two programmes benefiting agriculture directly funded through Landcare include the four-year, AUD 34 million Agricultural Stewardship Package (which includes grants to farmers to incentivise the adoption of improved biodiversity practices) and the AUD 55 million Smart Farms Small Grants programme (which funds uptake of sustainable agriculture projects and adoption of best practice natural resource management methods and runs through 2022/23). Additional government initiatives may also have relevance for the sector. For example, the government released its overarching National Climate Resilience and Adaptation Strategy in 2015.

5.4. Conclusions

Australia's overall agricultural policy framework has moved away from a paradigm of government support towards an environment where farm-level decision-making is based on market forces. This approach has facilitated structural change within the industry, and has made better farm-level risk management an integral component of the farm business toolkit. In this context, Australia's agricultural policy approach to

drought risk has also evolved over time, even in a landscape where the frequency of extreme heat events and the severity of drought conditions have been increasing. The policy framework has shifted from being a system that provided substantial *ex post* assistance for drought (mainly in the form of Exceptional Circumstances interest rate subsidies) to one that emphasises self-reliance and the importance of the enabling environment; and that supports preparation and improved farm risk management as the most effective means of combatting drought and its effects. This focus on farm-level risk management appears to be succeeding – productivity has been less variable in drier years, and the increasing FMD drawdowns in drought-affected states indicates that many farmers are using available tools to manage their risks on farm during difficult years.

A number of drought-specific *ex post* measures remain, however – some programmes continue to offer subsidies that may disincentivise preparedness, distort markets and hinder structural adjustment. Moreover, some producers continue to expect this support to be available at the federal level. The availability of some programmes, such as freight and fodder subsidies, or support for water to produce feed crops, underscores the challenges behind the political economy of reform. Particularly with respect to the *ad hoc* support for water for fodder crops, it is unclear whether the measure is purely a political rent, or if in fact the move suggests that existing policies and water management paradigms are insufficient to support farmers in extreme drought. Similarly, while federal government policy is not to provide business support, this does nonetheless occur through concessional loans and other measures. Although this intervention is unlikely to impede structural change if well-targeted, it could become a problem if loan uptake significantly increased. As illustrated by the current drought, the pressure on policy makers to "do something" when droughts occur means that this is a risk that should be considered. Recent OECD work indicates that success in reforming policies can be achieved, however, through evidence-based problem definition, objective setting and evaluation, the alignment of governance and institutions with the policy change, strategic stakeholder engagement to build trust, the rebalancing of incentives and the use of an adjustable sequence of actions (Gruère and Le Boëdec, 2019[35]).

The government's emphasis on the importance of research and innovation will be key to the future success of Australian agriculture. The sector faces continued challenges to productivity growth (which slowed considerably in the 2000s, largely due to adverse impacts from adjusting to a changing climate), so innovations in new technologies and production practices are needed to ensure that farmers can manage drought risk (OECD, 2015[1]). Accordingly, there may be scope to improve the cross-commodity linkages between sector-specific RDCs in the area of drought management and resilience.

One essential component in the evolution of Australia's policy approach to drought over time has been the willingness of policy makers and stakeholders to periodically review their policy frameworks, question underlying assumptions, and analyse the trade-offs of different potential approaches. Both drought-specific policy reviews and assessments of specific measures or programmes have proven useful in advancing the policy dialogue. Many of these assessments were qualitative rather than quantitative, however. While qualitative assessments are valuable for gaining insights into how the policies can be improved, in some cases they would be helped by more systematic collection and analysis of data to ensure that the policies are meeting their objectives in a cost-effective way.

The mixture of different programmes emphasising a self-reliant approach contribute to the various resilience capacities in different ways. Safety net (FHA) and income smoothing policies (FMDs and tax averaging) undoubtedly play a role in helping producers to absorb the effects of shocks by providing access to financial resources in difficult years. They may also have wider effects on adaptation and transformation, since, for example FHA recipients and clients are required to engage in activities that are intended to improve their circumstances, including diversifying operations, adapting their farm business or exiting farming. Financial counselling can complement programmes like FHA by helping to facilitate long-term behavioural change. Financial counselling supports farmers in hardship to address their financial management practices and make adjustments to their business. Capacities for adaptation and transformation are incentivised by transmission of market signals and an emphasis on self-reliance, but

government spending on innovation, research, extension and other public goods plays an important role as well.

Going forward, greater emphasis on the capacities needed to support the further *transformation* of the agricultural sector and individual industries in response to an increasingly drier climate will be important, with attention also being paid to the extent to which recently resumed *ad hoc* assistance measures may impede this transformation.

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Notes

[1] It is worth noting also that previous periods of severe water stress also motivated government actors to make substantial changes to the country's water markets. For more context, see Gruère, Ashley and Cadilhon (2018[6]).

[2] Several recent OECD publications have explored this issue at length. Recent OECD studies have characterised the Australian water allocation regime (OECD, 2015[37]), described the management of groundwater use in agriculture (OECD, 2015[38]), assessed the development and evaluation of water policies related to agriculture in the Murray Darling from the 1990s (Gruère, Ashley and Cadilhon, 2018[6]), and discussed their propensity to mitigate drought risks in agriculture (OECD, 2016[3]).

[3] Tax averaging ensures that farmers with fluctuating incomes do not pay more tax than salaried workers by averaging income over a given period and assessing tax on that average.

[4] Note that the programme considers farm household income, and not farm income alone.

[5] Eligibility is based on means tests for assets and income. For more details, see (Department of Human Services, 2019[36]).

[6] FHA and RFCS are not formally tied to each other, but participants in either programme can access the other.

[7] RIC does offer other products that are not intended for producers preparing for or recovering from drought. For example, RIC began offering an a new loan product in June 2019 – the AgRebuild loan – in response to the north and far north Queensland floods of January-February 2019, with loans of up to AUD 5 million available for eligible loan applicants, with a two-year interest-free period.

[8] Existing customers were also eligible for a two-year interest-free period.

[9] For more details on terms of eligibility, see https://www.ric.gov.au/agbiz-drought.

[10] See https://www.climatechangeinaustralia.gov.au/en.

6 Resilience to natural disasters in Canada

This chapter examines resilience to all types of natural disasters in Canada. Relevant agricultural policy frameworks are first presented, including an outline of risk governance for natural disasters according to the three-layer framework. This is followed by a discussion of how the country's agricultural sector stakeholders consider the five resilience dimensions in their approach to managing risks posed by natural disasters.

6.1. Introduction

Canada is a large country, with a small population relative to its land area. Although the agricultural and agro-food sector represents only 3.5% of Canada's economy, agro-food products comprise 11% of exports – 46% of which are primary agricultural products. Canada is one of the world's largest suppliers of beef, dry peas, lentils, pork, rapeseed, and wheat. Production systems vary across the country's regions, with dairy production concentrated in eastern Canada, specialty crop production prominent on the Atlantic and Pacific coasts, extensive cereal and oilseed crop production characterising the Western Prairies, and livestock production spread throughout the country (OECD, 2015[1]).

Given its vast territory and wide range of climates, Canada is exposed to a range of natural disasters and extreme weather events, including floods, hurricanes, landslides, storms, tornadoes, droughts and wildfires. Over the period 1980-2018, floods were the most costly events in terms of total estimated damage (CAD 8.4 billion), but winter storms and wildfires also caused more than CAD 5 billion in damage over the period (Public Safety Canada, 2019[2]). Agriculture can be impacted by any of these events, so having adequate frameworks for preventing and responding to such disasters is essential for the resilience of the sector. In the past, the events that have had the most severe impact on agriculture were floods and droughts. During some years, extreme weather events like early frosts have also been very damaging to crops, but generally would not have been considered disasters.

For the past few decades, the Canadian Government has refined its policy approach to managing disaster risk for the agricultural sector. Over successive policy frameworks, policy makers have increased support for initiatives that either prevent adverse events from impacting the sector, or else mitigate their effects. This focus on prevention has coincided with lower levels of *ad hoc* disaster payments to producers, as financial support to cope with adverse events is available instead through either *ex ante* tools such as crop insurance or through programmes and response frameworks that are defined before disaster strikes (OECD, 2019[3]). This reduced emphasis on purely financial tools as a means to manage risk has wider implications for the long-term resilience of the sector.

This case study will examine the implications of Canada's agricultural policy framework with respect to natural disasters on the resilience of the country's primary agriculture sector. The case begins by first examining the current policy landscape, including a discussion of relevant risk management strategies and measures according to the different risk layers. This is followed by an analysis of the policy approach along each of the five key resilience dimensions, as well as concluding comments.

6.2. Current policy landscape

Canada's agricultural policy framework emphasises risk management and investments in strategic initiatives (focusing largely on general services, such as knowledge generation or market development) as keys to improved sector resilience and sustainability. The country's agricultural policies have moved for the most part toward a strongly market-based focus since market price support programmes for grains, oilseeds, cattle and hogs were discontinued in the mid-1990s.[1] As price support policies for crops were dismantled, the country strengthened business risk management (BRM) programmes and general services. As with its predecessor Growing Forward 2 (GF2), the current policy framework – the Canadian Agricultural Partnership (CAP) 2018-23 – is comprised of a suite of BRM programmes and non-BRM programmes (also referred to as Strategic Initiatives) that are cost-shared between the Federal-Provincial-Territorial (FPT) governments. Strategic Initiatives help support the resilience and sustainability of the sector. These non-BRM programmes and projects cover diverse aspects of the agricultural sector, such as marketing, trade, scientific research, innovation, environmental sustainability, climate change, value-added agriculture and agri-food processing and public trust. At the primary producer level, five BRM programmes are provided under CAP:

- *AgriStability*, a whole-farm margin programme providing support in years of significant income declines.
- *AgriInvest*, a savings tool that provides matching contributions to producers who make annual deposits to a savings account, to help manage moderate declines in income or make investments in farming operations to mitigate risk.
- *AgriInsurance*, cost-shared insurance to reduce the financial impact of production or asset losses due to natural perils, which is delivered by the individual provinces.
- *AgriRecovery*, an FPT co-ordinated disaster relief framework.
- *AgriRisk Initiatives*, a programme that supports the industry to investigate risk, develop and implement new tools, as well as to engage the support and participation of the private sector in risk management (OECD, 2019[3]).

This suite of BRM programmes aims to find a balance between *ex ante* and *ex post* measures, while limiting the use of *ad hoc* forms of assistance.

The Canadian federal government's approach to managing catastrophic risk in agriculture has evolved in recent decades, including a shift in the government's role in responding to natural disasters. Under Canada's risk management policy framework of the early 2000s, catastrophic risks had no specific defining criteria, and consequently, all types of events that negatively affected farm income (including market downturns) could potentially be considered a "catastrophe" meriting *ad hoc* assistance. As a result, lobbying by producer organisations and media campaigns to pressure governments into providing *ad hoc* assistance were often successful. From 2000 to 2008, "catastrophic" *ad hoc* assistance was granted for a variety of events, including drought, low grain prices, avian influenza, and a hog buyout programme (Antón, Kimura and Martini, 2011[4]).

Under the Growing Forward (GF) (2007-12) and particularly moving into the Growing Forward 2 (GF2) (2013-18) FPT frameworks, Canada's approach to agricultural disaster events focused BRM programming more on severe risks that were beyond the capacity of producers to manage, while also allowing space for market-oriented adaptation and adoption of new risk management tools. This shift in approach was partially motivated by previous OECD findings that emphasised the improved efficiency of focusing efforts on the catastrophic risk layer. This refocusing of BRM programmes required a new approach to defining and managing catastrophic risks via a clarification of the objectives of BRM programmes (and some adjustment in their triggering thresholds), and an increasing focus on improving preparedness to extreme events. Simultaneously, more resources were devoted to non-BRM programming to help producers better manage and adapt to risks.

One of the most significant ways in which BRM policy with respect to natural disasters was adjusted was by clarifying the role of the government in responding to these type of events through the implementation of the AgriRecovery Framework beginning in 2006. AgriRecovery is not a programme, but is rather the decision framework used to determine whether or not a disaster relief programme should be designed and delivered to affected producers. The AgriRecovery Framework outlines the steps to be taken to determine if an assistance package is warranted, and details the criteria that must be met for each step. In contrast to the treatment of catastrophic events under previous policy frameworks, only certain types of events are eligible for consideration under AgriRecovery – disease outbreaks, pest infestations, extreme weather, and contamination of the natural environment. Furthermore, in order for an event to trigger an initial assessment, it must be judged to be non-recurring, abnormal, and result in extraordinary costs (that is, costs that farmers would not normally face, but must be incurred in order to resume operations or mitigate the impacts of a disaster, such as replanting of damaged trees). If an event meets these criteria, then a formal assessment is carried out to determine if *ex post* assistance is needed.

Events are assessed on a case-by-case basis, so no explicit quantitative impact thresholds are defined *ex ante* for producers.[2] That being said, assessments are carried out (jointly between FPT governments)

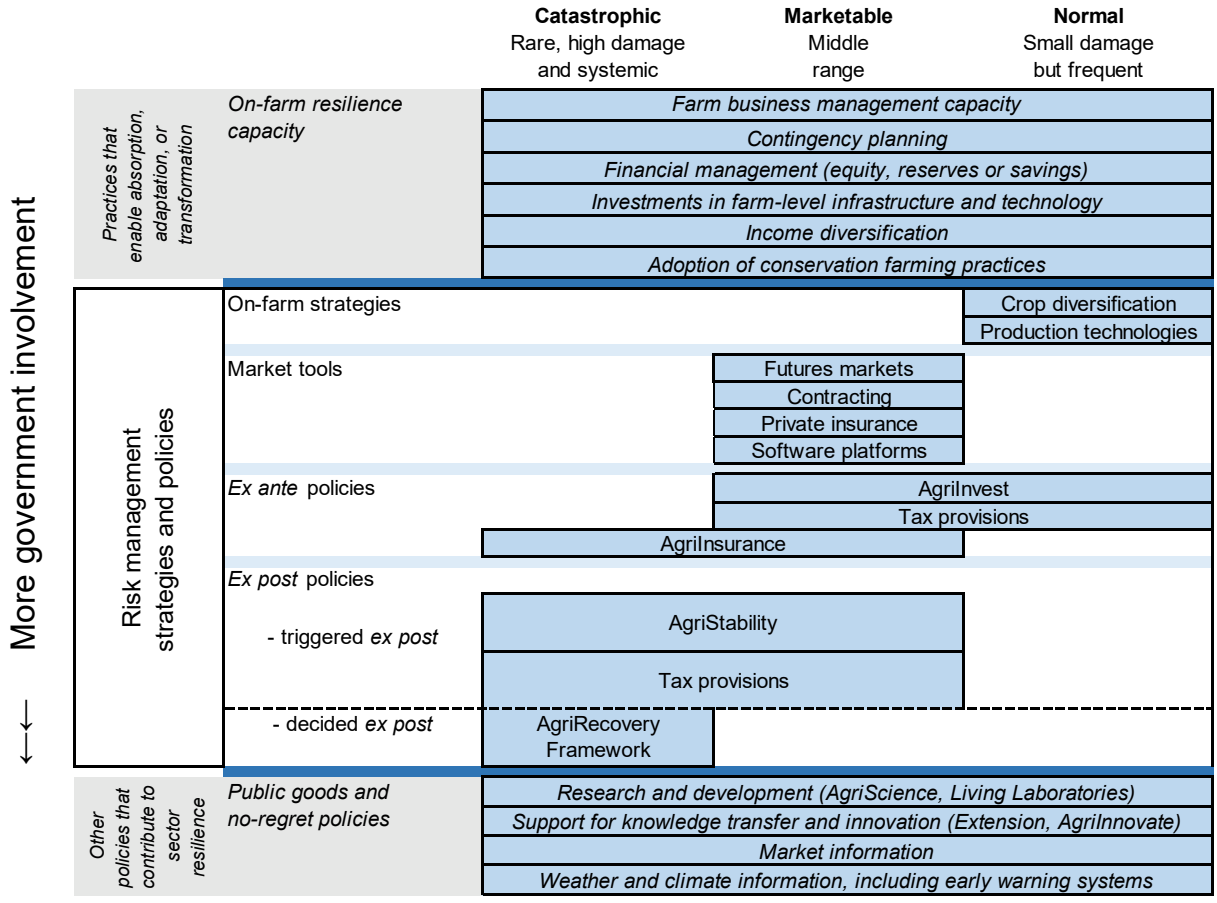
according to pre-defined criteria. The event must be a collective experience affecting a large number of producers, result in significant negative impacts on farmers' capacity to produce or market their products, result in significant extraordinary costs, and be beyond the capacity of producers to manage after accounting for assistance available through existing programmes like AgriInsurance and AgriStability. In fact, AgriRecovery does not provide assistance to cover production or revenue declines. Instead, the other programmes in the BRM suite – AgriInsurance and AgriStability – are the primary source of financial assistance to producers for income losses in disaster situations (Agriculture and Agri-Food Canada, 2018[5]). If the assessment confirms the need for assistance given significant extraordinary costs, then a response package is developed (compensating affected producers for up to 70% of extraordinary costs, which excludes compensation for production or revenue declines) and implemented with the aim of mitigating the impacts of the disaster and ensuring that farming operations can resume as soon as possible in the wake of a disaster. Assessments carried out under AgriRecovery also commonly provide recommendations on how similar losses can be avoided in future. In some cases, as a result of an AgriRecovery assessment, information is shared with the relevant Province or Territory to promote the development of new tools to deal with similar losses.

Outside of the BRM policy suite, Canada's federal government has also launched other initiatives to improve disaster management in agriculture. In 2016, FPT governments drafted the Emergency Management (EM) Framework for Agriculture in Canada, which established their intention to prepare for the immediate aftermath of extreme events by integrating disaster response and risk reduction plans into broader national emergency management frameworks. The EM framework elaborated the four pillars on the EM continuum – prevention and mitigation, preparedness, response, and recovery – and emphasised that effective EM is the shared responsibility of government, industry, and other stakeholders in order to achieve improved resilience for the sector as a whole.

Canada's policy adjustments under successive frameworks have progressed in more clearly defining stakeholder responsibilities relative to different magnitudes of risk, although additional refinements could be pursued (OECD, 2019[3]). In conjunction with producers' baseline capacities to manage on-farm risk, the resulting policy toolkit offers producers an array of options designed to help them manage risk of different magnitudes – including absorbing the negative effects of shocks and responding to a changing risk landscape by adapting or transforming their operations – as illustrated below according to the different risk layers (Figure 6.1).

There is evidence that Canadian farmers are investing in building on-farm resilience capacities, and commonly employ on-farm risk management strategies. First, farmers are increasingly investing in developing business management capacities through training and education, evidenced by the rising share of producers completing trade or college level educational programmes – 35% in 2016, versus just 26% in 1996. These programmes typically provide training in both technical skills (such as machinery operation and repair) and farm business management, helping producers to develop the skills necessary to support entrepreneurship and on-farm resilience (Tran and Shumsky, 2019[6]). This capacity for entrepreneurship is also demonstrated through Canadian farmers' widespread adoption of new innovations for improved sustainability, including planting improved varieties or implementing farm management practices like no-till (OECD, 2015[1]). Other skills gained through these programmes, such as contingency planning or decision-making based on early warning systems, can help producers absorb or mitigate the impacts of catastrophic events.

Figure 6.1. Strategies and policies employed in Canada for risk management and resilience



Source: Author's own elaboration.

Canadian farmers also utilise a number of financial strategies to cope with and respond to natural disasters. First, the average Canadian farm has sufficient liquidity to be able to cope with an unexpected event (Farm Credit Canada, 2017[7]). Although this may not be sufficient to manage catastrophic events, such liquidity provides at least a short-term bridge until other assistance is delivered. National statistics indicate that, on average, Canadian farms have more than sufficient assets to cover current financial obligations, but not always in a sufficiently liquid form to cover short-term debt obligations[3] (Statistics Canada, 2020[8]). Second, income diversification is widely employed by Canadian farm households – in 2014, nearly 50% of average farm household income was earned off-farm (Statistics Canada, 2019[9]). Finally, previous OECD work has also indicated that a majority of Canadian farmers consider crop diversification to be an effective risk management strategy (Antón, Kimura and Martini, 2011[4]), although more recent data on the number of crops grown per farm is not available.

Canadian farmers use some market instruments to manage risk, including trading of futures contracts, along with private insurance products. However, these are mostly intended to hedge against price fluctuations rather than losses incurred from natural disasters. That being said, some private sector tools are available in the risk management landscape that have implications for natural disaster preparedness, including software platforms for risk management planning.

Within the policy sphere, *ex ante* risk management policies available to help producers prepare for and manage risk include financial tools that producers can access to help cope with natural disasters, allow them to make investments in their operations to help them adapt to current conditions or anticipate future

ones, or insure their production against losses. The bulk of government *ex ante* assistance is provided through the AgriInsurance programme. Through this programme, insurance products covering yield and quality losses are available for most commodities, with the government subsidising premiums at a rate of around 60% (Office of Audit and Evaluation, 2017[10]). Plans are subsidised by FPT governments, and are delivered at the provincial level – the different provinces typically offer plans to cover their most relevant products, so they can vary significantly by province. The majority of the country's crop production is covered by the programme (around three-quarters of non-forage crop value in 2014/15), and producers can select from different levels of coverage available in their province.

The AgriInvest programme is a farm financial management tool. Governments provide annual matching contributions (up to 1% of Allowable Net Sales, but not to exceed CAD 10 000) to producers who make deposits to their accounts. The balances can be used to help manage income declines at any time, including in the wake of a disaster event, or to make investments to improve farm preparedness to adverse events. The programme is widely used by Canada's farmers, with 75% of producers participating in the programme in 2014. However, the average annual matching contribution is quite low, ranging from CAD 2 000 to CAD 3 500 between 2007 and 2014, and the average account balance is estimated at CAD 23 000 (Del Bianco, 2018[11]; Office of Audit and Evaluation, 2017[10]). Thus, despite the matching funds provided by the government contributions, on average farmers are not accumulating individual AgriInvest balances that are high enough to deal with catastrophic losses. In addition, previous OECD work indicated that producers do not draw down AgriInvest funds during periods of shock or income decline, suggesting that the programme plays little role in helping farmers to manage income risk (Antón, Kimura and Martini, 2011[4]).

Similarly, some provisions of the tax code can also serve as an *ex ante* mechanism for reducing risk, as they allow producers to either smooth income variability over a period of years, or else support capital investments through accelerated depreciation provisions (OECD, 2020[12]). For example, Canadian farm businesses can claim a capital cost allowance tax deduction over a period of several years, which can be used for purchases of some types of farm equipment, allowing producers to make on-farm investments that may enable them to better confront future risks. Provinces and territories may offer additional tax incentives to producers to incentivise investment or reduce input costs.

Ex post policies provide additional tools to manage the impacts of natural disasters in Canada. These policies fall into two categories – those that are triggered *ex post* but are defined prior to an event (and require producers to express their participation in advance as well), and those that are decided *ex post*. With respect to the first group of policies that are triggered in the aftermath of an event, the primary policy tools used in Canada are protection against substantial revenue loss using AgriStability, and tax deferral provisions. The AgriStability programme provides whole-farm support (in contrast to AgriInsurance offering commodity-based coverage), for large margin declines (a decline of 30% or more relative to a farm's historical reference margin), regardless of the underlying reason. The programme previously provided tiered levels of coverage, with support eligible from 85% of the reference margin under the highest level. However, programme evaluations deemed that this design could crowd out other risk management strategies, and a single 70% threshold was adopted as a result. This lower threshold also better reinforces the delineation of the catastrophic risk layer. However, despite the comprehensive coverage offered, participation in AgriStability has declined in successive policy frameworks. Several factors may have played a role in this declining participation. First, strong sector performance in recent years in the form of record net cash income has reduced producer reliance on AgriStability. Additionally, benefits are delivered at a substantial delay with respect to when the decline in margin is experienced, because benefit calculation requires first obtaining and processing individualised producer information. This delay reduces the programme's effectiveness in helping producers cope with the negative impacts of catastrophic events. The tax code also contains some provisions that are triggered *ex post*, which can help producers to absorb the effects of catastrophic risk. In one example, livestock producers can utilise the Livestock Tax Deferral

provision to defer a portion of the proceeds from their sale of part of their breeding herd due to drought or flood to the following year.[4]

With respect to policy tools that are decided *ex post*, the AgriRecovery framework described above is invoked to determine whether or not *ad hoc* assistance packages are warranted to help farmers manage exceptional losses not already covered by other existing BRM programmes. Although the decision on whether or not to offer an assistance package is decided after the fact, it is important to note that this decision is informed by a consistent, pre-defined process as laid down in the framework.

As part of the CAP Framework, the government also supports improved on-farm risk management through no-regret policies such as expenditures on public goods, taking the position that proactive investment in the sector can help mitigate risk and reduce the incidence and impact of severe losses from natural disasters. These initiatives include investments in research and innovation, knowledge transfer, provision of market information, and publication of information on weather and climate risks (including early warning systems).

The FPT governments prioritise investing in research, which can substantially improve farmers' capacities for managing risk. At 9.7% of total support to agriculture, public expenditure on agricultural innovation systems in Canada is high by international comparison – well above the OECD average of 3.6% (OECD, 2018[13]). At the same time, total public R&D in agriculture in Canada has been declining as a share of agriculture value added, and is now under 2% (OECD, 2019[14]). Under the Strategic Initiatives umbrella, AgriScience and AgriInnovate aim to speed the development and adoption of innovations, including innovations that reduce and mitigate the impacts of catastrophic risks, and production risk more broadly. This includes research into new vaccines to mitigate risks to animal health; investments in foundational science to make crops or livestock more resilient to pests and climate hazards; new science or tools from genetics, biotechnology, geomatics, artificial intelligence, or nanotechnology that can improve environmental performance or strengthen production resilience; and support for farm adoption of decision support tools, farm management software, or precision agriculture tools that underlie improved on-farm resilience. Outside of funding to agricultural R&D provided by federal policy, other public institutions also fund agricultural research, including universities, the National Research Council and provincial governments.

Knowledge transfer initiatives play a large role in ensuring that these technologies and practices are taken up by the industry. These activities predominantly take the form of extension and agricultural training programmes, which are typically partially funded by AAFC or provincial ministries of agriculture and delivered by educational institutions or farm organisations. Publicly-funded extension complements initiatives run by banks, credit unions, commodity associations, private sector accounting firms, and not-for-profit farm organisations to improve farmer knowledge of risk management. For example, Farm Management Canada (FMC) is a national organisation dedicated to providing farm management advice to the country's producers, funded by both AAFC and private partners. FMC produces resources, information, and tools that facilitate sound farm-level management decision-making.

Programmes that provide market or weather information are also in place to help producers make informed farm management decisions. AAFC produces sector outlooks and forecasts periodically, according to the needs of a given sector, and these provide some overview of risks currently facing the sector. Early warning systems are in place to advise producers on the development of a number of hazards, including pests. AAFC has recently begun publishing weekly extreme weather indices for a number of variables (e.g. temperature, precipitation), and also forecasting conditions in the coming month (AAFC, 2019[15]). In conjunction, AAFC publishes a bi-weekly Agroclimate National Risk Report that details current conditions in each province and also provides a forecast of conditions in the week to come.[5] These condition assessments are partially informed by reports from a volunteer network of growers and industry partners around the country, as well as a vast array of weather data sets and models. Aside from the condition reports, AAFC publishes a dedicated Drought Monitor report to track the development of this hazard across

the country. In addition to providing information on current and forecast drought conditions, the Drought Watch programme also provides a variety of guides detailing farm management practices to help producers prepare for and mitigate impacts from drought and other extreme weather events, including guidance on erosion, water conservation, and pasture management under dry or other adverse weather conditions. Digital technologies, such as artificial intelligence and satellite imagery are also increasingly being integrated into crop monitoring and forecasting information processes and products (Villeneuve, 2018[16]).

Outside of the specific agricultural risk management framework, other federal departments and agencies have a role in mitigating or responding to catastrophic events, including Environment and Climate Change Canada, Public Safety Canada, Transport Canada, Infrastructure Canada, and the Canadian Food Inspection Agency. For example, in the event of a large-scale natural disaster, the government of Canada provides financial assistance to provincial and territorial governments through the Disaster Financial Assistance Arrangements (DFAA) administered by Public Safety Canada. These funds are paid directly to the provinces, but could potentially benefit affected farms or agricultural sector stakeholders.

6.3. Canada's experience in enabling resilience in the face of natural disasters

The orientation of the agricultural risk management policy framework in Canada continues to evolve from a reactive approach to one that instead prioritises *ex ante* measures. With respect to disaster response and preparedness, this has meant increasing support for proactive risk management and research into tools or strategies that will improve the long-term viability of the sector, as well as adjusting how disasters are defined and addressed. At the same time, some measures may have unintended negative consequences on long-term sustainability, increase exposure to some types of natural disasters, or transfer risk that should be borne by farmers to the public budget.

6.3.1. Managing catastrophic risk is increasingly focused on ex ante measures

One of the keys to improved sector resilience to natural disasters is preparation for future catastrophic events. Over the past few policy frameworks, the Canadian Government has increasingly focused on policies and programming that help to support preparedness and resilience to natural disasters, rather than solely financial assistance delivered after an event. Most recently, this change in approach was motivated by falling participation in AgriStability, as noted above. In conjunction with this shift in approach, spending on disaster response programming has fallen. Although various factors may have contributed to this decline (including the random nature of high-impact disaster events potentially causing fewer large-scale disasters over the period (Office of Audit and Evaluation, 2017[17]), or rising incomes and improved on-farm management of risks as indicated above), those reduced expenditures freed up resources to allow Canada to allocate more agricultural policy funding to innovation (OECD, 2015[1]). Through greater resources for Strategic Initiatives and FPT cost-shared programmes, FPT governments are investing in improved farm-level management, knowledge systems, and information and early warning platforms that help producers to avoid or mitigate the impacts of adverse events.

In conjunction with these proactive investments, the government has made progress in better defining the boundary of the catastrophic risk layer and disciplining *ad hoc* assistance. First, the kinds of events that are eligible for assistance under the AgriRecovery Framework are now more clearly specified, as well as the conditions for when targeted assistance initiatives could be warranted. Additionally, thresholds within AgriStability have been adjusted and simplified to provide coverage only for more severe contractions in margins. Today, most financial assistance in the wake of disasters is delivered through programming that is defined *ex ante*, and expenditures on *ad hoc* assistance are limited. At the same time, some ambiguity remains in the definitions for AgriRecovery (e.g. what constitutes "significant extraordinary costs") that may not provide clear signals to producers and other stakeholders (Ker et al., 2017[18]). While this is intended

to ensure that the framework is sufficiently flexible to respond to a range of different circumstances, the lack of clarity may make it difficult for producers to understand where their responsibilities for disaster risk management lie.

This shift to disaster proactivity is further underpinned by ongoing efforts to better understand and prepare for the wider risk environment. Some PT governments, as well as industry associations and commodity groups, undertake scenario analysis and foresighting exercises to assess risk and possible future threats. Horizon scanning for potential future threats is also undertaken, but to a much lesser extent.

6.3.2. Canada's approach to managing natural disaster risk focuses on trade-offs over time, but could better address trade-offs across actors and outcomes

In considering the resilience of an overall agricultural system, stakeholders should assess trade-offs for different time frames, actors, and outcomes. The current policy framework has made progress in prioritising future resilience to natural disasters by emphasising preparedness and contingency planning. Beginning with Growing Forward in 2007, Canada's agricultural policy frameworks have increasingly shifted resources from *ex post* assistance measures toward investments in science, research and innovation initiatives that aim to help producers adjust their operations to better confront catastrophic risks.

But other trade-offs exist within Canada's approach that may result in uneven outcomes for resilience to natural disasters in either the short or the long term. First of all, the institutional setup may deliver uneven incentives for producers in different parts of the country. This is because agricultural policy is not solely the jurisdiction of the national government – rather, provincial and territorial governments have developed their own programmes within the scope of the national framework. Additionally, there are some provincial risk management programmes which fall outside of the FPT frameworks (Ontario and Quebec). While this system may on the one hand ensure that programmes are better targeted to local conditions, it may also create conditions where interest groups have more influence over the policymaking process and use this leverage to engage in rent-seeking behaviour that does little to improve the capacity of farmers to respond to disasters (Ker et al., 2017[18]). While this diversity of provincial approaches and programming may affect the incentives to prepare for risks among producers in different parts of the country, Canada is currently making efforts to ensure a more holistic approach to risk where possible, including by enhancing data sharing between provinces and programmes.

There are also indications that there may be trade-offs between outcomes under the current BRM suite and the sector's ability to mitigate the effects of natural disasters. In particular, the crop insurance literature has found that subsidised insurance (such as that which is offered through AgriInsurance) incentivises growers to expand production onto marginal land – a high risk/high reward practice that can increase producer exposure to natural hazards like floods (Claassen et al., 2011[19]; Miao, Hennessy and Feng, 2016[20]). Indeed, recent analysis has indicated that shifting crop yield distributions from a subset of Canadian farms is consistent with producers adopting these types of higher risk/higher return production practices (Ker et al., 2017[18]).

Similarly, the adoption of certain beneficial environmental management practices, such as wetland conservation, would contribute to the improved sustainability and long-term resilience of the sector and mitigate the impact of certain future natural disasters (particularly floods) (Pattison-Williams et al., 2018[21]). However, these practices may also be disincentivised by current programmes, which make the adoption of these types of practices more costly for farms, trading off long-term benefits of ecosystem services for short-term financial benefits. For example, simulated returns of a representative cropping farm in Alberta indicated that the BRM suite exacerbated economic disincentives to the adoption of certain beneficial management practices that involve land use change (such as buffer strips or wetland restoration), with the authors concluding that participating in BRM programmes "may result in reduced uptake of many environmentally friendly production practices or land use changes" (Jeffrey, Trautman and Unterschultz, 2017[22]). These findings suggest that there could be some trade-off between farm capacity to cope with

risk in the short-term and the farm's longer-term environmental sustainability or capacity to provide ecosystem services that could ameliorate the impact of natural disasters. This linkage could be better considered in future policy frameworks. For example, there could be further scope for additional BRM programmes to include cross-compliance mandates for adoption and implementation of certain beneficial management practices.

At the same time, some efforts are underway to create better linkages between risk management and environmental outcomes that would mitigate the effects of natural disasters. In one example, the Province of Saskatchewan has launched the "Climate Resilience Measurement Framework" initiative, which seeks to improve the province's resilience to climate change by measuring progress on targets across five key areas (natural systems, economic stability, physical infrastructure, community preparedness, and human well-being) to build absorptive, adaptive and transformative capacity in each area. While the initiative is not specific to agriculture, it does contain a number of different measures intended to improve the sector's long-term resilience, including an indicator for crop diversification as a means of enhancing soil health, mitigating exposure to pests and diseases, and managing sector financial risk.

6.3.3. Collaborative approaches and recurrent evaluations allow risk management policies to evolve and better confront catastrophic risks

Defining disaster risk frameworks through collaborative approaches is important to ensure that all stakeholders are aware of their responsibilities for managing risk. A wide array of stakeholders – including producer associations, provincial ministry advisory boards, agricultural wetland/marshland conservation commissions, university training centres, private sector participants, individual farmers and academics – participate in developing Canada's agricultural policy frameworks, including disaster response frameworks.

For instance, the 2016 EM Framework establishes *ex ante* the roles and responsibilities of all actors in agricultural emergency situations, providing clarity on the actions stakeholders should undertake to successfully manage emergencies. Among other responsibilities outlined in the EM Framework, producers are tasked with establishing and maintaining risk management plans, adopting best management practices, and reporting adverse events; provincial and territorial governments should develop and provide exercise simulations and trainings and oversee activities that prevent or mitigate the impact of events in their jurisdiction; and the federal government is responsible for providing scientific advice and fostering an enabling environment for the creation of best management practices and biosecurity plans and measures, contributing to research and development that can provide large-scale benefits in reducing the impacts of emergencies, and raising awareness and engaging partners on understanding risks and the need for prevention (AAFC, 2016[23]).

Collaborative approaches can also be used to establish risk ownership for industry-specific risks, including through Value Chain Round Table events (OECD, 2019[14]). For example, the Animal Health Canada Working Group, which includes members from industry and FPT governments, has a governance model based on an industry-government partnership for animal health management and emergency responses, which covers decision-making, resource sharing and programme management. As a result of the Working Group, the meat processing industry has proposed a governance structure review to ensure that responsibilities for managing animal production risks are properly established.

Outside of policy development and understanding of risk ownership, FPT governments also regularly communicate with producer associations and stakeholders regarding possible future developments in potentially catastrophic risks, including pest infestations, or the evolution of disease outbreaks as a consequence of climate change. These discussions can also occur as part of broader government consultations at the provincial level, in concert with other relevant provincial ministries. Outside of these outreach efforts, government actors also regularly communicate via social media, news conferences, stakeholder networks, and websites to ensure that both producers and the general public stay informed about risk management policies, programmes, and developments.

Periodic re-assessments of policy outcomes also help ensure that risk management frameworks remain effective in a shifting risk landscape. AAFC's Office of Audit and Evaluation conducts reviews of all programmes every five years to determine if programmes are meeting their objectives and continue to be relevant towards overall departmental policy objectives. These reviews generally lead to adjustments aimed at improving programme effectiveness. For example, a 2013 report on the approach to AgriRecovery resulted in a number of adjustments to improve the timeliness of assistance intended to help producers cope with and recover from catastrophic events, and a 2017 evaluation provided some additional insights (Office of the Auditor General of Canada, 2013[24]; Office of Audit and Evaluation, 2017[17]).

The policy framework for responding to catastrophic risks can also be revised outside of statutory assessment processes. For example, under the AgriRecovery process, extreme events are assessed to determine if they meet the criteria to warrant assistance. As part of this assessment process, evaluators identify ways that current programmes could be adjusted in order to help the sector better prepare for similar events in the future. For example, in 2012, a warm spring and then sharp frost event severely damaged fruit trees across Ontario. Although evaluators determined that existing BRM programmes provided sufficient assistance to help producers manage the impact of the event, they also made recommendations on how similar negative outcomes could be avoided in the future through enhancing stakeholders' preparedness and mitigation efforts – in this case, through improvements to existing tree-fruit insurance plans, or by providing support through Strategic Initiatives for on-farm investments in mitigation technologies (Ontario Ministry of Agriculture, Food and Rural Affairs, 2016[25]). Furthermore, restrictions on accessing AgriRecovery for recurring events provide further incentives for all stakeholders to adjust policies and adopt the assessment recommendations accordingly. In another example, an FPT review including input from an external expert panel analysed the effectiveness of the whole BRM framework in 2018 (including response to catastrophic risk), and its alignment with policy objectives and principles. The review determined that there was a need to develop new tools – not necessarily administered by government bodies – to cover risks not targeted by the BRM suite.

6.3.4. Canada's overall agricultural policy framework supports the development of on-farm resilience capacities

While the BRM policy suite provides tools to help producers to manage or recover from catastrophic risks, other policy initiatives support farmers in enhancing their entrepreneurial skills to both absorb shocks and adapt or transform operations in response to a changing landscape. Various programmes funded through Strategic Initiatives aim to develop the capacities of farmers to experiment, innovate and adapt to reduce exposure to natural disasters – indirectly by funding the development of new technologies and innovations, and directly by supporting the adoption of these innovations. One notable example is the Living Laboratories Initiative, which fosters agricultural innovation through the use of a collaborative experimentation model, partnering farmers and researchers to co-develop, test and refine new on-farm practices or technologies. The programme's goals include helping Canada's agricultural sector adjust to climate change, reduce water contamination, improve soil and water conservation, and maximise habitat capacity and biodiversity (AAFC, 2019[26]). By tapping into farmer expertise, this approach tests innovations in real world conditions, encourages problem-solving by producers, and can encourage uptake of innovations. This approach may be particularly relevant to speeding innovation uptake, as more than two-thirds of the country's producers indicate that obtaining knowledge and experience from fellow farmers informed their decisions about implementing new products, processes or practices (FPT Governments, 2018[27]). Other federally-funded CAP programmes have also indirectly helped producers to improve their farm management capacity. In particular, various projects funded through the AgriRisk initiative have generated data or tools designed to improve overall farm management. While the overarching AgriRisk Initiatives programme supports the development of new risk management tools by funding research and development, microgrants for academic research proposals, and administrative capacity building, the R&D

stream in particular prioritises the development of tools by not-for-profit organisations (such as industry organisations or co-operatives) that could help producers better manage certain defined risks. One such initiative that received support through AgriRisk was the Agrometeo weather information platform for Quebec, which provides data to help inform farm-level decision-making in extreme weather situations.

Farmer capacity for experimentation and adaptation is also supported at the provincial level. For example, the Manitoba Agriculture Diversification Centre research stations carry out a number of activities that contribute to the long-term sustainability and adaptability of farms, including conducting trials on new commodities or crop varieties to determine if and how they can be adapted to Manitoba's agroclimatic conditions (Manitoba Agriculture Diversification Centres, 2019[28]). Elsewhere, the CAP-funded Enabling Agricultural Research and Innovation Program supports investments in either the development or adaptation of innovations in the province of New Brunswick (Government of New Brunswick, 2018[29]). Additionally, FPT cost-shared programmes address other key resilience capacities. For example, the British Columbia Agri-Business Planning Program offers grants for specialised business planning assistance in a variety of areas, including assessment and development of a business and financial risk management strategy, or specialised disaster recovery planning to farm businesses affected by natural disasters (Province of British Columbia, 2019[30]).

On-farm resilience is also reinforced by a clear understanding of risk management responsibilities, including knowledge of the boundary defining the catastrophic risk layer. The different programmes of the BRM suite all have provisions that help to define this layer (including clearly defined damage thresholds), and thus provide an incentive to develop more effective long-term risk management strategies. Although *ad hoc* assistance programmes are commonly associated with lack of definitions and clear signals, the Canadian vehicle for managing ad hoc assistance – AgriRecovery – largely avoids this problem by reinforcing the boundary of the catastrophic risk layer in a number of ways. First, declines in production or revenue alone are not sufficient to warrant assistance. In fact, even if a response programme is developed, it cannot include financial assistance for these losses, as they are already eligible for assistance under other BRM programmes. Second, programmes under AgriRecovery are cost-shared 60/40 between the federal and provincial-territorial governments – a practice that incentivises both levels of government to invest in risk reduction, improving overall resilience and reducing the need for *ex post* payments (Clarke and Dercon, 2016[31]). Finally, in line with the OECD holistic framework, which indicates that catastrophic events are rare, recurring events are not eligible for assistance through the AgriRecovery framework,[6] serving as a further incentive for long-term risk mitigation. The fact that AgriRecovery is a relatively small programme in terms of expenditures within the BRM portfolio suggests that these efforts to enforce the boundary have been successful. At the same time, it is not clear that the current programme boundaries are providing adequate market signals to incentivise producers to engage in improved on-farm preparedness– particularly given that there is evidence that in some instances, the availability of subsidised crop insurance may have encouraged more risk-taking behaviour (Ker et al., 2017[18]).

Ensuring that all farmers have the necessary risk awareness, financial capacity to cope with adverse events, and knowledge of resources available to help them make informed enterprise management decisions in some cases requires more targeted programming – particularly toward young farmers. Canada recognises the potentially differing capacity levels of young farmers to confront catastrophic risks, through both special provisions in existing programmes, and by providing initiatives that specifically target that demographic. For example, the new AgriDiversity programme offers support for skills, leadership and entrepreneurial development to reduce barriers to entry for underrepresented groups in the agricultural sector, including young farmers, but also people with disabilities, women, and Indigenous peoples (OECD, 2019[3]). With respect to developing entrepreneurial capacities of young farmers, some specific provincial-level programmes are available. For example, Nova Scotia's "Small Farm Acceleration" programme provides business planning support to young farmers, and also provides working capital to help producers carry out activities identified in the business plan (Province of Nova Scotia, 2019[32]). Young farmers also in some cases have access to special financial products or more favourable financing terms. For example,

under the federal Canadian Agricultural Loans Act, young farmers (with fewer than six years in operation) can provide a lower down payment of 10% versus the 20% requirement for existing farms. Certain provincial programmes also offer low interest loans to young farmers. Farm Credit Canada (FCC), a crown corporation, offers programming suited to young farmers. FCC provides customised financing through its Starter Loan and Young Farmer Loan programmes, both of which offer preferential interest rates and have no loan processing fees. These beneficial lending terms and improved access to credit can both reduce financial risk for young farmers, and also improve their resilience by allowing them to make investments in their operations to improve their ability to manage or adapt to changing conditions.

6.3.5. Rising support to innovation and public goods enables farmers to respond to and prepare for natural disasters

Spending on information, knowledge, and extension has been growing over the past decade, and improving farmer access to information, technologies, and best practices has been a key pillar of Canada's transition to a largely *ex ante* risk management framework. Spending on general services has increased in both absolute and relative terms, reaching CAD 2.1 billion in 2016-18, and accounting for 27.5% of total support to agriculture (OECD, 2019[3]). At the same time, it is not clear the extent to which these programmes target resilience-building rather than productivity-increasing activities.

Programmes funded through the Strategic Initiatives portion of Canada's CAP support various areas that have implications for improved management of catastrophic risks in the medium- and long-term, including climate change, environmental conservation and animal health. Recent investments in research, development, commercialisation and adoption through the AgriInnovation programme (the precursor to the current "AgriInnovate" and "AgriScience" programmes), for example, have produced substantive outcomes that are oriented toward the future success of the industry. As of March 2016, projects funded through AgriInnovation yielded 37 new products, processes, or technologies that either minimised catastrophic threats to crops, optimised livestock efficiencies, or improved overall food health and safety, and produced an additional 15 innovations related to improved environmental sustainability, including adapted beneficial management practices or new decision-support tools (Office of Audit and Evaluation, 2017[33]).

Several public goods have been valuable in helping producers make informed farm-level decisions in response to natural disaster risks, including sources that advise producers on current conditions (early warning systems), and those that help them to plan and prepare for disaster events (such as knowledge networks). AAFC's National Agro-Climate Information Service's Drought Watch provides a variety of early warnings and climate variability information products and services to the sector, including data on current conditions, information on how weather and climate conditions may impact agriculture, and advice on farm management practices to help producers prepare for and mitigate risk to crops, livestock and land during drought conditions. Other systems that notify producers of upcoming risks with respect to flooding, wildfire, and water availability are managed in collaboration with provincial ministries and municipalities, and risks related to plant health or pest impacts are also monitored. With respect to preparing for potential emerging catastrophic risks, the Canadian Food Inspection Agency and AAFC contribute to an information network on emerging risks related to animal health, which provincial governments then communicate to farmers and industry organisations. At the same time, some additional integration or co-ordination of these efforts could be warranted. In particular, some provincial and territorial initiatives (such as early warning systems or farm decision-making platforms) could be useful for the country as a whole as a means to help producers either mitigate or adapt to risks. Policy makers could explore opportunities to scale-up successful programming to national level for the benefit of all Canadian producers, or identify means through which information collected in one province could be useful in informing response or policy in another. A common mechanism of evaluating and benchmarking these tools could identify and more easily facilitate these types of spillovers.

Functional and resilient infrastructure also facilitate producer-level resilience to natural disasters. At the federal level, Infrastructure Canada engages in programming for rural economic development. Provincial governments are also active in investing in rural infrastructure that benefits the agricultural sector, including enhanced broadband access, expanded weather station networks (with Manitoba and Quebec providing two notable examples) and increased biosecurity at border points. In some cases, municipalities have made investments in infrastructure upgrades that specifically benefited farmers as well.

6.4. Conclusions

Canada's approach to managing catastrophic risk has evolved over the past few decades and agricultural policy frameworks, reflecting the government's goal of shifting to a more proactive policy framework and reducing dependence on reactive policy responses. Beginning with GF2 and continuing through the CAP, greater resources have been devoted to Strategic Initiatives and FPT cost-share programmes that contribute to improved long-term on-farm resilience to natural disasters, by helping farmers prepare for, respond to, and adapt to both their current and future risk environments. In particular, Canada encourages agricultural resilience by emphasising the role of innovation as a proactive risk management strategy, by helping producers to avoid or mitigate the impact of natural disasters. At the same time, current incentive structures reflected in the total BRM package tend to favour productivity-enhancing innovations rather than resilience-building advancements. These two goals need not always be in conflict, with some practices or innovations – such as investments in soil health – potentially furthering both aims. Regardless, more attention should be paid to this balance in future policy frameworks. Capacity building, including training and extension, are also critical to better sector preparedness, although not all producers have the same access to these services, as they are delivered by provincial governments.

At the same time, BRM programmes have been refined to more effectively and efficiently help farmers cope with adverse events. Most prominently, the country has made an effort to reduce *ad hoc* assistance, and instead ensure that financial assistance to help producers cope with and recover from adverse events is delivered through statutory programmes. In particular, the reform of *ad hoc ex post* assistance under the AgriRecovery framework represents an important attempt to both discipline *ad hoc* assistance while also providing a feedback mechanism for improved risk management programme design. The boundaries established by the framework ensure that AgriRecovery does not overlap with other programmes, and that systems are better prepared for future events.

Despite progress in disciplining *ad hoc* assistance, sector resilience could be enhanced through policy adjustments in a few key areas. First, the benefits of Strategic Initiatives and cost-shared FPT programmes could be better realised if successful programming could be easily identified and adopted on a larger scale. Although many instances of successful and innovative Strategic Initiative programmes were identified, these efforts are currently fragmented. Some stronger form of national strategy or co-ordination mechanism could be a beneficial means of ensuring that efforts are not being duplicated in multiple areas, that all producers can benefit from useful innovations in tools or approaches, and that information or results generated through these initiatives is used to inform other advancements in policy where relevant. While locally-tailored tools and approaches remain valuable, in order to more effectively promote the goal of improved resilience overall, policy makers should consider making national-level investments where the greatest value-for-money gains can be achieved after holistically analysing available policy options.

Second, there is an opportunity to explore how linkages between BRM programmes and environmental outcomes could be strengthened to improve the long-term resilience of the sector. Farmland could play an increasingly important role in delivering nature-based solutions to help mitigate the impacts of future natural disasters (including through buffer strips and wetland restoration) – particularly as climate conditions become increasingly variable. Accordingly, there is a need to ensure that the impacts of BRM programmes on environmental outcomes are both well-understood and then taken into account in programme design.

Third, additional evaluation of the performance of the risk management policy toolkit may be needed. Presently, the risk management framework is comprehensive, with policies in some cases extending beyond the catastrophic risk layer. Although the programmes are designed to ensure that producers are not receiving double compensation for losses, there is some overlap in programming, in that there are multiple programmes that could compensate a producer's losses for a given adverse event, increasing the potential for crowding out on-farm resilience and risk management strategies or market solutions. To avoid crowding out in particular, there is a need to critically assess the appropriate threshold for intervention that triggers support for production and income losses under AgriInsurance and AgriStability (programmes that are intended to provide support for catastrophic events). There may also be scope to reconsider the need for so many BRM programmes to be supported by the government. For example, the small average annual farmer contribution to AgriInvest savings accounts (despite the incentive of matching funds) suggests that producers use other risk management tools or strategies to manage normal and middle-range risks, and the lower-than-anticipated proportion of producers withdrawing on their accounts in the face of larger declines also reinforces this view (Del Bianco, 2018[11]).

While the thresholds between risk layers have been more clearly defined in Canada over time, it should be noted that farmer production decisions will reflect those thresholds *and* the whole package of available policy measures. In this regard, there is some evidence that Canada's current overall BRM programme design has incentivised further risk-taking behaviour. As such, the boundaries between normal, marketable, and catastrophic risks may need to be periodically reassessed to determine how much risk should be transferred to the public sector and how much should be the responsibility of producers, with stakeholders bearing in mind that too much reliance on the public sector likely harms long-term farm resilience by incentivising riskier behaviour.

Nevertheless, Canada's process for policy evaluation and evolution provides a good example of how policies can be improved iteratively, supported by evaluation and participatory processes. Policy assessment combined with an understanding of the value of stakeholder dialogue and feedback has been important to the evolution in design of both the overall policy framework and individual programmes and initiatives. Past policy revisions have been underpinned by a serious consideration of evaluation results and adjustments in programme design to resolve identified issues. Recent policy development efforts have integrated farmer and industry viewpoints, and have also established clearer understandings of risk management responsibilities.

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Notes

[1] Supply management continues for the dairy, poultry and egg sectors, and generates significant market price support for dairy products, which accounted for 40% of dairy gross farm receipts in 2016-18 (OECD, 2019[3]).

[2] The AgriRecovery Framework does include quantitative criteria, but these are not public information.

[3] The current liquidity ratio of the average Canadian farm in 2018 was greater than 2, indicating that current assets more than covered current liabilities. However, the average acid test liquidity ratio (liquid assets minus inventories) of 0.433 indicates that these assets may be in formats that may be difficult to immediately covert to cash form. For more information on these concepts, see (Statistics Canada, 2015[35]).

[4] Producers must be located in designated drought or flood regions, which are experiencing forage yields less than 50% of the long-term average as a result of droughts or floods.

[5] See, for example, AAFC (2019[34]).

[6] There are a few exceptions to this provision, including if FPT governments are currently determining whether or not there is an alternative long-term solution, or if they have assessed the situation and determined that it is uninsurable or unable to be effectively addressed through existing government or private sector programmes (Agriculture and Agri-Food Canada, 2018[5]).

7 Resilience to animal and plant health risks in Italy

This chapter examines resilience to animal and plant health risks in Italy. Relevant agricultural policy frameworks are first presented, including a discussion of animal and plant health risk governance according to the three-layer framework. This is followed by a discussion of how the country's agricultural sector stakeholders consider the five resilience dimensions in their approach to managing animal and plant health risk.

7.1. Introduction

The Italian agricultural sector is very diverse and the country is a significant producer of grains, oil crops, fruits, vegetables, dairy, and meat. Within the European Union, Italy has been the largest agricultural economy in terms of gross value added since 2012, and is the largest producer of a variety of goods, including durum wheat, rice, soybean and tomatoes (Eurostat, 2019[1]). Additionally, the country is one of the world's largest exporters of apples, cheese, grapes, ice cream, olive oil, wine and other foodstuffs. While agricultural value added represents 2% of GDP, agriculture still represents nearly 4% of the country's employment (OECD, 2019[2]). In addition to the diversity of production, the sector's farms are very heterogeneous, with a large number of very small farms or non-commercial farms producing alongside increasingly larger farms that are competing in international markets.

Previous investigations have concluded that agriculture in the Mediterranean Basin is highly exposed and vulnerable to climatic risks, with producers also facing a wide range of risks from plant and animal diseases related to the diversity of production (Pontrandolfi et al., 2016[3]). Managing animal and plant disease risk is particularly challenging for the sector. Italy's fruit and vegetable sector is exposed to a large number of plant diseases and, as a significant producer, faces potentially high losses in the event of a disease outbreak. Similarly, with large national herds of cattle, sheep, and poultry, preventing and managing animal disease outbreaks is also a major priority for the sector. In both cases, preventative measures and pre-established response frameworks are key to averting negative impacts from these types of risks. However, very small farms may lack the necessary skills, resources or incentives to take preventative measures, which in turn can have implications for the sector as a whole. As a result, a key challenge for the government is ensuring that all farms – including small, non-commercial enterprises – are both incentivised and have the capacity to implement on-farm biosecurity measures necessary to manage pests and diseases.

This case study examines Italy's approach to improving sector resilience with respect to animal and plant health risks. First, the case study describes the current state of the sector and the policy landscape. It then assesses the measures Italy is taking to manage animal and plant health risks according to the five dimensions of the OECD risk management framework for agricultural resilience.

7.2. Sector and current policy landscape

The Italian agricultural sector has undergone substantial restructuring in recent decades; nevertheless, the sector remains extremely heterogeneous. Italy has a large number of very small farms, some of which have low productivity, while others are poorly integrated into agricultural markets. In fact, around one-quarter of farms produce solely for their own consumption, and even amongst farms that sell their products, more than half registered sales of less than EUR 10 000 in 2010 (Buglione et al., 2018[4]). There are also larger, increasingly specialised commercial farms that are competitive in international markets (Cardillo et al., 2016[5]). This heterogeneity has implications for producer capacities to compete – including their ability to respond to and manage risk (Box 7.1).

Animal and plant health risks are addressed under both agricultural and public health policy frameworks, with supranational EU policy structures overseeing both. Agricultural policy (including policies with respect to risk management) is elaborated under the EU Common Agricultural Policy (CAP), but some national-level risk management tools are also in place outside of the CAP (Box 4.2). Regulations on animal and plant health are overseen by the European Food Safety Authority (EFSA) under the EU Directorate-General for Health and Food Safety.[1] Policies, practices, and frameworks developed at these two levels have implications for how animal and plant health risk is managed in Italy, both at the farm level and in the sector at large.

Box 7.1. TFP growth and innovation in Italian agriculture

Despite evidence of structural change in the Italian farm sector over the past few decades, growth in total factor productivity (TFP) was virtually stagnant in Italy between 2006 and 2016 (Buglione et al., 2018[4]). Various factors underlie this weak growth, including lack of economies of scale, fragmentation in production, and poor farmer managerial skills, with the overall implication that many Italian farms are not driven to innovate, invest, or modernise.

But estimates of aggregate TFP mask divergences between larger professional operations and smaller farms that are less market-oriented. The differences between these two groups are starkest when examining agricultural activities regionally. Agriculture in the southern part of the country is largely less productive and relies on products that have higher off-farm value added. Moreover, output in value added per worker is around half that of counterparts in the country's center-north, where agriculture is increasingly focused on intensification and production of high quality goods (SVIMEZ-ISMEA, 2018[6]).

Nonetheless, growth of market-driven and innovative firms is beginning to change the overall dynamics of the sector – farm sizes are increasing, there has been a marked reduction in the number of farm entities that allocate more than half of their production to own consumption (from 40% in 2010 down to 22% in 2013), and labour productivity rose by 9.3% between 2007 and 2016 (Buglione et al., 2018[4]). These statistics reflect general structural change, investments in technical efficiency, and a higher focus on production of quality goods.

Box 7.2. Agricultural policies for risk management

Agricultural risk management in Italy is governed under EU and national level policies.

EU Level

Agricultural policy at EU level is governed under CAP,[1] which is comprised of two Pillars.

- Pillar 1: Direct Payments and Common Market Organisation (CMO)

  Direct payments are based on farm area, and are conditional on complying with certain production and environmental management practices. In addition, Italy enacts voluntary coupled support for certain sectors and participates in the Small Farmers Scheme, which provides a simplified direct payment to farmers (of EUR 1 250 per farmer at maximum) and also exempts them from environmental management obligations. Outside of direct payments, the CMO portion of Pillar 1 provides the framework for market intervention measures, including public intervention (purchase and storage of certain products by EU countries, which are then sold back onto the market at a later date), storage aid to the private sector, exceptional measures, and sector specific aid schemes (including some insurance schemes and mutual funds, such as the wine or fruit and vegetable schemes). Both direct payments and market measures are intended to help producers manage price or income risk. The Pillar 1 budget for Italy for 2014-20 is more than EUR 27 billion.

- Pillar 2: Rural Development Programme

  Programming under the Rural Development Programme is designed to meet objectives in six priority areas, using a menu of 20 pre-defined policy measures. Member States or regions develop their own plans to meet overall objectives. Italy manages funds through 21 regional Rural Development Plans (RDPs) and two national-level programmes, with specific risk management

tools covered under the national RDP. Italy's rural development budget for 2014-20 is EUR 20.9 billion – initiatives are co-financed, with EUR 10.4 billion coming from the EU budget.

Measures specifically targeting improved risk management fall under Focus Area 3B: "Farm risk prevention and management".[2] Measures (M) funded in Italy to achieve targets under 3B, along with share of expenditures under 3B, include:

- M01: Knowledge transfer and information (0.3%)
- M02: Farm management and advisory services (0.4%)
- M05: Restoration of assets or prevention (12%)
- M08: Investments in forest areas (1%)
- M16: Co-operation (0.4%)
- M17: Risk management (85%)

Italy

Italy's agricultural risk management policy tools are detailed each year in an annual "National Risk Management Plan" released by the Ministry of Agricultural, Food and Forestry Policies (MiPAAF). The plan defines the available risk management tools available within the scope of CAP Pillar 2 (including a list of the crops and animals for which insurance products can be developed, as well as insurable events – including catastrophes and other adversities, plant pests and diseases, and animal diseases), as well as national-level tools outside the CAP. Within the scope of the CAP, risk management tools such as insurance are funded under M17 (although other measures can be used to improve farm-level risk management, as observed by the spending allocations under Focus Area 3B). For 2014-20, Italy has allocated funding to the following tools:

- 17.1 – Financial contributions to premiums for crop, animal and plant insurance (87.4%).
- 17.2 – Financial contributions to mutual funds (6.3%).
- 17.3 – Income stabilisation tool (6.3%).

Outside of the CAP, Italy also provides assistance for agricultural risk management in various forms through the National Solidarity Fund (FSN), including:

- Financial contributions to premiums for insurance against the destruction of animals in response to disease.
- Financial contributions to premiums for insurance of agricultural structures.
- Financial contributions to premiums for index-based policies.
- Financial contributions to premiums for revenue-based insurance policies for durum and soft wheat.
- *Ad hoc, ex post c*ompensation for expenses incurred by agricultural enterprises for the restoration of production activity following damage to production, structures, or infrastructure, only in cases where the damage is caused by an event not elaborated by the National Risk Management Plan.

Notes:

1. For a more detailed description of the complete EU agricultural policy structure under CAP, see (OECD, 2017[7]).

2. At the same time, it should be noted that expenditures on other measures could have implications for improved risk management whether or not they are considered under FA3B, including spending on research, farm management, and knowledge transfer.

Sources: MiPAAF (2019[8]) Report di Avanzamento della Spesa pubblica dei Programmi di Sviluppo Rurale 2014-2020: Secondo trimestre 2019; European Commission (2016[9]) CAP in Your Country: Italy; ENRD (2017[10]) Focus Area 3B: Farm Risk Prevention and Management; ISMEA (2019[11]) Rapporto sulla gestione del rischio in agricoltura 2019.

Governance arrangements for managing animal and plant health risks – including biosecurity system infrastructure, services, regulations and emergency response frameworks – are prescribed in dedicated legislation. Regarding animal health, the new EU Animal Health Law (EU Regulation 2016/429) entered into force in April 2016, and will apply from 21 April 2021. This regulation streamlines the legislative framework governing animal health in the European Union (which was previously addressed under multiple regulations), and is based on the "One Health" premise that prevention is preferable to the cure. The Law provides the overarching animal health framework for all EU Member States, including laying out a harmonised approach for disease prevention, notification, control and eradication; defining priority diseases; and prescribing provisions for dealing with emerging diseases. The regulation also elaborates the responsibilities of the different actors in managing animal health risk:

- Farm operators should bear primary responsibility for prevention and control of the spread of animal diseases, including the obligations to keep up-to-date animal health records, and to immediately notify authorities when they suspect the presence of certain diseases.
- Veterinarians are tasked with taking all appropriate measures to prevent the introduction, development and spread of diseases, including early detection, proper diagnosis, and awareness-raising.
- Member States are required to ensure the functionality of a competent animal health authority, which should oversee tasks including application of eradication measures, implementation of a surveillance programme, disease awareness, reporting on disease incidence, and registration of livestock operations.
- Penalties for non-compliance with the regulation are set by the individual Member States.

Italy has yet to put in place an implementing regulation detailing the specifics on how it will implement the EU Animal Health Law. In the meantime, animal health in Italy is governed by various regulations (including, for example, the Veterinary Policy Rule 320/54), but remains the responsibility of the Director General of Animal Health and Veterinary Medicine under the Ministry of Health. That agency is responsible for surveillance, maintaining a registry of livestock operations, running a central crisis unit for emergency situations, carrying out audits and inspections for compliance, and generally managing risk in the area of animal health.

Similarly for plant health, a new EU "Plant Health Law" (EU Regulation 2016/2031) entered into force on 13 December 2016, and will be applicable from 14 December 2019. This regulation builds on previous legislation to provide the overall framework for preventing the introduction or spread of harmful pests and diseases that affect all crops, fruits, vegetables, flowers, ornamentals and forests, and is based on provisions laid down in the International Plant Protection Convention (IPPC). Among its provisions, the Law stresses the importance of prevention and early detection and mandates systematic pest surveys to that end; establishes lists of quarantine and priority pests that could potentially have large economic, environmental or social impacts; describes the notification obligations for Member States and operators; and lays out the rules on movements of plants and plant products. Specific responsibilities assigned to the different actors in the regulation include:

- Operators (including farmers, but also other actors involved in the production, transport, and trade of plants and plant products) are obligated to notify competent authorities if they suspect the presence of a quarantine pest, provide the competent authority with all needed information, and take necessary measures needed to prevent the spread of the pest in question in accordance with any instructions provided by the competent authority.
- Member States are tasked with carrying out surveys for quarantine pests, taking all necessary phytosanitary measures to eradicate quarantine pests (including the establishment of demarcated areas consisting of an infested zone and a buffer zone), notifying the Commission and the other Member States when its competent authority confirms the presence of a new quarantine pest in its

territory or in a part of its territory where it was previously not present, and establishing contingency plans for priority pests capable of entering its territory.

- As with the Animal Health Law, penalties for non-compliance are set by the Member States.

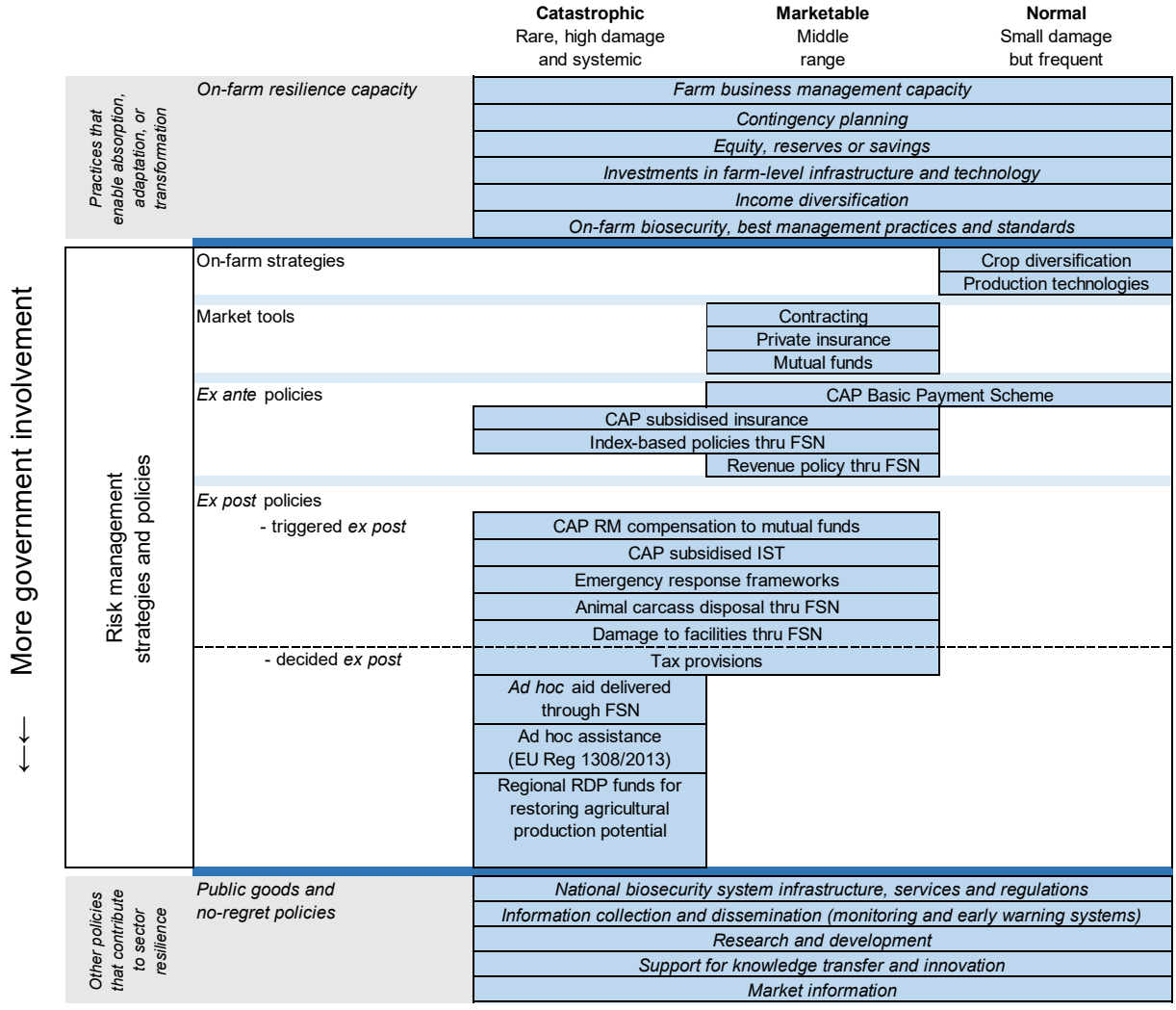
There is as yet no implementing regulation for the application of the Plant Health Law in Italy, but responsibilities for plant health and protection are carried out under the previous legislation by the National Phytosanitary Service (SFN) under the direction of MiPAAF. Among its functions, SFN is responsible for phytosanitary control of imports, implementing a permanent monitoring programme, handling phytosanitary emergencies, and certifying exports. SFN is comprised of a central unit, regional phytosanitary service offices, and a national phytosanitary committee, which carries out both technical consultative and propositional activities.

Prevention and management of plant and animal disease risks cut across risk management layers, with measures, tools, and strategies needed at all levels – producers can reduce their risk exposure through farm management and good agricultural practices (including on-farm biosecurity measures) – and they can use on-farm risk management strategies to cope with small reductions in farm income; private sector tools are available to help manage mid-range declines in income (including losses due to plant and animal diseases); and government risk management policies help farmers to cope with large income declines through both *ex ante* and *ex post* arrangements (including disaster payments, mutual funds, and IST). General services for the sector, such as national biosecurity systems, monitoring and early warning systems, and investments in research and knowledge transfer, also play a role in disease prevention and management (Figure 7.1).

There is evidence that farmers are investing more in developing their on-farm resilience capacities, in terms of human capital and capacity to deal with fluctuating farm incomes, although national averages may mask relative differences in capacity between very small and larger, more market-oriented farms. Available statistics with respect to on-farm human capital indicate that the overall share of farm enterprise heads with some agricultural training is low – just 5.3% of producers in 2013, compared to 8.3% in the European Union overall (Buglione et al., 2018[4]). At the same time, statistics also indicate that the educational attainment of Italy's next generation of farmers is improving relative to previous generations, and the number of farmers engaging in agricultural training is also on the rise (Buglione et al., 2018[4]). In 2013, just over 30% of all of the country's farmers had attained at least a high school diploma. However, amongst farmers under the age of 40, 67% had at least a high school degree, with 13% having graduated university – double the 6% share for the sector as a whole.[2] Shifts in the structure of the industry also signify an increasing prevalence of professional versus subsistence farms – while the number of farms declined by nearly 20% from 2007-17, the number of professional entities organised as joint-stock companies and partnerships rose (SVIMEZ-ISMEA, 2018[6]).

Financial capacity is also crucial for on-farm resilience to risk. In this area, enterprise diversification has been a priority for sector development. Over the past decade, the financial importance of secondary income-generating activities to farms increased in every Italian region. By 2018, the contribution of secondary on-farm activities and support activities had grown to 21% of all value produced from agriculture, with renewable energy generation (mostly solar power) and agritourism the most important on-farm income diversifying activities (ISTAT, 2019[12]). The growth of agritourism in particular has been substantial in Italy, with more than 23 000 firms registered in 2017, up from 13 000 in 2013 (ISTAT, 2018[13]; Buglione et al., 2018[4]). Farms also practice product diversification. An analysis of farm-level data from 1981-2003 indicates that over that time frame, Italian farms cultivated 4.7 crops on average (Bozzola, 2014[14]). Finally, a majority of Italian farms have a good capacity to repay their current liabilities – 62.5% of farms have a liquidity index score that is acceptable (between 0.5 and 1) or positive (greater than 1) (SVIMEZ-ISMEA, 2018[6]).

Figure 7.1. Strategies and policies employed in Italy for animal and plant health risk management and resilience



Source: Author's own elaboration.

Market instruments utilised fall into two categories – instruments that help producers to manage the financial losses associated with plant and animal health risk, and those that help producers to prevent losses from these risks. With respect to the first category, some market instruments are available, although risk markets in general are considered poorly developed in Italy compared to other OECD countries (ISMEA, 2018[15]). A few private insurance products are offered for plant and animal disease risks, and some private, non-subsidised mutual funds are also available (DG Agri, 2017[16]). With respect to instruments for prevention, private consortiums are increasingly developing decision support tools to help producers mitigate or manage mid-level animal and plant disease risks. For example, the CondifesaTVB producer consortium located in the Veneto region offers a digital decision support tool (in the form of an App) to wine grape growers to facilitate better management of phytosanitary risks. The App – BODI™ – forecasts meteorological conditions at the vineyard level, calculates a risk index for certain pathogens, and offers a list of authorised crop protection products to confront the risk.[3] Italian farmers also increasingly purchase consultancy services aimed at helping them to adopt optimal practices to reduce their risk exposure. On average, Italian farmers spend the same amount on consultancy services as on insurance premiums (Pontrandolfi et al., 2016[3]).

Government assistance to cope with animal and plant health risks is provided through a range of measures that cover agricultural risks more broadly, including *ex ante* measures, measures that are triggered *ex post* but defined *ex ante,* and measures that are defined *ex post*. The largest of the *ex ante* measures are direct payments received by producers under CAP Pillar 1, representing 63.2% of Italy's CAP expenditures in 2018 (DG Agri, 2019[17]). Although these payments are not designed as a risk management tool, they do contribute to farm income stabilisation for some of the country's producers. In particular, CAP payments between 2005 and 2012 were estimated to cover 100% of variable costs on average for farms that are not insured, indicating that they had little need for additional risk management tools (Pontrandolfi et al., 2016[3]).

Under CAP Pillar 2 (Rural Development Programme) the largest *ex ante* government risk management measure is support for subsidised crop and livestock insurance policies (with policies covering losses in both volume and product quality) – an estimated 87.4% of expenditures on risk management tools funded under M17 are dedicated to insurance premium subsidies (ISMEA, 2019[11]). Policies are administered by insurance companies, but the premiums are subsidised through RD funds at a maximum rate of 70%,[4] with the minimum threshold for compensation set at production loss of 20%. Italy has also recently introduced some new types of insurance policies funded through the FSN, including index-based policies for cereals, forage crops and oilseeds, and a revenue guarantee for durum and soft wheat. Thresholds for these policies are higher (damage must exceed 30%), and support is lower (65% of premiums). In 2018, nearly 62 000 farmers purchased insurance, representing the first rise in policy purchases since 2014. However, coverage rates vary widely based on region and commodity – nationwide, 18.7% of the value of crop production is insured, but coverage rises to more than 30% in regions with substantial production of high-value crops like wine grapes and apples (ISMEA, 2019[11]). In conjunction with these subsidised insurance policies, there is a large market for supplemental, non-subsidised policies, nearly all of which provide coverage for losses even smaller than the 20% threshold of subsidised policies. Of producers who purchase subsidised policies, 90% purchase a supplementary policy as well (ISMEA, 2019[11]).

Other provisions of the CAP are defined *ex ante*, but are triggered *ex post* for responding to risks to plant or animal health. These are namely CAP risk management tools activated by the Italian Government to help farmers manage larger declines in income and catastrophic risks, including support for mutual funds using M17.2, and support for sectoral income stabilisation tools (IST) under M17.3 (Box 4.2). Mutual funds can be set up to provide compensation for adverse weather conditions, animal and plant diseases, pest infestations, and environmental emergencies. The government can provide subsidies for up to 70% of the premium, and the damage threshold for compensation under the funds is a minimum of 30% (ISMEA, 2019[11]). Italy has also introduced sectoral level IST tools for fruits and vegetables, durum wheat, cow's milk, olive cultivation, and poultry. The tools use cost indices to calculate income losses, which facilitates the calculation and reduces the reporting burden for individual farms. Up to 70% of the premium is subsidised, and damages must exceed 20%. However, having been so recently introduced within the 2019 National Risk Management Plan, data on uptake, expenditures and outcomes under these new tools is not yet available.

Outside of the CAP, two noteworthy types of *ex ante* policy frameworks that are triggered *ex post* are relevant in dealing with catastrophic animal or plant disease events. First of all, effective catastrophic event response depends upon having effective emergency response frameworks in place prior to a disease event. For animal diseases, the Ministry of Health operates the Central Crisis Unit (UCC), which brings together stakeholders from across the government to ensure that the response to a disease outbreak is effective and co-ordinated. Aside from these emergency frameworks, the Italian Government also subsidises premiums for insurance against damage to agricultural facilities and for the destruction of livestock necessary to mitigate the spread of disease under the FSN. These policies have no damage threshold, but are subsidised at a rate of 50%. Most spending on premium subsidies through the FSN (68%) supports policies for animal carcass removal (ISMEA, 2019[11]).

Italy also provides some assistance that is decided *ex post*, but it represents a small amount of resources overall. The first is support through the FSN to restore agricultural production activities following damage to production, facilities, or infrastructure that is not covered under the National Risk Management Plan. Payments of this type are estimated to account for roughly 8% of annual total risk management expenditures (ISMEA, 2018[15]). This setup serves to discipline *ad hoc* payments, as assistance through the FSN is only available for non-insurable events. Payments are subject to fund availability, and typically only cover a fraction of damage incurred. *Ad hoc* assistance can also be delivered through certain EU provisions. For example, EU Regulation 1308/2013 defining the rules for the Common Market Organisation (CMO) allows the implementation of exceptional support measures in response to severe market disturbances attributed to a loss in consumer confidence due to public, animal or plant health and disease risks. CMO measures can be activated in response to large declines in prices for any reason, however. In 2018, market measures activated under the CMO represented 11% of Italy's CAP expenditures, with Italy spending more on market measures than any other EU Member State (DG Agri, 2019[17]; DG Agri, 2019[18]). Outside of these measures, regional RDP funds can also be used to provide *ex post* assistance – all regions allow some funds for M05 on "Restoring agricultural production potential damaged by natural disasters and introduction of appropriate prevention" in their plans, but these are typically used for a very specific sector that has been damaged by a certain risk. However, as funds can also be used for preventative measures, the share of payments that qualifies as *ex post* assistance is not clear. Finally, discounts on tax bills are also sometimes enacted *ex post* for farmers that have experienced catastrophic events.

The Italian Government also helps farmers to manage animal and plant health risks through no-regret policies such as expenditures on public goods to help to prevent disease outbreaks from occurring, and support for better on-farm decision-making. Such measures play an important role in preventing disease outbreaks and mitigating their impacts.

Most prominently with respect to plant and animal health, the government has a role in maintaining national veterinary and plant health systems and organisations that prevent, control, and monitor diseases, supported by an effective regulatory framework (OECD, 2017[19]). In the realm of animal health, these functions are carried out by the Directorate of Animal Health and Veterinary Medicine under the Ministry of Health. One of the areas that the Directorate oversees is information sharing with respect to disease monitoring and notification. Regarding monitoring, the Directorate prepares an annual plan for the prevention and control of main diseases, in accordance with EU and Italian legislation. Animal disease outbreaks can be notified through the National Animal Disease Information System (SIMAN) on the Veterinary Information System website (Salute, 2018[20]). Confirmed cases of diseases for which notification is required[5] are then transmitted to the EU-wide Animal Disease Notification System (ADNS). The Directorate is also launching a collaborative platform – called ClassyFarm – between veterinary officials and corporate veterinarians to improve sector-wide collaboration in the management of animal disease risk. The goals of the platform include improving monitoring, analysis, and better targeting interventions for improved food safety and quality, outside of merely disease reporting.

On plant health, and in accordance with both national and EU regulations, Italy executes an annual plant pest and health monitoring exercise with the goals of detecting new outbreaks in a timely manner and providing detailed information on the status of known outbreaks so that appropriate phytosanitary measures can be taken in response (MiPAAF, 2019[21]). The annual national monitoring exercise includes a detailed plan that identifies where assessments should be carried out (home gardens, cultivated areas, nurseries, forests, green spaces, or other sites) for a list of different specific pests in all of Italy's regions.

In conjunction with monitoring efforts, early warning and information systems are in place for both plant and animal diseases, typically in the form of web portals.[6] These include general information portals (such as the Italian Veterinary Information System[7] and the National Veterinary Epidemiological Bulletin[8]) and portals focused on specific diseases, (such as the Blue Tongue Information System[9] and the Emergenza *Xylella*[10] sites). International organisations also publish information portals that can be utilised by

stakeholders, including the OIE's WAHIS Interface,[11] the EPPO Alert List,[12] or the joint FAO-OIE-WHO Global Early Warning System for health threats and emerging risks at the human-animal-ecosystems interface (GLEWS+).[13] These information collection and monitoring systems function in combination with established plant and animal health standards and frameworks, which define the diseases to be monitored, the appropriate response or preventative measures needed to reduce or eliminate a given threat, and the relevant responsibilities of different actors. However, the usefulness of these systems in reaching the country's older farmers – who are typically less connected to technology – may be limited.

Research and innovation that contribute to better management of animal and plant diseases in Italy are funded under different mechanisms, and potentially involve a large network of institutions. With respect to funding arrangements, individual regional RDPs can fund specific projects. At the same time, many initiatives contained within regional RDPs are conducted under the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) – one of five EU innovation partnerships founded in 2012 that brings together different actors (farmers, researchers, experts, businesses, NGOs) from a variety of backgrounds (public, private, national and regional) to speed innovation through an interactive approach. Through the EIP network, temporary EIP-AGRI Focus Groups can be set up to investigate a specific subject, including taking stock of research or identifying needs for further work. RDP funds can be used to set up EIP-AGRI Operational Groups that tackle a specific practical problem or opportunity, which could lead to a new innovation. While RDP-funded projects confront more localised issues, Italy also benefits from the EU-wide Horizon 2020 research programme, which provides EUR 3.7 billion for funding over seven years for projects related to "Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy." Horizon 2020 funds can also support EIP-AGRI projects or multi-actor thematic networks, which compile existing knowledge and disseminate it to relevant stakeholders. Using these (and other) sources of funding, Italy is home to various research institutions with high capacity for innovation in food and agriculture, including the Council for Agricultural Research and Analysis of the Agricultural Economy (CREA), the Institute for Sustainable Plant Protection (IPSP), the Institute of Services for the Agricultural Food Market (ISMEA), National Research Council (Consiglio Nazionale delle Ricerche), and the network of ten Experimental Zooprophylactic Institutes (IZS), as well as research capacity housed in universities.

In conjunction with research and development efforts, other no-regret investments funded through regional RDPs contribute to better on-farm capacity to manage risk in Italy (including animal and plant health risks). For example, under the 2007-2013 CAP, around 169 000 farmers participated in training courses, 32 000 farmers received advisory services, 44 000 farms received assistance to fund farm modernising improvements, and 6 300 farm enterprises received support for diversification (Buglione et al., 2018[4]). Under the 2014-2020 CAP within the risk management sphere specifically, all regions allocate some funding to restoring damaged production capacity or introducing preventative measures to mitigate natural disaster risk, and more than half of regions devote a small part of their RDP funds to knowledge transfer and innovation initiatives specific to risk prevention and management (ISMEA, 2019[11]). Numerous regions also fund co-operation projects undertaken to better integrate researchers, farmers, and the private sector in developing innovations for the sector.

Finally, the Italian Government also produces other information that helps producers to make farm management decisions. These include data and reports that track general sectoral trends, market monitoring and outlook reports, which are produced periodically by ISMEA.

7.3. Italy's experience in managing animal and plant health risk for resilience

There is a strong awareness in Italy that the risk landscape is shifting, and that in response, the country's agricultural risk management policy framework needs to be both comprehensive – that is, effective in helping to manage a wide range of risks – as well as flexible enough to adjust to constantly changing

circumstances. In the area of animal and plant disease risk, current disease outbreaks are testing the country's prevention and response frameworks, demonstrating areas where the systems are working well, but also indicating where further resources should be devoted to improve the sector's resilience to these types of risks.

7.3.1. Shift toward ex ante instruments is reflected in support received by producers and Italy's policy approach, but improved long-term disease risk management requires greater focus on prevention and planning

Improving sector resilience to plant and animal diseases depends upon establishing policy frameworks, response mechanisms, preventative measures and research capacity in advance of disease outbreaks to both mitigate their effects (for example, by limiting their spread), and also to help producers cope with negative outcomes in a predictable way. Recent domestic reviews of the country's risk management framework stress the importance of the holistic approach to risk in agriculture, including encouraging the development of flexible *ex ante* and *ex post* policies designed to respond to a variety of potential scenarios (ISMEA, 2018[15]). Additionally, developments in EU-level legislation on animal and plant health have made strides to better emphasise the importance of prevention in managing these types of risks.

Italy has already taken steps to shift its risk management policy framework to focus on *ex ante* instruments, reflected through its support for insurance products (and to a lesser extent, measures that are set up *ex ante* but triggered *ex post*, such as support for mutual funds or the income stabilisation tool). These measures also cover farm financial risks, which are not specific to impacts of animal or plant disease events. Around 76% of Italy's risk management spending is for *ex ante* measures like insurance, with an additional 13% of spending on RD measures, and 11% of spending coming from the FSN (which includes both *ex ante* and *ex post* measures) (ISMEA, 2018[15]). Following reforms to EU rules in the 2017 Omnibus regulation, uptake and coverage levels for insurance have increased, suggesting that more producers are in a position to financially cope with severe losses (ISMEA, 2019[11]). Italy has also shown a willingness to refine its risk management tools to provide more cost-effective coverage and help producers hedge against risk (both by electing to fund the different risk management measures available under CAP, and also by making legislative changes to allow the development of these new tools). However, the lack of clear guidance and details on policy implementation has so far hindered their development and uptake (Cordier and Santeramo, 2019[22]).

At the same time, there is an awareness that a more holistic approach to managing risk is needed, particularly to develop new risk management tools; reduce the heavy reliance on insurance premium subsidies in the risk management framework; and enhance the use of RDP measures for risk prevention, innovation, and training (ISMEA, 2018[15]; Pontrandolfi et al., 2016[3]). In particular, there is scope to increase support to risk prevention measures that would reduce the need for these tools by helping producers to avoid negative impacts from adverse events in the first place – particularly through greater awareness and training regarding good on-farm biosecurity practices.

Despite this awareness, risk prevention is not a focus of the current National Risk Management Plan. While RD measures under M05 (funds for the restoration of production potential damaged by disasters and the use of preventative measures) and M08 (including funding to prevent damage to forests) are mentioned in the National Risk Management Plan, there is no further elaboration or emphasis on the importance of those activities in Italy's framework for managing risk in agriculture. This is somewhat reflected in the share of funding for prevention in domestic expenditures – from 2014 to 2018, support for risk management tools has averaged around 8.4% of total domestic spending, while support for M05 (restoration and prevention) has averaged only 1.6% of spending, leaving risk prevention with a still smaller share.[14] Further on from funding shares, M05 is activated with respect to plant and animal health threats in fewer than one third of the regional RDPs.[15] To some extent, this reflects the relative economic threat posed by some specific

risks to the regions in question given their main sectors, but the lack of measures taken by adjacent regions suggests that a more integrated approach to prevention of these risks could be warranted.

Increased focus on prevention on-farm through the implementation of good biosecurity practices could be complemented by additional forward-looking activities, including more dedicated and co-ordinated efforts to anticipate new diseases, prepare response plans, and notify actors about emerging or imminent threats. For example, foresighting activities such as horizon scanning, scenario analysis and sector outlooks can help build long-term resilience. Italian stakeholders conduct scenario analyses to inform policy frameworks (both as part of their seven-year planning process to support *ex ante* policy measures, and to inform the yearly reviews of the National Risk Management Plans), but there are no systematic foresighting exercises carried out by domestic stakeholders with a view to reducing risk exposure or increasing preparedness.[16] Multi-stakeholder foresighting exercises have the potential to improve sector resilience through multiple pathways, including informing policy makers on industry priorities and capacity to manage or respond to risks; informing contingency planning exercises and research priorities; and providing a vehicle to improve farm-level preparedness for these risks by helping farmers to better understand how uncertain future events could impact their operations. Some projects of this nature have been undertaken that targeted better sector-wide preparedness, which could provide a blueprint for future exercises. For example, the joint JRC/EFSA CLIMPEST project looked at how geographical disease risk for citrus black spot would likely evolve under potential climate change scenarios (Castellari S., Venturini S., Ballarin Denti A., Bigano A., Bindi M. et al., 2014[23]). There could also be scope to link the annual pest monitoring exercise to longer-term foresighting or scenario planning activities.

7.3.2. Gains in producer incentives for on-farm risk management from discipline of ad hoc assistance may be offset by other CAP measures

Italy has made a number of policy adjustments towards giving more incentives for farmers to better manage their risks from animal and plant diseases (although most of these policies are not specific to animal and plant health risks). These shifts imply trade-offs in budget, time frame, and outcomes. First of all, Italy has made substantial progress in reducing *ad hoc* disaster assistance available for all types of adverse events under the FSN. Because the programme is now only available for carcass disposal, repair of structures, or to restore productive activities damaged by events not outlined in the National Risk Management Plan, the layers of responsibility are clear. Consequently, national outlays under FSN represent only a very small amount of total damages incurred due to catastrophic events – the fund paid out EUR 29 million in assistance in 2017, representing just 1.5% of total damages incurred (ISMEA, 2019[11]). Some operational limitations of the FSN may also disincentivise producers from depending on it in cases of catastrophic losses – past analysis indicated that compensation from FSN is not well-linked to the damage incurred, and the time lag between the event and the compensation can be substantial (Santeramo et al., 2016[24]).

This limited availability of *ad hoc* assistance should serve as an incentive for producers to take more responsibility for managing general farm risk, including from animal and plant health events (either by implementing on-farm measures, or through the utilisation of risk management tools). However, the net effect for on-farm risk management is less clear given conflicting incentives from the rest of the policy framework of support under the CAP. Although a substantial portion of Italy's RD funding is dedicated to risk management, spending is small compared to direct payments under Pillar 1, which represented nearly two-thirds of Italy's CAP expenditures in 2018 (DG Agri, 2019[17]). While direct payments can have an income stabilising effect, they also limit producer risk management incentives – specifically, direct payments can crowd out other risk management strategies and tools (Mathijs, 2017[25]). Evidence for crowding out has been found in the Italian context – research on Tuscan farms indicated that while farms that received single farm payments were more likely to undertake at least one on-farm diversification activity, higher direct payments reduced the overall number of diversification activities (Bartolini, Andreoli and Brunori, 2014[26]). Other authors found that direct payments are actually correlated to higher revenue variability, indicating that because the payments stabilise total farm income, they can incentivise farmers

to make riskier production choices (knowing that their total income will remain stable), and they can also detract from the uptake of specifically-designed risk management instruments (Severini, Tantari and Tommaso, 2017[27]).

Direct payments may also crowd out use of other risk management tools, such as insurance. By a large margin, the most commonly insured crops nationwide (by both number of farms and total insured value) are specialty crops, led by wine grapes and apples (ISMEA, 2019[11]). These crops receive less support under Pillar 1 (although Pillar 1 does include some measures for the wine sector, in Italy the wine sector is not included in the direct payment scheme), and analysis has concluded that direct payments have no income stabilising effect for horticultural farms (Severini, Tantari and Di Tommaso, 2016[28]). In contrast, the types of farms where researchers found that direct payments contributed to farm income stabilisation were those for which direct payments comprise a greater share of total farm income – typically farms raising field crops, grazing livestock, or mixed livestock/mixed crops-livestock.

While there is evidence that provisions of the CAP can cause some crowding out of other risk management efforts, the risk management programme menu itself is likely not affecting production decisions. The national risk management plan provides for insurance policies for a wide variety of crops and livestock, and insures producers against a variety of risks – no specific sector is favoured. The IST, however, has thus far been defined only for certain sectors (poultry, bovine milk, fruit and vegetables, wheat, and olive growing).

Although substantial resources have been devoted to tools to help producers absorb the consequences of adverse events, the comparative focus on animal and plant health risk prevention, adaptation and transformation is less pronounced, at least within the context of CAP – spending on pest and disease control measures (which could fund either prevention or *ex post* mitigation) averages less than 1% of Rural Development expenditures, and spending on natural disaster prevention is similarly limited. These activities could be funded through other mechanisms, but at the very least, prevention, adaptation and transformation are not a focus of the CAP. At the same time, there is greater awareness that adaptation and transformation may be critical to the sector's future, and consequently, these are concepts that are increasingly considered in research programmes and discussions of the future direction of the sector.

7.3.3. Policy frameworks evolve in collaboration with stakeholders, but ineffective incentives coupled with gaps in communication and public trust have undermined past disease control efforts

Previous OECD work has noted that the management of risks from pests and diseases is more complicated because the unobservable actions of individuals can have strong externalities, with the implication that the primary policy challenge in this area is ensuring appropriate incentives for farmers and all stakeholders to take socially efficient action to prevent outbreaks (OECD, 2011[29]). Processes that collaboratively establish risk management responsibilities can contribute to the development of these types of incentive structures by ensuring that the perspectives and objectives of all stakeholders are considered collectively.

Italy's current policy framework is developed under a collaborative and iterative process. The annual development of the National Risk Management Plan takes place after a consultation process with a technical committee composed of representatives from regions, crop protection associations, the insurance sector, and farmers. The effectiveness of the previous plan is also evaluated within the technical committee, which can lead to revisions of the overall plan or adjustments in the design or offer of insurance policies.

At the same time, past events have indicated that additional efforts in this area may be necessary to improve communication and trust amongst stakeholders; firmly establish the risk management responsibilities of different actors; and ensure that all farmers have adequate incentives to prevent and notify risks. This can be particularly challenging in some parts of Italy, where small, non-commercial

farmers have different incentive structures and different risk perceptions. These producers are typically outside of policymaking processes, are less likely to purchase insurance, and may not be reached or influenced by existing risk communication structures.

For example, poor stakeholder co-operation and ineffective risk communication hindered initial containment measures for X*ylella fastidiosa* in Southern Apulia (Saponari et al., 2019[30]). The disease was first found in the region in 2013, leading to the declaration of a state of emergency by the Italian Council of Ministers in February 2015 (Catalano et al., 2019[31]). A strategy for the containment and eradication of the disease was then laid out in 2015,[17] which included the removal of infected plants, the removal of all host plants within a radius of 100 m regardless of their health status, and provisions to manage disease vectors (which would later include mandates for spraying insecticides to control the population of the primary disease vector). However, many farmers in the affected area were resistant to the containment measures, highly sceptical of the underlying science, and questioned the motives of both scientists and authorities (Abbott, 2018[32]). As a result, many growers ignored the mandates, contributing to the disease's spread. Recently, the number of outbreaks in the previous buffer zone indicated that eradication in the zone was no longer possible, resulting in the border of the containment zone being moved 20 km north in June 2018.[18]

Stakeholders recognised that part of the reason for this breakdown is poor public trust, combined with ineffective risk communication. At a 2017 EU Ministerial Conference convened specifically to address the disease, stakeholders agreed to undertake targeted awareness-raising campaigns to improve acceptance of the measures and increase transparency regarding surveillance and control measures by making results available to the public (European Commission, 2017[33]). Embodying these declarations, Italy's "Intervention Plan for the Revival of the Agricultural and Agri-food Sector in the Territories Affected by Xylella," (released by MiPAAF in February 2019 under Ministerial Decree 1785), outlined a targeted communication and outreach strategy to combat *X. fastidiosa*. The strategy includes a dedicated communication team to ensure a coherent national messaging strategy and respond to misinformation, awareness-raising campaigns in affected areas, and the organisation of technical meetings and seminars. In addition, this renewed commitment to transparency has also been evident through the establishment of a dedicated web portal[19] for Apulia that posts the results of monitoring efforts, latest news, and other useful information. These types of measures represent an advance in stakeholder engagement that will help to better define risk management responsibilities for all actors to improve collective disease management outcomes.

7.3.4. On-farm resilience capacities vary across the territory, but examples of experimentation and adaptation capacities on-farm could inform future programme development

As noted above, the Italian farm sector contains both large, commercial farms and very small farms that may not be well-integrated into the market. A large share of farmers producing for their own consumption are also of an advanced age, with very low levels of technology use in their operations and limited capacity or incentive to innovate. But recent evaluations have also indicated that an increasing proportion of the sector is innovating, competitive, and well integrated into world markets.

Italian stakeholders participate in EU-wide knowledge networks that connect producers in different countries to foster collaborative innovation in best practices on plant and animal health. For example, Italian swine producers and stakeholders share information on best practices and innovations for improved health management through the EU Pig Innovation Group portal (EU PiG, 2017[34]), and Italian dairy farms have participated as pilot farms in the EuroDairy thematic network, testing how certain innovations affect biodiversity, resource efficiency, socio-economic resilience, and animal welfare (EuroDairy, 2019[35]).

Italian legislation also includes provisions designed to foster business collaboration and networking among small agricultural firms that may otherwise not have sufficient capital or capacity to undertake new

investments or innovation on their own. For example, a regulation that allows an "agricultural network" contract was introduced in 2014, which permits flexible contractual arrangements among two or more firms without requiring them to merge. This allows smaller agri-food businesses to leverage common resources, achieve scale synergies, and access new technologies to improve their competitive position. By the end of 2017, more than 4 500 agricultural firms were participating in these types of network arrangements (SVIMEZ-ISMEA, 2018[6]).

There is also increasing evidence of on-farm experimentation and innovation to find solutions to animal or plant health issues, which can be supported by certain CAP RD measures. In one example, growers in Apulia collaborated with researchers in testing *X. fastidiosa* disease management strategies, including attempting to identify disease-resistant cultivars in the hopes of rebuilding the local olive sector (Saponari et al., 2019[30]). Although these activities can be funded through various mechanisms, several Italian regions are currently using RD funds from M16 on co-operation to finance pilot projects for the development of new products, practices, processes and technologies.

Recognising that young and beginning farmers may lack the knowledge and capacities to manage risk effectively, a number of programmes include provisions targeting that group specifically. For example, beginning farmers can receive a full grant to cover their insurance premiums, ensuring that they have the capacity to cope with the aftermath of catastrophic losses from animal and plant health events. Specific training and mentorship opportunities also target capacity-building of young farmers. For example, the FarmLab project connects young farmers to host companies for real world operational training on a range of topics, including organic farming, obtaining SPS certifications for nursery products, and utilising precision farming systems to improve crop management.

7.3.5. Resources dedicated to research and other public goods in Italy are producing results, but there is scope for better co-ordination and improved linkages to risk management frameworks

In animal and plant disease risk management frameworks, one of the primary roles of government is the provision of general services that cross all risk layers, including funding research, education, training, risk assessment, communication, information, and providing national biosecurity infrastructure, services and regulations (OECD, 2017[19]). Knowledge generation and innovation is particularly important in managing plant and animal disease, as the threat profiles of diseases can change quickly.

Italy has substantial research expertise in the form of various agencies, universities, and research organisations dedicated to topics in plant and animal health, as well as agricultural risk management more generally. There are also various research projects that are funded at the EU-level. For example, a number of Horizon 2020 projects are underway to either help Italy prepare for new threats or manage existing ones. The Horizon 2020 work programme for 2018-20 funds projects working toward an African swine fever vaccine, cataloguing new and emerging risks to plant health, and investigating integrated health approaches and alternatives to pesticide use (European Commission, 2019[36]). These Horizon 2020 resources have resulted in innovative new approaches to disease identification and management. For example, one project identified a new way to detect *X. fastidiosa* infection in visually asymptomatic trees through remote sensing, potentially greatly facilitating disease containment efforts (Zarco-Tejada et al., 2018[37]). Additional future investments in similar research agendas are also foreseen as the next iteration of the CAP develops (OECD, 2019[38]). In addition to Horizon 2020 projects, several stock-taking exercises have been carried out by EIP-AGRI focus groups (including on olive tree pests and diseases, diseases and pests in viticulture, and reducing antibiotic use in pig farming). Local operational groups under EIP-AGRI are also working on issues related to risk management, including risk mapping and the development of new monitoring systems.

Although there are various research projects underway with implications for improved management of animal and plant health in Italy, there are two additional considerations in this area. First of all, for maximum

effectiveness against cross-border threats, better co-ordination of research and knowledge sharing at EU level may be needed (EASAC, 2014[39]). Encouragingly, progress is being made in this area, as thematic networks supported under EIP-AGRI are a good example of how EU and Italian actors are working to close this gap. Second, although research is underway on some topics that are important to sector viability, overall resources for research have actually fallen – average Italian domestic expenditures on agricultural research have declined by nearly a quarter under CAP 2014-2020, compared with the previous CAP.[20] This decline has been somewhat offset by EU-level spending increases (particular under the Horizon 2020 umbrella), but increased funding for these types of initiatives should be a priority for improved prevention and mitigation.

In order to be effective, research on new methods, production practices and risk prevention measures needs to be disseminated to producers. Knowledge transfer on plant and animal diseases in Italy is carried out through various mechanisms. Rural development M01 and M02 provide funding for knowledge and advisory services of all types, including on topics related to general farm enterprise risk management, and on topics specific to plant and animal health management. Thematic networks under the EIP-AGRI umbrella also contribute in this space. For example, various Italian stakeholders participate in the EU WINETWORK for knowledge transfer and exchange between European wine-growing regions, and one of the network's primary objectives is to co-create a knowledge reservoir on two diseases that affect wine grapes (WINETWORK, 2015[40]). The EIP Operational Groups can also contribute to knowledge transfer, given that they include a cross-section of industry actors. MiPAAF also carries out targeted knowledge transfer activities in the area of risk management, including through information brochures or specific events.

Aside from research, innovation and knowledge transfer, other information services also contribute to biosecurity management. Early warning systems in particular can be a useful tool to communicate animal and plant health risks to stakeholders, facilitating more rapid decision-making to mitigate the risk. For both plant and animal diseases, various early warning platforms exist, hosted both within Italy and externally by other international organisations. For example, the Lombardy region's "Risk Bulletin for Rice Blast Fungus" is produced on a daily basis, with infection risk scores calculated on the basis of weather conditions at the commune level, including the forecast for the coming three days.[21]

While all of these public goods contribute to better animal and plant disease management, they appear to be poorly connected with the National Agricultural Risk Management strategy – as noted above, risk prevention measures for agriculture are not mentioned in the sector's 2019 risk management plan.[22]

7.4. Conclusions

Achieving a truly holistic risk management framework requires ensuring appropriate consideration of risk prevention, risk mitigation and risk coping in one integrated system. With respect to animal and plant disease risk, disease management frameworks at both the EU and Italian national level seem to be clearly defined, although several tools and instruments can be applied outside of the catastrophic layer. At the same time, the risk management framework places heavy emphasis on some parts of this system (particularly risk coping tools), and given the characteristics of the Italian agricultural sector, additional efforts may be needed to adequately address the animal and plant disease risk prevention and mitigation dimensions. Most prominently, a key challenge for the sector is to establish good biosecurity practices among non-commercial farmers. This is particularly important to manage plant and animal diseases, given that inaction by a small number of farmers can result in substantial negative impacts for the sector (Enright and Kao, 2015[41]). Addressing animal and plant health risk in this population starts with an improved understanding of the behavioural drivers (including farmer goals, attitudes, and cultural norms) and risk management capacities of these actors, which would inform the design of targeted prevention and control plans as needed (OECD, 2017[19]). Collaborative approaches should be the bedrock of these plans – these

populations should be targeted through local-level consultations, specifically-tailored communication strategies, and locally-executed extension and education programmes that are developed within the relevant cultural context and with an understanding of farmer capacities and goals. The recently-released *Xylella* intervention plan makes strides in this area, but more regular participatory processes involving these groups should be considered to better manage new future risks.

More effective prevention and mitigation when dealing with evolving animal and plant health risks in Italy also requires devoting resources to research and innovation that reduce the probability of adverse events or reduce the impact of those events. Italy has substantial research expertise that will be crucial for the sector to confront future challenges in the realm of plant and animal health. Projects and initiatives funded through Rural Development and Horizon 2020 are already underway that are investigating new solutions to evolving disease threats. Focus groups operating under EIP-AGRI have brought together a variety of experts in research networks, and farmers are also increasingly involved in the innovation process.

Italy's recent adjustments in risk management frameworks have largely focused on refining risk coping tools. In fact, Italy has been one of the leading proponents of innovating new risk management tools for Europe. Under CAP 2014-20, Italy has spent the most on risk management measures under Pillar 2, and is the only country to have activated all of the available tools – support for insurance, mutual funds, and the income stabilisation tool. However, a lack of guidelines at the EU level, consultations, and support for design of some of these tools have delayed their development and uptake. Consequently, the effectiveness of these new tools at helping producers to absorb the impacts of animal and plant disease outbreaks remains unclear. As they are implemented and refined over the course of future National Risk Management Plans, care should be taken to ensure that these tools do not crowd out private initiatives.

At the same time, other policies – direct payments in particular – may in some cases reduce the demand for public risk management tools or private measures, as such payments are sufficient for many producers to insulate them from the impacts of most adverse events. Further consideration of the interactions and trade-offs of the different policies would help to ensure that the available tools are both efficient and effective. A more consistent approach to support across farms (with payments and tools considering whole farm income instead of individual commodities) would also have implications for risk management tool uptake and farm-level risk management strategies.

Finally, greater linkages between the risk prevention policies and risk coping tools would help to improve the effectiveness of animal and plant health risk management. This reflects the findings of earlier scholarship in this area – a more holistic risk management framework for Italy and other EU countries for long-term resilience should give more weight to risk prevention and mitigation and not focus solely on risk coping mechanisms like insurance, while taking care not to crowd out private measures (Mathijs, 2017[25]). Some linkages have developed in other areas of risk management policy (for example, more advanced mapping of frost risk with the goal of informing the design of parametric insurance policies), but there is scope for greater integration of the two in order to cultivate adaptive and transformative capacities in producers, and thereby reduce the need for policies designed solely to absorb risk impacts.

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Notes

[1] In addition to these authorities, Italy and the European Union are signatories to various international agreements or participate in international organisations that have implications for plant and animal health, including disease monitoring, notification, research, and standards-setting activities. These include the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures, the International Plant Protection Convention (IPPC), the European and Mediterranean Plant Protection Organization (EPPO), and the World Organisation for Animal Health (OIE).

[2] Author's calculation based on the number of producers of all age groups 40 years and under, of the categories "with qualification (no university entry)," "high school diploma," and "with university degree or diploma" from ISMEA's Territorial Agricultural Indicators Database, Section B1: Census 2010 – SPA2013, http://www.ismeamercati.it/flex/FixedPages/IT/IndicatoriElenco.php/L/IT/F/101/SEZ/B.

[3] https://www.condifesatvb.it/bodi.

[4] Or at a rate of 65% for coverage for crops against only two risks.

[5] Diseases for which notification is required can be found in the Regulation (EU 2016/429).

[6] There are many such notification portals, covering slightly different jurisdictions or representing different interest groups. As such, it is not possible to catalogue all of these here, but some of the most relevant organisations to consult include the European Food Safety Authority (EFSA), the European and Mediterranean Plant Protection Organization (EPPO), Pest Organisms Threatening Europe (POnTE), and the OIE's World Animal Health Information Database (WAHIS).

[7] Available at https://www.vetinfo.it/.

[8] Available at http://www.izs.it/BENV_NEW/index.html.

[9] Available at https://bluetongue.izs.it/j6_bluetongue/home.

[10] Available at http://www.emergenzaxylella.it/portal/portale_gestione_agricoltura.

[11] Available at https://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home.

[12] Available at https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list.

[13] Available at http://www.glews.net/.

[14] Calculations based on Italy's reported PSE domestic expenditures.

[15] Apulia, Emilia-Romagna, Lazio, Lombardy, Piedmont and Sicily.

[16] It should be noted that various foresighting and horizon scanning activities for plant and animal diseases are carried out by EU-level agencies or organizations (including EFSA, EPPO, and JRC), with the participation of Italian stakeholders. The critical gap identified here is that outcomes of those exercises should be downscaled and discussed at a more local level.

[17] EU Decision 2015/789.

[18] EU Decision 2018/927. The Decision noted that, "due to the significant delays in the removal of plants infected by the specified organism, the risk of further spread towards the north of the Apulia region is high as the current containment and buffer zones no longer fulfil their functions."

[19] See http://emergenzaxylella.it.

[20] Calculations based on Italy's reported PSE domestic expenditures.

[21] See https://www.ersaf.lombardia.it/it/servizio-fitosanitario/protezione-delle-piante/bollettini/bollettini-riso-(rischio-infezione-brusone).

[22] Preventative measures with respect to forest management are mentioned, and although a mention of M05 is included, the description curiously includes only the restoration aspect of the measure.

8 Resilience to animal and plant health risks in the Netherlands

This chapter examines resilience to animal and plant health risks in the Netherlands. Relevant agricultural policy frameworks are first presented, including a discussion of animal and plant health risk governance according to the three-layer framework. This is followed by a discussion of how the country's agricultural sector stakeholders consider the five resilience dimensions in their approach to managing animal and plant health risk.

8.1. Introduction

The Dutch agricultural sector is highly productive, innovative and export-oriented (OECD, 2015[1]). The sector's activities are diverse – livestock and crop sectors deliver almost equal shares of output value, with a large contribution from open field and greenhouse horticulture as well. Although agriculture represents a small proportion of the economy and total employment (roughly 2% of both employment and gross value added) (OECD, 2019[2]), agriculture plays an outsize role in trade – the country is the second largest agricultural exporter in the world – with Dutch agri-food products accounting for roughly 20% of the country's total export value (European Commission, 2018[3]).

Characteristics of the country's agricultural sector have implications for the risk profiles of different industries. For livestock, the sector is characterised by a high concentration of intensive farms – an environment that has the potential to facilitate the spread of pests and epidemic diseases (Meadows et al., 2018[4]) that could, in turn, result in major disruptions to production at the farm level and significant spill-over effects on up- and downstream activities (Melyukhina, 2011[5]). The proximity of urban areas, the perception of risk by the general public and the social acceptability of prevention and response measures may thus all have an impact on the kinds of measures chosen to manage disease risks, with wider implications for overall sector resilience. For crops and horticulture, the sector produces a wide variety of plants, which are susceptible to an array of different pests and diseases. The heavy reliance of the sector on exports increases the potential economic consequences of plant disease outbreaks, as one shipment of diseased product could result in disruption of trade for all Dutch suppliers.

Outbreaks result in both direct and indirect costs on producers. Directly, they can result in additional costs to farmers to control and mitigate pest and disease damage, and also lower revenue as a result of production losses and disrupted access to markets. Indirectly, outbreaks may have long lasting consequences on local consumers' perceptions and preferences, and trade relations may be disrupted well beyond the elimination of the disease. For example, various trading partners imposed import restrictions on EU beef and veal in the wake of the 2001 Bovine spongiform encephalopathy (BSE) outbreak in the European Union. Market access has been regained on a country-by-country basis, with Dutch exports to Korea re-established only recently in September 2019 – nearly 20 years after the initial outbreak.

Given the sector's intensive production of many internationally-traded, high value crops and livestock products, there are numerous potential pathways for the introduction of plant and animal diseases. At the same time, the sector has actively engaged in limiting the occurrence, extent and consequences of pest and disease outbreaks. This case study focuses on the management of animal and plant disease risks in the Netherlands. After describing the policy landscape relevant to animal and plant disease risks, it will then explore the extent to which the Netherlands' approach to managing these types of risks exhibits the five dimensions of the OECD risk management framework for agricultural resilience.

8.2. Current policy landscape

National and supranational policy frameworks and multilateral commitments influence the management of animal and plant disease risk in the Netherlands. First, Dutch agriculture operates under the governing framework of the European Union's Common Agricultural Policy (CAP). Because the CAP is the overarching agricultural policy framework, it includes some measures that affect the incentive structures of producers and their capacity to respond to plant and animal health risks (Box 5.2), but it is not the main instrument under which animal and plant disease are managed in the Netherlands. Rather, specific EU regulations on Animal Health (Regulation 2016/429) and on Plant Health (Regulation 2016/2031)[1] provide the legislative framework for animal and plant health. These regulations require Member States to carry out controls that prevent the introduction and spread of organisms harmful to animals and plants and plant

products, respectively. Member States have a notification obligation in case of an outbreak. The Plant Health Regulation expands the one-list classification of harmful organisms used up to now[2] and identifies "high priority organisms", causing severe damage, and "Regulated Non-Quarantine Pests" whose presence in plants for planting can cause damage during the subsequent cultivation process. The law also narrowly defines the actions to be undertaken in cases when organisms are present or suspected and their timing.

Controls and inspection activities are foreseen under EU Regulation 2017/625, which ensures the application of food and feed law including on animal health and welfare and plant health. The Regulations also mandate the Standing Committee on Plants, Animals, Food and Feed to oversee phytosanitary and veterinary activities at EU level. The Committee brings together experts from Member States and the Commission to develop eradication and surveillance programmes that are co-financed by the European Union and the Member States.[3] Emergency measures are funded by grants and can be implemented immediately so as to minimise damage to plant and animal health and limit trade disruptions.

Domestically, national policies oversee the sector's compliance with EU regulations and the multilateral system.[4] The principal legislative frameworks in this area are the Dutch Animal Health and Welfare Act, and the Dutch Plant Health Act, which are the national implementing regulations for the overarching EU rules. In addition, national policies influence the sector's preparedness for sanitary and phytosanitary risks and, when such risks materialise, the sector's response. With a long history of risk exposure, national policies have evolved to mostly focus on consultation and co-operation institutions and processes to monitor and control sanitary and phytosanitary risks and co-ordinate response when necessary. They cover both preventive monitoring and control and compensations for restoration. These activities take place under the oversight of the Ministry of Agriculture, Nature and Food Quality and its independent agency, the Netherlands Food and Consumer Product Safety Authority (NVWA). For animal health, the Ministry contracts some activities to the Animal Health Service.

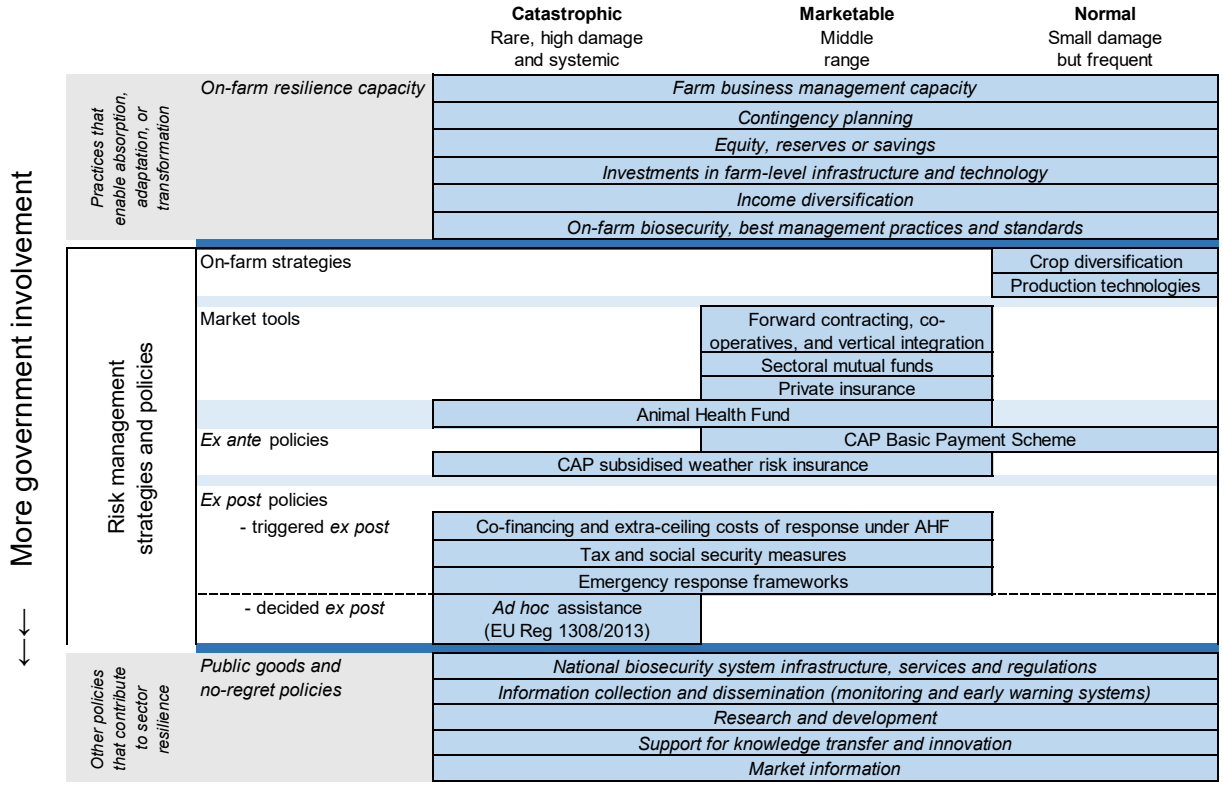
Prevention and management of plant and animal disease risks cut across risk management layers, with measures, tools, and strategies needed at all levels – producers can reduce their risk exposure through farm management and good agricultural practices (including on-farm biosecurity measures), and they can use on-farm risk management strategies to cope with small reductions in farm income; private sector tools are available to help manage mid-range declines in income; and government policies help farmers to cope with large income declines. General services for the sector, such as national biosecurity systems, monitoring and early warning systems, and investments in research and knowledge transfer, also play a role in disease prevention and management (Figure 8.1).

Dutch producers generally take a proactive approach to the management of disease risks on-farm. Many farms rely on high-technology and intensive production, which helps to limit their exposure to risks from the natural environment (as reflected in the country's low yield risk profiles) (Melyukhina, 2011[5]). Crop producers employ preventive plant protection methods, relying heavily on the use of fertilisers and plant protection products (75% of the agricultural land is classified as high input per hectare, compared to an overall average of 26% in EU28 as a whole) in conjunction with technological improvements and other strategies as a means of reducing yield risk on-farm, including from damages caused by plant diseases (European Commission, 2018[3]). Horticulture producers in particular rely on preventive protection methods, as production occurs in a controlled environment. Livestock farms follow strict hygiene rules in order to reduce disease risk.

Dutch producers are also generally well positioned to deal with the impacts of pest and disease outbreaks, as they possess many of the characteristics that are associated with the capacities to absorb and adapt or transform in respond to risks. First of all, educational attainment is generally high in the Netherlands, with the agri-food sector boasting a well-educated labour force that actively adopts new innovations (including to manage animal and plant disease risks) (OECD, 2015[1]). In terms of finances, most farms are in a financial position to absorb fluctuations in income, with the proportion of solvent farms rising 4 percentage

points to 71% since 2010 (Berkhout, 2019[6]). However, diversification is not widely used as a risk management strategy, mostly due to the high degree of specialisation at the farm level. In 2011, only 12% of Dutch farmers reported using enterprise diversification as a strategy, with crop rotation employed primarily to improve the quality of high value crops and as a means to reduce plant disease risk (Melyukhina, 2011[5]). Income from secondary on-farm activities is limited (around 3% of agricultural output), but has been growing, rising nearly 12% between 2016 and 2018 (DG Agri, 2019[7]). Off-farm income is also of limited relevance for Dutch agriculture – only 18% of respondents had off farm income in 2009 (Melyukhina, 2011[5]).

Figure 8.1. Strategies and policies employed in the Netherlands for animal and plant health



Source: Author's own elaboration.

Market instruments or tools relevant to the management of animal and plant health risks include strict quality standards demanded by production contracts or partners in value chains, unsubsidised market tools to help producers manage the financial losses associated with plant and animal health risk, and joint public-private tools for managing financial losses. Contracted production and vertically-integrated value chains are relevant for many products, and contract terms and purchaser specifications typically require that farms undertake some actions to reduce their disease risk. For example, greater than 90% of livestock production is part of an integrated value chain, and consequently must comply with private standards and farm quality assurance systems. Plant producers are also commonly part of integrated value chains (particularly in the vegetable sector) and must comply with private standards, some of which relate to biosafety measures such as GLOBALG.A.P. (Good Agricultural Practice).

The private sector offers some hail and multi-peril crop insurance products, but few products specific to animal and plant diseases are available (Benninga et al., 2017[8]). These are mostly small non-subsidised mutual insurance schemes specific to a single commodity and a limited range of disease risks. These risks are typically not covered by larger insurers because of information problems related to moral hazard and

adverse selection, which can be better addressed by small insurance schemes with good knowledge of members, direct access to clients, and involving members on the governing board of the scheme.

These mutual schemes also encourage on-farm management of plant and animal disease risk, including through premium differentiation. For example, in the livestock sector, the Avipol poultry mutual adapts premium payments to farmers' liquidity capacities and creates incentives for risk prevention through premium differentiation associated with conditions on farming practices (Bergevoet and van Asseldonk, 2018[9]). In the plant sector, the Potatopol mutual insurance was set up to cover potato brown rot, potato ring rot and PSTVd (Potato Spindle Tuber Viroid). It has achieved an adoption rate of 90% of seed potatoes, 75% of starch potato and 50% of table potatoes. Potatopol encourages on-farm risk prevention through premium differentiation and strict terms and conditions with respect to good farming practices (Chartier et al., 2018[10]). However, not all mutual funds have been successful in attracting a critical mass of contributors. For example, the Porcopol scheme ceased operations in 2012 because of limited participation.

Outside of mutual insurance schemes, there is a limited availability of insurance coverage for consequential losses, but fewer than 10% of producers participate in these insurance schemes. These policies typically offer a basic cover of 10-15% indemnity to producers if their herd is eradicated due to an outbreak of foot and mouth disease (FMD).

One of the challenges to effectively and holistically managing animal and plant disease risk is that the lines defining the responsibility of farmers to manage risk (both using on-farm strategies and with market tools) and the role for government in preventing and responding to outbreaks is often blurred – there are roles for both actors in both disease prevention and response given the potential for substantial negative externalities from the actions of individuals. In the animal health sphere, actors in the Netherlands resolve this ambiguity through a joint public-private partnership that shares the costs and responsibilities for prevention and response among agricultural sector stakeholders and the government through a mechanism called the Animal Health Fund (Box 8.1). This fund acts as an *ex ante* instrument to discipline *ad hoc* assistance, by ensuring that the actors themselves are bearing the costs related to periodic outbreaks, with the government only contributing once costs have breached a threshold agreed upon in advance. Farmers participate in the fund by contributing levies that are differentiated by livestock activities, based on the risks of outbreaks and their potential consequences. Each activity (bovine, swine, poultry and small ruminants) is responsible for its own outbreak costs up to a predetermined maximum ceiling over the five-year duration of the Fund. The government covers compensations for catastrophic risk when expenses exceed this ceiling.

Box 8.1. Dutch Animal Health Fund

The Dutch Animal Health Fund (AHF) links together public and private actors in one arrangement to jointly cover the direct costs relating to the control and eradication of outbreaks of epidemic livestock diseases. The participation of producers in the Animal Health Fund is arranged by an Agreement for financing the control of contagious livestock diseases, signed by government stakeholders and eight livestock sector stakeholder organisations. The Agreement has a set duration of five years, with the current Agreement set to end in December 2019. This updating of the Agreement every five years allows actors to take stock of the situation, analyse the experience gained under the previous Agreement, and ensure that cost are appropriate given expected future risks.

Various mechanisms laid down in the Agreement affect the incentives that producers and other actors have to prevent and control the spread of disease. To prevent disease outbreaks from occurring, specific prevention and monitoring programmes are part of the fund, and the operational costs of control measures are paid for through the fund, including blood sampling for analyses; tests and other

screening measures; purchase, storage, administration and distribution of vaccines, medicines, and substances for the treatment of animals; and preventive slaughtering or culling of animals or the destruction of animal products. Because these activities are funded by all producers in the sector, all farmers then have equal access to these control measures. At the same time, individual farmers are incentivised to decrease their risk profiles through the application of levies that are differentiated according to production practices for some livestock species. In the area of controlling disease spread and eradication, early reporting is also incentivised through differentiated compensation rates: full market value compensation is offered for culling of animals that are visibly healthy at the time of veterinary inspection, compensation is halved for sick animals (animals showing clinical signs of the epidemic disease) and no compensation is offered for dead animals.

The government covers compensations for catastrophic risk – in this case, when expenses exceeding the ceiling. Under EU State Aid rules, the Netherlands has notified subsidies to the AHF up to a maximum EUR 863 million for the period 2015-21. While additional expenditure could occur in the case of a disease outbreak, conditions would apply.[1]

Note: 1. https://ec.europa.eu/competition/state_aid/cases/254062/254062_1684955_90_2.pdf.

Outside of this public-private partnership and general disease management frameworks and processes, there are few government policies explicit to the management of animal and plant diseases. At the same time, incentive structures for production choices and disease management could be affected by other policies available more broadly. With respect to *ex ante* instruments, these are dominated by CAP measures (Box 8.2), the largest of which are direct payments received under CAP Pillar 1, which represents 81% of the Netherlands' 2018 CAP expenditures (DG Agri, 2019[7]). The government also provides premium subsidies to multi-peril weather insurance products using Rural Development funds, intended to reach 3.2% of all farmers (European Commission, 2018[3]). In past years, the government sometimes provided start-up capital for sector-specific mutual funds, and also provided reinsurance cover to some products (Melyukhina, 2011[5]).

Box 8.2. EU-level agricultural policies affecting risk management in the CAP

Policy measures that help producers to manage agricultural risk broadly in the Netherlands fall under the EU-level Common Agricultural Policy[1] (CAP), which is comprised of two Pillars:

- Pillar 1: Direct Payments and Common Market Organisation (CMO)

Direct payments are based on farm area, and are conditional on complying with certain production and environmental management practices. In addition, the Netherlands enacts voluntary coupled support for certain sectors. Outside of direct payments, the CMO portion of Pillar 1 provides the framework for market intervention measures, including public intervention (purchase and storage of certain products by EU countries, which are then sold back onto the market at a later date), storage aid to the private sector, exceptional measures, and sector specific aid schemes. Both direct payments and market measures are intended to help producers manage price or income risk. The Pillar 1 budget for the Netherlands for 2014-20 is around EUR 5.2 billion.

- Pillar 2: Rural Development Programme

Programming under the Rural Development Programme is designed to meet objectives in six priority areas, using a menu of 20 pre-defined policy measures. Member States or regions develop their own plans to meet overall objectives. The Netherlands manages and disburses funds through the national Dutch Rural Development Programme, with a budget of EUR 1.69 billion for 2014-20 –

initiatives are co-financed, with EUR 825 billion coming from the EU budget, EUR 446 million of national co-funding, and EUR 413 million of additional national funding top-ups. Dutch RDP expenditures cover the following priority areas:

- 2: Competitiveness (30.22%)
- 3: Food chain organisation, including risk management (4.39%)
- 4: Ecosystems management (56.25%)
- 6: Social inclusion and local development (6.69%)
- Cross-cutting: Technical assistance (2.46%)

Spending under priority 3 is wholly devoted to Measure (M) 17: Risk management tools. This money goes toward subsidies for all-weather crop insurance.

Notes: 1. For a more detailed description of the complete EU agricultural policy structure under CAP, see (OECD, 2017[11]).
Sources: European Commission (2016[12]) *CAP in Your Country: the Netherlands*; ENRD (2017[13]) Focus Area 3B: Farm Risk Prevention and Management.

There are several measures that provide assistance to producers *ex post* to help them cope with adverse events, including instruments that are triggered *ex post* and instruments that are decided *ex post*. With respect to the first category, the first measure relates to government funding responsibilities under the AHF. Although the fund is cost-shared between public and private actors, the cost-sharing only applies up to a given ceiling – above that ceiling, the government covers all costs. These expenditures are provided as under EU State Aid provisions (which may be disbursed in special circumstances provided they comply with EU Competition policy) for the express purposes of controlling and managing animal health risks.[5] A maximum total expenditure of EUR 863 million of State Aid has been provisioned for the period from 2015 to 2021. Additionally in the event of a veterinary risk, EU co-financing provides 50% reimbursement to Member States for the costs of compulsory and pre-emptive slaughter and of related operational expenditures (with the coverage is raised to 60 % for FMD) under EU Regulation 652/2014.

Other *ex post* assistance measures are available to agricultural workers, but these measures are not specific to the agricultural sector. For example, the Dutch social security system offers loans to self-employed workers (including farmers) in financial distress. The assistance is in the form of interest-free loans, which may be provided for one year to cover subsistence needs, or for ten years with interest for working capital. In the agricultural sector specifically, the use of this type of income support for the self-employed is at present mostly limited to entrepreneurs in intensive livestock farming and greenhouse horticulture. Certain tax measures can also be used after the fact to help compensate for losses from disease outbreak events. Although the Dutch tax system does not offer any concessional rates to farmers, it does offer the possibility of tax averaging, as well as a loss set-off facility (where losses can be offset retroactively against income from other years). As with the social security provisions, these tax concessions are available to all businesses and are not unique to agriculture.

With respect to *ad hoc* measures decided *ex post*, Dutch law does include a facility for providing assistance related to catastrophic events – the so-called “Law on Disasters and Severe Accidents”– but it has rarely been used for agriculture (twice in 1998 for severe rainfall events), and no specific provisions are made under the law for either epidemic livestock or plant diseases. *Ad hoc* assistance could be delivered through certain EU provisions, however, subject to EU State Aid rules. For example, EU Regulation 1308/2013 allows the Commission to take exceptional support measures (at the request of Member States) in instances of serious market disturbances related to animal or plant health and disease risks, with the measures co-financed between the EU and the relevant Member State.

No regret policies and public goods are cross-cutting, and play a role in reducing risk exposure and the impact of adverse events across all risk layers. In the area of animal and plant disease risk, the most

important policies of this type are regulations and investments to maintain the national biosecurity system infrastructure and services, which help to prevent, control and monitor diseases. Monitoring, surveillance, and early warning for outbreaks are carried out on an ongoing basis by the responsible organisations for the various sectors. The national monitoring and surveillance system for animal health was initiated by the government and the livestock industry, and is carried out by the Animal Health Service. The Animal Health Service oversees the national Animal Health Surveillance System (AHSS), which is an accessible and voluntary system that collects livestock health information from farmers, veterinarians, the processing industry, research institutes and public health authorities and shares information with all stakeholders who may need to take action.[6] Monitoring occurs through both reactive (farmer-reported disease incidence, pathology reports, veterinary monitoring of poultry, and veterinarian environmental toxicology) and proactive channels (monitoring and surveillance studies and programmes undertaken by the Animal Health Service). For example, livestock farmers and veterinarians alike can also consult the "Veekijker" telephone help desk service, through which experienced and specialised Animal Health Service veterinarians provide free expert, tailored advice and assistance.

Individual livestock sectors are also actively involved in organising surveillance through sector-specific veterinary services. The Veterinary Monitoring Poultry (VMP) is a co-operative agreement between a number of poultry veterinary practices and the Animal Health Service. Practitioners voluntarily provide digital information on poultry health, including the vaccinations administered and their findings during farm visits, along with registration of any prescribed antibiotics. For the pig sector, pig veterinarians record their findings in the Online Pig Health Monitor following each farm visit, including any animal health problems detected. Surveillance and diagnostics in wild animal populations is carried out by the Dutch Wildlife Health Centre. Their work is particularly important for tracking long-distance migratory bird populations, who may spread avian influenza (AI) to domestic poultry populations (Lycett et al., 2016[14]).

For plants, disease events occurring in either the Netherlands or in neighbouring countries are published on the NVWA website, which feed into farm press website and publications. In crisis or high risk situations, updates are provided frequently.

Research and innovation is a priority in the Dutch strategy for the agri-food sector, and the agricultural innovation system involves numerous actors. The Dutch "golden triangle" innovation model relies on co-operation between businesses (both firms and farmers), government and knowledge institutes to stimulate innovation (OECD, 2015[1]). While there are a variety of knowledge institutes, the Wageningen University and Research Centre is a key actor, including in the areas of plant and animal health, as well as foresighting, economic modelling and analysis to inform future policies and initiatives (OECD, 2015[1]).

At present, the general research agenda for the sector focuses on a variety of topics, including how the sector can be more resilient to future animal and plant health risks. Several of these programmes are financed using RDP funds, with knowledge generation activities responsible for 2.1% of the Dutch RDP budget (European Commission, 2018[3]). In fact, innovation is key component of the plan, as it links environmental objectives with improved sector competitiveness. There are various initiatives targeting the different sectors. In the livestock sector, the Dutch Government funds resilience-enhancing programmes such as the Global One Health initiative. Examples of research devoted to improving resilience against plant diseases include investigations into innovative detection methods and early warning systems.

Knowledge transfer and outreach can play an important role in building farmers' capacities to manage risk. In the Netherlands, extension services are provided by the private sector, including sector-specific extension consultancy firms (livestock[7] and plant[8]). Stakeholders also utilise study groups (organised by farmers associations, suppliers or processors) as a form of low-cost learning and outreach, with the groups considered an important mechanism for spreading information to stakeholders. Knowledge exchange also proceeds through private networks, which involve specialised extension providers, extension experts from suppliers and processors, farmer and branch organisations, and farmer journals. In the livestock sector specifically, veterinary practitioners have a key role in delivering outreach and education on best practice

for risk management during disease outbreaks and new developments in animal health. Veterinarians can take courses for continuing professional development and volunteer to become a member of the Royal Dutch Society of Veterinary Medicine as a means to ensure that they are optimally equipped to provide guidance for related animal health advices.

Although most knowledge transfer is carried out by private actors, there is still a recognition that there is a role for government in the transfer of new innovations in technology and management practices to agricultural stakeholders. For this reason, the Netherlands uses a substantial portion of their Rural Development budget to fund co-operation projects that aim to transfer knowledge between researchers, agriculture sector actors, and other stakeholders – the country's RDP foresees that 180 co-operation projects will be undertaken, resulting in the training of nearly 18 000 people (European Commission, 2018[3]).

The Dutch Government is also carrying out larger investments in the agricultural sector with a view towards improving sector resilience more generally. For the livestock sector, restructuring has been motivated by economic pressure, welfare regulations, and environmental regulations – all of which have implications for longer-term sector resilience. Livestock sector restructuring priorities in the coming years include a reduction in the number of animals, reduced human health risks, and improved animal living conditions in densely populated livestock areas. The budget for these restructuring initiatives is EUR 200 million total over a period of several years beginning in 2019, with EUR 120 million for reducing the pig population, and EUR 60 million marked for stimulating innovations in the pig, poultry, and dairy goat sectors (Ministry of Agriculture, 2018[15]). In the plant sector, the costs of investments for improving resilience under potential future conditions are in contrast largely borne by growers and the value chain.

Other no regret policies are funded through RDP measures, but their relevance to the sector's ability to manage animal and plant health risk is less clear. As the main focus of the country's RDP is to restore, preserve, and enhance ecosystems related to agriculture, a large portion of the Netherlands budget is devoted to supporting investments related to water and soil management (European Commission, 2018[3]). These investments certainly have implications for environmental sustainability, and potentially have positive spillover effects for disease management as well.

8.3. The Netherlands' experience in managing animal and plant health risk for resilience

The Dutch approach to managing animal and plant health risks relies heavily on prevention as the most cost-effective means of controlling disease outbreaks. Other features of disease management frameworks in the Netherlands also contribute to improved management of these types of risks, including *ex ante* definition of risk management roles and responsibilities, strong stakeholder collaboration, evaluation of instruments for effectiveness, and adjustment of processes where needed.

8.3.1. The strong focus on preparation and ex ante activities positions the sector to effectively respond to outbreaks

Improved resilience against animal and plant disease risk starts with a focus on prevention and mitigation of current risks, combined with dedicated efforts to monitor and adjust to changes in the risk landscape. The current Dutch policy framework for managing animal and plant disease is characterised by strong efforts to anticipate, prevent, and mitigate risks. Only in the case of animal diseases is some *ex post* compensation provided, but even then assistance is delivered through a previously defined, cost-shared, public-private mechanism. The effectiveness of this proactive approach depends on effective communication and co-operation among stakeholders in anticipation of disease risks. Private and public stakeholders work together in advance of outbreaks to ensure that sufficient response capacity is in place,

and good practices to manage animal and plant health risks are well-integrated into the day-to-day operations of Dutch farms.

In the case of animal health risks, this process of prevention and mitigation begins with regular foresight exercises and risk assessments, and the subsequent drafting of contingency plans that clearly outline crisis management roles in advance. This helps to mitigate impacts and allow actors to recover more quickly from disease outbreaks. All of these activities are integrated into the mechanics of the Animal Health Fund. Stakeholders conduct a long-term risk assessment and foresighting exercise every five years in advance of establishing a new Agreement for the Animal Health Fund. During this assessment, stochastic disease spread simulations are carried out to estimate the likely costs of disease outbreaks.[9] The disease spread models are also utilised on a more regular basis as requested to evaluate different disease control scenarios, and long-term forecasting exercises consider potential shifts in disease risk due to climate change.[10] The results of the long-term foresighting exercise help to determine the contribution ceilings for the different species under the fund, but also inform recommendations on disease prevention and control measures outlined in the Agreement.

Good national biosafety measures provide the foundation for prevention efforts: all animals must be entered into the identification and registration system, and the amount of contact between animals from different farms is limited. Additionally, to better prepare for potential outbreaks, stakeholders from the Ministry and representatives of the livestock sector meet regularly to update contingency plans and conduct response simulation exercises. This emphasis on preparedness also includes pre-positioning for crisis situations, as government actors also contract vital service suppliers to be hired during outbreaks.

With respect to plant disease risks, Pest Risk Assessments and contingency plans are already in place for the list of harmful organisms identified in EU legislation. The NVWA sets priorities for action, response, and intervention based on that list, in co-operation with the EPPO, the Ministry, and the European Union.

Foresighting exercises are also carried out to consider the likelihood of plant and animal diseases that serve as a basis of risk management strategies. NVWA runs these exercises in co-operation with branch organisations representing different stages of the value chain (propagation, production and trade of plants and/or plant products). As for livestock, these exercises consider the likelihood of new pests or disease vectors becoming established in Dutch territory under potential climate change scenarios. Based on the results of these exercises, organism-specific preventive risk management strategies are determined. Responses and contingency plans are also informed by additional scenario analysis. For example, Wageningen Economic Research carried out an analysis of the probability distribution of the cost of plant disease outbreaks at different production stages, accounting for uncertainty in the introduction, transmission, and detection of pests (Benninga et al., 2017[8]). Contingency plans are updated on an as-needed basis – when there are indications that the current risk is underestimated, or when a quarantine organism becomes established in large areas of the European Union, the risk from the organism is reassessed. These plans are formulated at national level under the responsibility of the Ministry and the NVWA, but can be executed locally.

The focus on prevention and mitigation continues with the conducting of monitoring exercises for priority pests and organisms. In both animal and plant disease frameworks, notifications are required for certain diseases or organisms under EU legislation, and monitoring activities are carried out accordingly. For livestock, prevention and monitoring programmes are part of the Animal Health Fund, and the Animal Health Service is responsible for carrying out ongoing disease monitoring exercises. For plants, monitoring and surveillance activities are carried out as needed. Surveillance activities can be particularly crucial to successful eradication campaigns. For example, following the outbreak of *Anoplophora glabripennis* in 2010, disease control efforts (including cutting infested trees and host plants within 100 meters) were combined with intensive surveillance efforts to eradicate the disease, leading to the Netherlands regaining its pest-free status in 2016.

Where *ex post* policies are relevant, they are well-defined in advance of outbreaks. For livestock, the costs and responsibilities sharing scheme to prevent and control animal health risks is outlined in the Animal Health Fund Agreement. Furthermore, responses under this system are predictable as it remains in place for five years and, at the same time, it is evaluated and adjusted at the end of the five years cycle to take into account potential future risks before the Agreement is renewed. For plants, there is no compensation for disease impacts,[11] so *ex ante* tools are the most important risk management measure by default. At the same time, actors are exploring means to better link a prevention-driven and incentive-oriented approach to financial aid for control and eradication of plant disease. In this vein, private organisations were asked to draft a proposal for a fund related to plant disease control.

Taken as a whole, the *ex ante* approach to disease management in the Netherlands has been accompanied by fewer outbreaks of epidemic livestock diseases. Since 2000, the number of farms affected by notifiable diseases has fallen substantially – only AI outbreaks have become more frequent, and even then, the number of infected farms has declined (Van Asseldonk, Bremmer and Bergevoet, 2019[16]). The linked prevention and response mechanism of the AHF may have played a role in this improvement. The clearly elaborated *ex ante* framework outlining responsibilities and responses under the AHF, combined with the Fund's cost-sharing mechanism, provide strong incentives for preparedness and prevention. Aside from improved animal health outcomes, the implementation of the AHF has also resulted in reduced costs for the government in combatting animal diseases (Bergevoet, de Lauwere and van Asseldonk, 2019[17]).

8.3.2. Clear incentives play an important role in ensuring that stakeholders take individual action to manage plant and animal health risks

The actions of individuals to prevent and control outbreaks have potentially large spillovers on the rest of the sector. For this reason, it is crucial to have the incentives in place that motivate all stakeholders to prevent and control diseases. In the Netherlands, frameworks related to the management of animal and plant diseases do provide such incentives. First, the involvement of the Dutch Government in managing animal and plant health risk is mainly limited to prevention and proactive management activities. Although the Dutch "Law on Disasters and Severe Accidents" provides a facility for *ad hoc* response to disaster situations, there is no provision under this law for epidemic livestock or plant diseases. Expenditures on *ex post* activities are limited to cost-sharing for the Animal Health Fund, as well as a few instruments that are not specific to agriculture, and that have limited uptake within the sector (including loans to cover subsistence needs or business working capital for self-employed workers in financial distress). Moreover, even in the case of the Animal Health Fund, response is linked to *ex ante* preventative measures by means of the levy differentiation of stakeholders.

The Netherlands' strong focus on *ex ante* measures also avoids crowding out the development of private solutions that reflect the specific risks faced by individual sectors. For example, the potato sector mutual insurance POTATOPOL provides coverage for losses from three specific potato diseases. Available risk management policies and instruments in the area of animal and plant health do tend to target specific sectors, however, largely because the risk profiles of the sectors vary greatly, and the relevant preventative actions to be taken need to be described on a commodity-specific basis. This leaves some sectors with no market or public mechanism for dealing with financial losses due to disease impacts.

Although Dutch agricultural risk management policies focus on the catastrophic layer, other policies affect farmer incentives to manage risk as well. Most prominently, farmers receive one-fifth of farm receipts from EU direct payments (OECD, 2019[18]). Elsewhere in the European Union, this type of support has been found to actually increase risk-taking behaviour, reduce farmer take up of risk management instruments on offer and impede private risk management approaches (Severini, Tantari and Tommaso, 2017[19]).

While trade-offs at the policy level are focused on prevention over *ad hoc* response, there is evidence that farms and the sector at large have moved beyond merely having strategies in place to help them absorb or cope with risk, and are instead undertaking adaptation or transformation actions in response to their

exposure to animal and plant disease risk. This transformation of the sector to increase long-term resilience to disease is encouraged by plant and animal disease policy frameworks. For example, in response to the 1997 Classical Swine Fever (CSF) outbreak, the pig sector was restructured, establishing corridors and regional compartments. In contrast, changes have been more incremental in the plant sector, as no major shifts in plant health policy have taken place over the past decade.

8.3.3. The Netherlands employs collaborative approaches and iterative risk evaluation to inform disease management frameworks

Effective disease management calls for proactively establishing incentive structures to ensure compliance, because the actions of individuals to prevent and control outbreaks have potentially large spillovers on the rest of the sector, (OECD, 2011[20]). Participatory approaches can be used as a means of outlining the responsibilities of all stakeholders and agreeing on appropriate incentives. The Netherlands' animal and plant disease risk management frameworks are developed and implemented based on deep and ongoing engagement with all relevant stakeholders to inform disease prevention, control, and response efforts. This engagement occurs in different spheres, including the analysis of the risk landscape, the formulation of policies, and the evaluation of outbreak response and policies. For animal health management, government and livestock sector stakeholders meet regularly (at least biannually) to discuss the animal health situation and develop monitoring plans. Regarding plant health, NVWA meets with stakeholders (including representatives of branch organisations from both the arable farming and horticultural sectors) three to four times per year in order to ensure that all stakeholders are aware of recent developments in plant health risk. Actors discuss the current situation, and use the discussion to inform decision-making and policy development.

Further on from regularly discussing developments in the risk environment, government bodies and actors from the agricultural sector collaborate to develop policy, ensuring that all stakeholders are aware of their responsibilities and are incentivised to take ownership for managing their set of risks. In the animal health space, the most prominent example is the drafting of the Agreement for co-financing the prevention and control of contagious livestock diseases. Farmer contributions are defined by sector and are proportional to expected costs. This collaborative approach to outlining responsibilities gives farmers a chance to express their views on the best means of preventing and controlling outbreaks. The approach also aims to raise awareness among farmers, outline incentives for early disease reporting, and improve support for control measures, since producers acknowledge and understand the necessity for such measures well in advance of outbreaks (Van Asseldonk, Bremmer and Bergevoet, 2019[16]).

The Netherlands also maintains mechanisms for evaluating the effectiveness of responses to disease outbreak events in consultation with the relevant stakeholders. With respect to animal disease, control strategies and costs are evaluated by relevant stakeholders and the Ministry in the wake of small disease outbreaks. Large outbreaks are instead evaluated externally, with four such evaluations conducted since 2000.[12] For outbreaks of plant diseases, internal evaluations are conducted for each outbreak event, involving actors from the private sector, the Dutch NPPO, private inspection authorities, and the Ministry.

In addition to evaluating individual disease outbreaks, other policies related to animal and plant health are also reviewed and discussed regularly. Specifically, discussions on the performance of the AHF are held annually between stakeholders and the Ministry. Aside from these annual performance reviews, an independent external evaluation of the Animal Health Fund's performance over 2000-18 was also carried out in 2018. Although the review determined that there was not sufficient data to objectively evaluate the effectiveness and efficiency of the AHF, stakeholders interviewed during the course of the review indicated that they viewed the AHF as an effective and efficient means of maintaining animal health while also controlling disease outbreak costs (Bergevoet, de Lauwere and van Asseldonk, 2019[17]).

8.3.4. Limited role of government encourages on-farm risk management, and opportunities for farmer capacity improvement also exist

The capacity of the sector to effectively manage animal and plant disease risk relies on individual farmers making effective risk management decisions to collectively manage the risk to the wider sector (OECD, 2017[21]). Dutch farmers on average demonstrate a high capacity to absorb and manage risk, and are supported by a policy framework that provides incentives to develop good on-farm risk management capacities. First and foremost, Dutch farmers operate in an environment that is very much driven by the market, including their integration into vertically integrated global supply chains, where maintaining high quality standards is a requirement. As such, they make their production and risk management decisions given strong market incentives to control disease outbreaks.

Outside of market incentives, disease policy frameworks establish clear responsibilities, incentives, and triggers for needed action. In both the animal and plant health spaces, EU regulatory frameworks define the diseases or the quarantine pests for which control and prevention plans are to be applied, and Member State contingency plans outline the control strategies to be used. In the livestock sector, the Agreement between farmers and government agencies governing the AHF lays out clear responsibilities for disease control measures. Additionally, the levies that producers pay to participate in the fund are differentiated by the farmer's individual level of risk exposure for some species,[13] which incentivises the implementation of autonomous on-farm disease reduction measures. Timely disease reporting is also encouraged by compensation rates that vary according to the health of the animal at the time of veterinary inspections – healthy animals are compensated at a rate of 100%, sick animals at a rate of 50%, and farmers receive no compensation for dead animals. No compensation scheme for livestock losses exists outside of this AHF mechanism. For plant producers, the responsibilities of growers in preventing and responding to disease risks are laid out generally in the EU Plant Health Regulation, but were also detailed more specifically in the grower code of conduct for preventing and reporting phytosanitary risks that was jointly drafted by the private sector and the Dutch Government. The Dutch Government and private stakeholders also co-operated on the development of the "Fyto Compass" tool, which helps to increase producer awareness of plant disease risks and provide recommendations on how such risks can be prevented (Fyto Compass, 2019[22]). No compensation scheme is in place for plant disease losses.

The financial capacity of farmers to respond to or plan for risks is supported through various programmes and tax provisions. The Agricultural Loan Guarantee Fund guarantees investments with insufficient collateral that would normally not be approved by mainstream banks, with loans of up to EUR 600 000 guaranteed at 80% through the fund, while sustainability investments can be guaranteed at 80% up to EUR 2.5 million. The programme provides special options for young farmers, who are eligible for guarantees up to EUR 1.2 million. A 2015 impact assessment of the programme determined that it does fulfil its mandate in providing financing guarantees for young farmers or other holdings with insufficient collateral (Van der Meulen, van der Meer and van Asseldonk, 2015[23]). Some tax measures, including tax averaging and the loss set-off facility, also support financial capacity to absorb risks. However, the efficacy of these instruments to assist farmers in coping with losses from animal and plant disease losses has not been quantified.

8.3.5. No regret policies focus on research, early warning, and environmental health, with initiatives facilitated by close collaboration between all actors

Public investments in key services for the agricultural sector and the implementation of no regret policies can contribute to better management of animal and plant disease risks across all risk layers. One of the primary roles of government in this area is the provision of general services, such as knowledge generation and transfer. Research and innovation have long been key components of the Dutch agricultural sector's competitiveness strategy. These activities are especially important to stay ahead of evolving risks from disease outbreaks. The quantity and quality of research produced by Dutch knowledge institutes is high,

and there is close collaboration between the private sector, government actors and researchers (OECD, 2015[1]). The research agenda is heavily influenced by the needs of the private sector, with input from the government and relevant knowledge institutes. In this area, the most relevant initiative is the funding of public private partnerships through the Dutch Rural Development Programme. Programmes delivered through these partnerships aim to develop practical solutions that directly benefit actors in agricultural production chains, while also enhancing the viability and competitiveness of the sector. Current programmes intend to reach 5% of all Dutch farmers (European Commission, 2018[3]). In addition, training will be delivered to 18 000 farmers, and 180 co-operation projects will be supported through the RDP, potentially enhancing the risk management or adaptive capacities of many of the country's producers.

The Netherland's systems for notification and early warning of animal and plant diseases seem to be well-integrated with the industry needs. For livestock, the AHSS takes both a proactive and reactive approach to monitoring animal disease outbreaks, and information is conveyed rapidly to relevant stakeholders. For plants, NVWA publishes real time information on phytosanitary notifications and other updates on disease outbreaks on their website.

Another important focus of no regret policies in the Netherlands is on environmental quality. More than half of the Dutch RDP budget is allocated to ecosystems management, with a particular focus on water and soil management (European Commission, 2018[3]). Both of these areas could have positive implications for animal and plant health, as well as long-term sustainability. For instance, improved soil health frequently reduces negative impacts from plant pests [see, for example, (Magdoff, 2001[24])]. Similarly, improved management of effluents from livestock production could have positive implications for animal health as well. At the same time, investments in biodiversity and environmental quality could potentially increase wildlife/farm animal interactions, so care should be taken to monitor health of wild animal populations at this nexus.

Finally, from a general point of view, the management of all types of agricultural risks is aided by an enabling policy environment, including well-functioning and competitive markets, openness to trade and investment, high quality infrastructure, and high quality education systems responsive to business demands to provide a well-skilled labour force. In this vein, the Netherlands ranks highly – the overall policy environment in the Netherlands is one of the most favourable to investment worldwide, including for innovation to increase productivity and sustainability (OECD, 2015[1]).

8.4. Conclusions

In their approach to managing animal and plant disease risk, the Netherlands prioritises collaboration and *ex ante* approaches. The limited availability of publicly funded *ex post* assistance requires actors to proactively assess their risk exposure and implement strategies for risk prevention and mitigation. This approach has also avoided crowding out the development of private solutions, allowing market tools and public-private partnerships to develop instead. For example, the public-private partnership under the Animal Health Fund ensures adequate funding for disease prevention and control efforts, while the Fund's cost-sharing mechanism ensures that that government responsibility for assistance is limited to catastrophic outbreak situations. While no comparable, sector-wide mechanism currently exists for catastrophic plant disease situations, the government and relevant stakeholders are currently exploring the feasibility of such a fund. However, policy makers should critically evaluate the costs and benefits of a setting up a fund for plant health, in case existing plant protection and farm management practices are sufficient to manage the risk posed by plant diseases.

One factor that likely contributes to the success of Dutch animal and plant risk governance arrangements is the collaborative process under which the frameworks are developed. All relevant stakeholders are engaged in the risk assessment, monitoring, prevention, evaluation and policymaking processes, which helps to ensure that all actors are aware of their responsibilities for managing animal and plant disease

risk and are exposed to strong incentives to do so. This approach has also helped to improve the acceptability of disease control measures in the livestock sector, as actors are informed of potential measures in advance, and are financially incentivised to report suspected outbreaks swiftly.

For both sectors, substantial future challenges to disease management could result from the presence of new disease vectors in Dutch territory as a result of climate change. The sector is taking a proactive approach to these potential future risks, including raising the disease management implications of climate change in regularly-held stakeholder meetings, and considering climate change scenarios in risk assessment models. At the same time, the trade exposure of the sector and the close interactions between urban and rural actors may warrant further engagement of actors outside of agricultural value chains to effectively manage risks of disease transmission, particularly as new disease vectors reach the Netherlands in a changing climate.

The Netherlands also counts on high quality research institutions to help provide information about likely developments in future risks and innovate new methods of confronting those risks. The research agendas of these institutions are typically developed in collaboration with both government and industry stakeholders. While this model ensures that research remains topical and relevant, it may also guide efforts toward initiatives that seek the most immediate market value, at the expense of research that aims to guide adaptation and transformation in the long run. Additionally, while research output remains high, declining public expenditures in this area raises questions about long-term performance and continued capacity to innovate solutions to evolving animal and plant health risks.[14] There could be a need for more government co-ordination of an animal and plant health research agenda, which could be aided by more stability in long-term funding (OECD, 2015[1]).

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Notes

[1] EU Plant Health law (Regulation (EU) 2016/2031 on protective measures against pests of plants): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2031&from=EN, EU Animal Health law: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0429&from=EN, Regulation 652/2014 lays down provisions for the management of expenditure relating to the food chain, animal health and animal welfare, and relating to plant health and plant reproductive material allows for partly compensation of costs made by the national government in programmes oriented at eradication, monitoring and surveillance of animal and plant diseases.

[2] In Council Directive 2000/29/EC.

[3] EU Regulation 652/2014.

[4] The European Union and the Netherlands are a party to the World Trade Organization's (WTO) Sanitary and Phytosanitary measures (SPS) Agreement, which governs the use of measures necessary to protect human, animal or plant life or health so that they do not arbitrarily or unjustifiably discriminate between WTO members. Where they exist, the agreement requires that rules be based on international standards. For animal health, EU measures seek convergence with those of the World Organisation for Animal Health (OIE). For plant health, the global framework is laid down by the International Plant Protection Convention (IPPC).

[5] One such scheme is a maximum EUR 863 million of State aid for the period 2015-21 to subsidised services for the eradication of animal diseases and compensation of the value of animal slaughter through the Animal Health Fund. Reference SA 39008 reported in https://ec.europa.eu/competition/elojade/isef/index.cfm?clear=1&policy_area_id=3. https://ec.europa.eu/competition/state_aid/cases/254062/254062_1684955_90_2.pdf

[6] https://www.gdanimalhealth.com/monitoringsurveillance.

[7] http://www.dlvconsultancy.com/.

[8] https://delphy.nl/en/.

[9] For specific applications of these simulations, see (Backer et al., 2009[25]), (Backer et al., 2011[26]), and (Bergevoet et al., 2007[27]).

[10] Climate change is relevant to both livestock diseases epidemic and plant health, since it can lead to environmental conditions in which pests and diseases vectors that are currently not present in the Netherlands have an increased likelihood of survival and establishment.

[11] Aside from the existence of a few disease- and plant-specific mutual funds.

[12] These have been carried out in response to the FMD outbreak in 2001, the AI outbreaks in 2004 and 2015, and the Q-Fever outbreak in 2011.

[13] In the pig sector, levies are differentiated by animal contact structure, and in the poultry sector, levies are differentiated according to whether or not the production system is indoor or outdoor (with the risk of introduction of AI being higher for outdoor systems).

[14] Based on PSE calculations.

Annex A. Questionnaire on Resilience for Agricultural Risk Management

Some significant sources of risk and uncertainty are increasing for the agricultural sector, and the financial impacts of adverse events is rising. Consequently, there is a need for farmers – and the agricultural sector more broadly – to become more resilient. Resilience can be understood as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt and transform in response to adverse events", which in agriculture can include market volatility, more variable weather conditions under climate change, pest and disease outbreaks, natural disasters, and even events external to the agricultural sector, such as pandemics. Resilient farmers and systems are able to absorb the impact of such adverse events (including mitigating or preventing impacts), adapt to an evolving risk landscape, and transform the type of farming system – or even the agricultural sector itself – if the current system is no longer able to adapt to or recover from shocks.

A resilience approach to agricultural risk management means putting greater emphasis on what can be done *ex ante* to reduce risk exposure and increase preparedness, so that farmers recover more easily from adverse events and are less exposed to such risks going forward. It also encourages policy-makers to consider systems instead of individuals, recognising that the actions of individuals can have negative consequences for the wider agricultural sector due to linkages and knock-on effects. This questionnaire explores the extent to which countries are integrating resilience into their agricultural risk management policies by examining country approaches and policy responses in the five critical resilience focus areas: time frame, trade-offs, investments in on-farm resilience capacity, no-regret policies, and participatory collaborative approaches.

Key questions on time frame

The first step in integrating the concept of resilience into agricultural risk management policies is to consider the risk landscape over the long-term, including unknown future risks, and to place a greater emphasis on *ex ante* and preventative measures. The following questions explore the extent to which agricultural risk management policies take a long-term perspective, plan for a range of scenarios, and achieve an appropriate balance between *ex ante* measures and *ex post* assistance. Specifically, the answers to the questions on this area will cover:

- The extent to which governments incorporate a long-term view in their policy development and planning processes.
- The relative emphasis placed on *ex ante* policies, investments and planning processes versus *ex post* assistance.
- How information on risks is shared and communicated among stakeholders.

Questions

1. How often do governments re-assess the main risks to the agricultural sector and the role of government in responding to those risks (if any)? How are these assessments carried out, and over what time horizon? What impacts are taken into account in these assessments (e.g. only direct losses, or also indirect losses)?
2. Are foresighting exercises (e.g. horizon scanning, scenario analysis, and sector outlook) carried out for the agricultural sector? If so,
    a. By whom (government agencies, regional governments, industry organisations)?
    b. With what frequency, scope, and time horizon?
    c. Do these exercises consider climate change projections?
    d. How are these exercises used in developing and revising policies?
    e. Is there any evidence that these exercises help to drive decision-making in the long-term by public and private stakeholders in the sector?
3. How do government agencies inform stakeholders about current and potential future risks (including frequency of occurrence and likely impacts)?
4. What type of *ex ante* tools and strategies are in use? Is there evidence to show which policies are most effective at reducing the impact of adverse events?
5. On a scale of 1 to 10, how important are *ex ante* tools and strategies that reduce risk exposure (such as improved farm-level management or investments in infrastructure or knowledge systems) in the overall risk management policy framework (compared with *ex post* assistance in the form of ad hoc payments)? Is the relative emphasis on *ex post* assistance in the form of ad hoc payments increasing or decreasing?
6. Have analyses been conducted on the extent to which *ex ante* tools and strategies can remove the need for ad hoc *ex post* measures in response to adverse events affecting your country's agricultural sector? If so, what recommendations can be drawn from this analysis with respect to policy measures or risk management strategies?
7. Are disaster response and disaster risk reduction plans for the agricultural sector carried out independently, or are these plans integrated into broader national disaster frameworks and climate change adaptation plans? At what level of government are policies and plans on resilience and disaster response formulated: local/municipality, state/territory/province, regional, and/or national?

Key questions on trade-offs

A holistic policy framework for strengthening resilience to risks needs to take into account how policies build resilience to a range of current shocks and future risks, while also strengthening the resilience of farmers, the sector more broadly, and other actors in the value chain. *Ex post* assistance to current shocks and disasters may accelerate recovery, but it does not create incentives to increase preparedness for future risks, and may create an adverse selection problem by incentivising under-preparedness for future risks. Given budget and institutional constraints, agricultural risk management policies will involve trade-offs between these outcomes. The following questions explore the extent to which these trade-offs are taken into account, and the process for doing so, in developing agricultural risk management policies. The answers to the questions under this area will cover:

- How the policy development process takes into account the effects of current assistance, and risk management policies and tools on future resilience, while facilitating structural change.
- Which stakeholders are considered in the agricultural risk management policy development process.

- Whether risks are assessed individually or holistically, by accounting for correlations and comparisons of frequency and impact.
- The relative emphasis placed on ensuring that the sector can absorb the impact of risk, incrementally adapt to a changing risk environment, or transform when ecological, economic or social structures make the existing system untenable.
- The extent to which current risk management policies allow for flexibility in producer decision-making – for example, by facilitating adaptation and transformation in response to risk, and avoiding systems that "lock-in" production of a certain commodity or entrench a given production system.

Questions

1. Are public budgets for disaster response and *ex ante* preventative measures co-ordinated (e.g. are investments in disaster prevention planned with a view to reduce spending on disaster relief), or are the two activities funded under independent, non-related mechanisms? Are there any efforts to link the two in order to reduce disaster exposure and vulnerability?
2. To what extent is there a trade-off between investments in general services that support improved risk management (such as education and knowledge generation) and risk management policies targeting farmers, whether *ex ante* or *ex post*?
3. Do disaster relief and market-based risk management policies target specific activities or investments (for example, subsidised crop insurance that covers some commodities, but not others; or tied grants such as subsidies for freight or fodder, or for the restoration of particular assets)? Are there risk management tools that are specific to certain types of events?
4. Are policy impacts or spillovers on other stakeholders known (including on other actors in the agriculture value chain, related industries, and other sectors)? Are they taken into account during risk management policy development? If so, how, and for whom? How is the priority decision-maker identified in these cases?
5. Is there evidence that the agricultural sector is transforming towards more resilient systems? If so, what is driving this transformation (e.g. technical change, changes in market structure, improved information and research capacities, or a need to respond to a particular climate risk or resource constraint)? How is policy facilitating or impeding this transformation?

Key questions on investing in farm resilience capacity

Although policies and programmes can provide risk management options for catastrophic situations, farmers can also pursue strategies that will reduce their exposure to all levels of risk, both now and in the future. However, producers must first be exposed to the proper market signals or incentives to pursue this behaviour, and second, have the capacity to act on opportunities to do so. The answers to the questions under this area will cover:

- Whether or not market signals provide stakeholders with incentives to reduce their risk exposure.
- The extent to which the conditions for *ex post* assistance are defined in advance, and that stakeholders receive consistent signals about their responsibilities for managing risks.
- Whether risk management policies take into account changing farmer demographics.
- The importance of financial safety nets for crisis periods.

Questions

1. Does the overall risk management framework include policies (or provisions of policies) that incentivise on-farm investments to reduce risk exposure and improve long-term sustainability? If so, can you provide some examples?
2. What types of thresholds are in place for the various types of risks? In particular for catastrophic risk, how are such thresholds measured or identified? Do they apply to the overall agricultural sector, or are considerations given to certain subsectors?
3. Are the thresholds for when governments will respond in disaster situations explicit, such that producers can make farm management decisions with a clear understanding of where the boundaries between normal, marketable, and catastrophic risk layers lie? How are these thresholds communicated to farmers? Has *ex post* disaster assistance in recent years reflected these thresholds?
4. Are farmers supported or incentivised to engage in experimentation to adapt their operations to changing circumstances, in particular climate change? If so, how?
5. Do risk management programmes take into account the potentially contrasting needs of beginning versus experienced farmers?
6. Are there tax or other savings instruments designed to help producers maintain or improve stability of financial reserves for short-term crises? What are the rules governing the use of these instruments (for example, in response to normal versus catastrophic circumstances)?
7. Can farmers access economy-wide social assistance programmes that respond to personal financial difficulties?
8. Are current programmes assessed for their impacts on crowding out on-farm risk management strategies, such as diversification or purchase of insurance?
9. Is the availability of credit from the private market influenced by whether or not producers use government risk management programmes?

Key questions on no-regret policies

No regret policies are policies and investments in key capacities that build agricultural sector resilience to risk under a wide range of future scenarios and contribute to agricultural productivity and sustainability, which are of benefit even in the absence of a shock. Public investments in key sectoral capacities, including research and development, information, and appropriate investments in hard and soft infrastructure may support the capacities of farmers to absorb the impacts of normal and marketable risks, and adapt or transform in response to a changing risk environment (particularly due to climate change). The following issues will be covered by the answers to the questions in this area:

- How the agricultural innovation system contributes to resilience objectives.
- How real-time information on developing risks is generated, shared and communicated.
- How the wider enabling environment – including the maintenance of strong and effective institutions, adequate provision of public goods, and good governance through laws and regulations that are conducive to private-sector economic activity while addressing market failures – affects the capacity of different stakeholders to manage risks to their assets.

Questions

1. Are national or regional agricultural innovation systems undertaking research on risk management and resilience topics, with a focus on risks for the medium- (e.g. within the coming decade) and long-term (e.g. beyond ten years)? Are there any examples to highlight?

2. Are extension programmes being leveraged to deliver outreach and education to farmers on best risk management practices and new developments in risk management?
3. Are there initiatives outside of extension (including through the private sector) that target improving farmers' knowledge of risk management?
4. Are early warning systems in place to inform producers about developing risks? For what risks? Are there plans to update these systems or improve their coverage to additional risks?
5. Are major investments in infrastructure that is critical to the sector planned with a view toward improved resilience under potential future conditions?

Key questions on process

Gaps in resilience levels may be due to stakeholders lacking: awareness about risks; knowledge about what measures exist to increase resilience; and the boundaries between normal business risks (to be borne and managed by farmers), larger risks requiring market solutions (such as insurance systems and futures markets), and catastrophic risks potentially requiring public response. Moreover, as the risk landscape is shifting, risk responses relative to these boundaries may need to be periodically re-assessed in a collective process that considers the viewpoints and incentives of all stakeholders. The answers to the questions in this area will cover:

- Whether participatory mechanisms are in place for setting the boundaries between different risk layers and the responsibilities of different stakeholders in managing risk.
- Consider how often evaluations, reassessments, and policy/strategy redesign take place.

Questions

1. Are agricultural risk management policies developed in conjunction with farmers, industry groups, and other stakeholders? If so,
    a. Which stakeholders participate in/contribute to designing risk response measures?
    b. What does their participation or contribution entail? At what stages are they involved (planning, foresighting, assessment, implementation, financing)?
    c. Do stakeholders participate in the process to identify the risk layers, establish risk ownership, and define relative responsibilities?
2. What are the evaluation mechanisms currently in place for targeted risk management policies? How often are outcomes evaluated and policy responses reassessed? Are climate change projections and uncertainties considered in this assessment process?

Strengthening Agricultural Resilience in the Face of Multiple Risks

This report explores how countries can strengthen the resilience of their agricultural sectors to multiple risks. A shifting risk landscape in agriculture – due to increasing weather variability, natural hazards, pests and diseases, and market shocks – will require public and private actors to consider the risk landscape over the long term, place a greater emphasis on what can be done ex ante to reduce risk exposure and increase preparedness, and prioritise investments that build resilience capacities both on-farm and for the sector as a whole. This report offers a framework for applying resilience thinking to risk management in agriculture, and explores how four OECD countries – Australia, Canada, Italy and the Netherlands – are mainstreaming resilience into their agricultural risk management policy frameworks.

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