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**Strengthening agricultural resilience in the face of multiple risks**

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### **Note by the Secretariat**

This activity, mandated under Expected Output Result 3.2.1.1.5 of the 2017-18 Programme of Work and Budget (PWB) of the Committee for Agriculture (CoAg), summarises the literature on resilience as it relates to agriculture, and puts forward a proposal for how resilience can be integrated into the application of the OECD holistic framework for risk management in agriculture. This work is a draft based on the revised scoping paper, which was presented for discussion at the November 2017 APM meeting [[TAD/CA/APM/WP\(2017\)16/REV1](#)]. The next draft of this report will include case studies examining how member countries are mainstreaming resilience into their risk management policy frameworks.

This draft report is presented for DISCUSSION under Item 6 of the draft agenda of the 75th Session of the Working Party on Agricultural Policies and Markets on 13-15 November 2018.

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## *Executive Summary*

The risk environment for agriculture is becoming increasingly complex due to longer-term uncertainties associated with climate change, market disruptions, and financial risk. As a result, policymakers are increasingly prioritising improving the resilience of farmers, agricultural sectors and the global food system. However, the empirical evidence on what farmers, governments and other stakeholders can do to improve resilience in agriculture is limited, despite this rising interest. This report seeks to fill this gap by clarifying the concept of resilience with respect to agriculture, drawing on relevant literature including work on risk management, international development and adaptation to climate change. The report brings together the evidence base on relevant resilience measures, to help policymakers to better integrate resilience into their policy frameworks by re-conceptualising the OECD holistic risk management framework through a resilience lens.

The draft is structured as follows:

- Chapter 1 clarifies the concept of resilience with respect to agriculture. This includes a description of the three capacities that are necessary for improved resilience (absorptive capacity, adaptive capacity, and transformative capacity), and the three dimensions to be considered when formulating resilience policy (scale, target risk, and time frame)
- Chapter 2 presents a review of the literature on resilience measures, combining insights from different bodies of work on each of the identified capacities, and presenting them by actor in the risk management system, concluding with some implications for policymakers
- Chapter 3 revisits the OECD holistic framework for risk management in agriculture, taking into account insights from the resilience literature to inform a proposal for how resilience can be integrated into the future application of the framework

The next version of this report will also include various resilience country case studies, as well as final conclusions relevant for resilience policymaking. These sections have been included as placeholders in the current document.

# 1. Conceptualising resilience for policymaking

## 1.1. Introduction

1. Resilience is often employed as a catchall policy buzzword, which complicates the use of the concept for policymaking purposes. In order to be useful in the context of agricultural risk management, the term must first be removed from the abstract and made concrete. Toward that end, in this chapter, we define resilience for the agricultural context, detail the different capacities that contribute to resilience, and provide context on integrating resilience thinking into policymaking for risk management.

## 1.2. What is resilience?

2. 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<sup>[1]</sup>); resilient systems take many forms, and as such, resilience is highly contextual (Bahadur et al., 2015<sup>[2]</sup>); 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<sup>[3]</sup>). As such, definitions tend to be context specific (see Box 1.1). 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 1.1. 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<sup>[3]</sup>). 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:

- 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<sup>[4]</sup>).

- 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 reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014<sup>[5]</sup>).
- 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<sup>[6]</sup>).
- 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<sup>[7]</sup>).

3. 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 1.1, resilience can be understood as “the ability to plan for, absorb, respond, recover from, and more successfully adapt to adverse events.”<sup>1</sup> 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 and learning and adapting to them), and points toward a long-term goal (more successful adaptation or transformation).

4. 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). With respect to agriculture, the relevant scale could be the field, farm, region, country, or even the global food system (Bullock et al., 2017<sup>[8]</sup>). When considering the target risk, policymakers will need to consider all disturbances, hazards and shocks that have potential negative impacts on the agricultural sector. These events should be conceived of as deviations from a trend, and not trends themselves. Moreover, policymakers 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<sup>[9]</sup>). 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.

5. 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 (a combination of the probability/severity of adverse events and the value of the assets that could be affected by such events) and reducing vulnerability (the potentially irreversible damage inflicted upon businesses and livelihoods if the adverse event takes place) through the building of

<sup>1</sup> See National Academies of Sciences, Engineering, and Medicine ((n.d.)<sup>[158]</sup>), Resilience website, <http://www.nationalacademies.org/topics/resilience/> (accessed 8 June 2018).

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<sup>[10]</sup>). 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 (see Box 1.2) (Béné et al., 2012<sup>[11]</sup>; Mitchell, 2013<sup>[12]</sup>; Douxchamps et al., 2017<sup>[13]</sup>; Tanner, Bahadur and Moench, 2017<sup>[14]</sup>; FAO et al., 2018<sup>[4]</sup>).<sup>2</sup>

6. 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<sup>[15]</sup>). 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<sup>[9]</sup>). 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.

#### Box 1.2. 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<sup>[12]</sup>). 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<sup>[16]</sup>; OECD, 2011<sup>[17]</sup>). 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

<sup>2</sup> 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<sup>[156]</sup>) or “robustness” (Meuwissen et al., 2018<sup>[23]</sup>) instead, for example.

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<sub>[12]</sub>). In agriculture, adaptation often takes the form of adjustments to farm operations management, such as shifting planting dates, adjusting crop mix, 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<sub>[18]</sub>).
- 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<sub>[12]</sub>). 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<sub>[19]</sub>)]. In addition, a transformation can be either deliberate and anticipatory, or forced and reactive (Tanner, Bahadur and Moench, 2017<sub>[14]</sub>). 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.



7. 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<sup>[20]</sup>). 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.

8. 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

9. In order to achieve greater resilience and use this concept as a lens for formulating risk management policy, policymakers 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.

10. When considering the target 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<sup>[21]</sup>; Tendall et al., 2015<sup>[22]</sup>). This is, for example, the focus of the EU SURE Farm approach (Meuwissen et al., 2018<sup>[23]</sup>). This holistic approach is advocated because focusing on one scale of a country’s agro-food system may undermine resilience at another level (Walker et al., 2004<sup>[24]</sup>; Bahadur, Ibrahim and Tanner, 2013<sup>[25]</sup>). 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<sup>[26]</sup>). 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 health 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 has been advocated by OECD when dealing with water risks (OECD, 2017<sup>[27]</sup>).

11. With respect to source of risk, when evaluating whether to pursue a policy targeting specific or general resilience, policymakers 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<sup>[15]</sup>; Adger et al., 2011<sup>[28]</sup>). 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<sup>[20]</sup>). 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 dealing with specified resilience, the source of the shocks is better defined, and 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, policymakers will be called to choose their optimal level of resilience given existing budgets and policy frameworks. It may be the case that certain investments in general resilience are at present too great to justify their cost (Carpenter et al., 2012<sup>[29]</sup>). In formulating plans for improved resilience, policymakers 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.

12. 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<sup>[30]</sup>). 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<sup>[10]</sup>; Carpenter et al., 2001<sup>[31]</sup>).

13. 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<sup>[29]</sup>). 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 biases in favour of baselines and perceptions from the past can generate misalignments and maladaptations.

14. 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<sup>[32]</sup>). 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<sup>[33]</sup>; Antón et al., 2013<sup>[34]</sup>).

## 1.4. Summary

15. In this chapter, we have defined resilience in the context of agricultural risk management policy, including describing the primary capacities that make up resilience for agriculture – absorptive, adaptive, and transformative. We also emphasised that, for policymaking purposes, governments will need to consider the potential trade-offs of certain policies with respect to scale, target risk, and time frame. In the next chapter, we take a deeper dive into the academic and policy literature for evidence of resilience-improving measures relevant to the OECD agricultural context.

## 2. Literature on policies and strategies for resilience

### 2.1. Introduction

16. The previous chapter defined resilience and explored what it means for agriculture and for agricultural policymakers. 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.

17. 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 program 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 an OECD setting.
- 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.

18. 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.<sup>3</sup> 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

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<sup>3</sup> 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<sup>[159]</sup>)], 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.)(<sup>[157]</sup>)).

previous OECD work in the context of risk management (OECD, 2009<sup>[16]</sup>), climate change adaptation (Ignaciuk, 2015<sup>[18]</sup>), and economic resilience (OECD, 2014<sup>[3]</sup>), uniting these concepts for a more holistic view of how resilience can be operationalised in the agricultural sector.

19. 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.

## 2.2. Evidence base on measures to improve resilience

20. 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.

### *Absorptive capacity*

21. 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:

- **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:

- **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

22. 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<sup>[17]</sup>). 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, we turn now to relevant measures for each of the different actors.

### *On-farm measures*

23. Beginning at the farm level, a key finding from the literature is that several strategies for managing normal risks 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.

24. 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<sup>[8]</sup>), overall crop mix (Darnhofer, 2010<sup>[35]</sup>; Gaudin et al., 2015<sup>[36]</sup>; Hansen et al., 2018<sup>[37]</sup>), the presence of multiple on-farm income-generating activities (Darnhofer, 2010<sup>[35]</sup>; Hansen et al., 2018<sup>[37]</sup>), or a mix of on- and off-farm income sources (Nelson et al., 2016<sup>[38]</sup>; Smith and Frankenberger, 2018<sup>[39]</sup>; Darnhofer, 2010<sup>[35]</sup>; Jetté-Nantel et al., 2011<sup>[40]</sup>). 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<sup>[40]</sup>), 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<sup>[35]</sup>).

25. 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<sup>[16]</sup>). 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<sup>[39]</sup>). Safety net programs 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 programs were found to substantially

reduce reliance on negative coping strategies in developing country settings (World Bank, 2016<sup>[41]</sup>; Bastagli et al., 2016<sup>[42]</sup>; Asian Development Bank, 2018<sup>[43]</sup>). 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<sup>[39]</sup>). With respect to OECD countries, the same type of income smoothing is commonly incorporated into the tax code (Antón et al., 2012<sup>[33]</sup>). For example, under Canada’s “Livestock Tax Deferral” program, 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<sup>[44]</sup>).

26. 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<sup>[45]</sup>; OECD, 2016<sup>[46]</sup>). For example, with the increasing availability of farm-specific monitoring technologies, producers can now 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<sup>[47]</sup>).

27. 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<sup>[48]</sup>; Smith and Frankenberger, 2018<sup>[39]</sup>). 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 cooperation in times of crisis (Newman and Dale, 2005<sup>[49]</sup>). Researchers noted that policymakers could consider using networks to strengthen implementation of resilience policy initiatives (Bernier and Meinzen-Dick, 2014<sup>[50]</sup>). For example, governments can utilize farmer groups or commodity organizations to leverage messaging targeting producers in the wake of a shock.

### *Market tools*

28. 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.

29. The value of insurance as a tool for absorbing the negative effects of adverse events is well-established (OECD, 2009<sup>[16]</sup>; OECD, 2011<sup>[17]</sup>), 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<sup>[51]</sup>).<sup>4</sup> 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<sup>[52]</sup>) (Box 2.1).

30. There are a few examples of index insurance being used to build resilience in OECD countries. In OECD member countries, these types of programs 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,<sup>5</sup> which may limit widespread uptake. Nevertheless, two example programs include:

- In 2015, the US Department of Agriculture's Risk Management Agency started a pilot program providing insurance coverage for pasture and grazing land that was based on a rainfall index as part of an integrated climate resilience response (USDA Risk Management Agency, 2017<sup>[53]</sup>; Averyt et al., 2018<sup>[54]</sup>). However, it is too soon to assess the potential impacts of the program.
- Mexico has been running an index insurance program (CADENA) since 2003. An independent analysis of the program'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 program was effective at helping farm households absorb and bounce back from adverse events (De Janvry, Ritchie and Sadoulet, 2016<sup>[55]</sup>).

31. 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, programs have been found to crowd out both on-farm risk management strategies and private insurance options (Antón et al., 2012<sup>[33]</sup>; Ignaciuk, 2015<sup>[18]</sup>; van Asseldonk et al., 2018<sup>[56]</sup>); incentivise maladaptive outcomes (for instance, insurance can allow producers to remain viable while eschewing the adoption of other long-term risk management practices, perversely jeopardizing long-term sustainability) (Collier, Skees and Barnett, 2009<sup>[57]</sup>; Müller, Johnson and Kreuer, 2017<sup>[58]</sup>; OECD, 2014<sup>[45]</sup>; Annan and Schlenker, 2015<sup>[59]</sup>); or act as a disincentive to additional risk reduction (Surminski, Bouwer and Linnerooth-Bayer, 2016<sup>[51]</sup>). 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<sup>[60]</sup>). 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<sup>[51]</sup>; Weingärtner, Simonet and Caravani, 2017<sup>[52]</sup>).

<sup>4</sup> 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/>.

<sup>5</sup> 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 an. See (OECD, 2016<sup>[46]</sup>).



### Box 2.1. 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 programs are oftentimes unavailable or non-existent, due to problems of information asymmetry, moral hazard and adverse selection, and the high administrative costs of these programs in developing country settings (Collier, Skees and Barnett, 2009<sup>[57]</sup>; Ceballos and Robles, 2014<sup>[61]</sup>; Carter et al., 2017<sup>[62]</sup>). Index insurance programs 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<sup>[61]</sup>).

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

- Research analysing the likely distributional effects of Kenya's index-based livestock insurance (ILBI) program 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<sup>[63]</sup>).
- An analysis of the outcomes of a similar ILBI program 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<sup>[64]</sup>).
- In their 2009 analysis, Collier, Skees and Barnett note that at least 30 weather index insurance program pilots had been implemented from the early 2000s. But while pilot program results were promising, the empirical evidence on the effectiveness of the programs was inconclusive (Collier, Skees and Barnett, 2009<sup>[57]</sup>).
- A 2016 review of the available literature on index insurance programs identified cases where index insurance improved income, but also a few instances where programs 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<sup>[65]</sup>).
- A 2018 meta-analysis found that index-based insurance did not have a discernible effect on either stabilizing production or on household poverty, but it was strongly associated with increased uptake of capital and technology by participating households (Hansen et al., 2018<sup>[37]</sup>).

However, scholars note that with better data, more available information, and transparent program quality standards, these programs may be more likely to achieve their stated aims (Jensen and Barrett, 2016<sup>[66]</sup>).

32. 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<sup>[52]</sup>).

33. 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 [see, for example, (Linnerooth-Bayer and Hochrainer-Stigler, 2015<sup>[67]</sup>)]. 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<sup>[3]</sup>). Consequently, disaster funding tends not to be a budgetary priority (Kellett and Caravani, 2013<sup>[68]</sup>). 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 (see Box 2.2).

34. The broader evidence base for these approaches remains thin since they are a relatively recent phenomenon (Kellett, Caravani and Pichon, 2014<sup>[69]</sup>; OECD, 2015<sup>[70]</sup>). 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<sup>[70]</sup>; Swiss Re, 2017<sup>[71]</sup>). 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.)<sup>[72]</sup>).

#### Box 2.2. 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<sup>[73]</sup>; Swiss Re, 2015<sup>[74]</sup>). 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<sup>[75]</sup>). 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), although no examples of such bonds could be found to date (Re:Focus Partners, 2015<sup>[75]</sup>).

- **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<sup>[70]</sup>). This instrument has the benefit of ensuring that countries are able to immediately access funds in the wake of disasters, but they also contribute to the country's overall debt burden.
- **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<sup>[70]</sup>). 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.

35. 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<sup>[76]</sup>). 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<sup>[17]</sup>), although these tools have not yet been widely considered in the resilience literature.

### *Policy measures*

36. 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*

37. *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 coordination 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.

1. Providing information for improved on-farm and sectoral risk management

38. 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<sup>[77]</sup>). 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<sup>[78]</sup>; UNISDR, 2015<sup>[79]</sup>), and experience on both the development front and in the DRM sphere provide support to this as a cost-effective action (Hallegatte, 2012<sup>[80]</sup>; Braimoh, Manyena and Obuya, 2018<sup>[81]</sup>). Monitoring of conditions is also necessary to inform stakeholders about when they should take mitigating actions (Fan et al., 2014<sup>[82]</sup>), 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<sup>[83]</sup>).

## 2. Improved planning and coordination for more effective disaster response

39. In their detailed multi-country assessment of improving country response to natural disasters, Clarke and Dercon (2016<sup>[77]</sup>) 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 coordinated 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<sup>[77]</sup>). 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<sup>[83]</sup>).

40. Aside from coordinated 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<sup>[84]</sup>). But governments typically do not keep 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<sup>[77]</sup>). This is particularly worrying given that 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<sup>[74]</sup>). 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<sup>[70]</sup>). OECD member 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<sup>[70]</sup>). 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<sup>[85]</sup>). Colombia has used instead a contingent line of credit, to be accessed only in the event of a natural disaster (World Bank, 2017<sup>[86]</sup>). In 2010, severe rains triggered the disbursement of the funds, which allowed the country to expedite its recovery (Hallegatte, Rentschler and Walsh, 2018<sup>[84]</sup>).

### 3. Investment in disaster risk reduction

41. 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<sup>[87]</sup>; Mechler, 2016<sup>[88]</sup>; Multihazard Mitigation Council (MMC), 2005<sup>[89]</sup>). 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<sup>[14]</sup>). 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<sup>[69]</sup>). The literature provides several suggestions for how this gap can be addressed in order to improve absorptive capacity.

42. 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<sup>[87]</sup>). 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<sup>[90]</sup>).

43. 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<sup>[91]</sup>; IPCC, 2012<sup>[10]</sup>; ECONADAPT, 2015<sup>[92]</sup>). In an analysis of case studies covering Europe, for example, Tröltzsch (2013<sup>[93]</sup>) concluded that various measures related to agriculture, including the development of adapted crops and pastureland restoration, would have greater benefits than costs.

44. Even outside the realm of no regret options, producers and countries can follow other strategies to minimize the riskiness of DRM investments. First of all, they can prioritize 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 programs, the establishment of a crop monitoring and early warning system, or farmer capacity building (Hallegatte, 2009<sup>[91]</sup>; IPCC, 2012<sup>[10]</sup>; ECONADAPT, 2015<sup>[92]</sup>). 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<sup>[94]</sup>). 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<sup>[91]</sup>).

45. 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<sup>[95]</sup>) argue that making investments in DRM can unlock three types of benefits for countries...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.

#### 4. Enabling environment

46. 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<sup>[16]</sup>). 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<sup>[39]</sup>).<sup>6</sup> Markets are another area in which governments can act to minimize the risks from adverse events. Research has indicated that open markets can play a role in stabilizing food prices in times of crisis, ensuring that poor consumers continue to have economic access to food (Fan and Brzeska, 2014<sup>[96]</sup>; Dorosh, Kennedy and Torero, 2016<sup>[97]</sup>). 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

47. While coordinated 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 programs, the opportunity to build back better, and the potential benefits of disaster post-mortem analyses.

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<sup>6</sup> 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.

48. 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<sup>[84]</sup>)]. 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<sup>[76]</sup>). 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<sup>[98]</sup>). 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 \$1.6 billion in humanitarian response, and nearly \$2.5 billion in additional avoided losses. Putting a similar plan into action, in 2017, FAO and partner organizations mobilized 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<sup>[99]</sup>).

49. 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<sup>[16]</sup>; European Commission, 2017<sup>[100]</sup>). 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<sup>[101]</sup>; Clarke and Dercon, 2016<sup>[77]</sup>). 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<sup>[102]</sup>).

50. 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<sup>[77]</sup>). 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<sup>[103]</sup>). 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.

51. 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 program 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<sup>[84]</sup>). 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<sup>[84]</sup>). 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<sup>[104]</sup>). 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.

52. Once the event has run its course, the literature suggested that policymakers engage in a “post-mortem” 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<sup>[105]</sup>). Moreover, authors emphasised that planning, response, and learning should be an iterative process that incorporates new information after every disaster (Keating et al., 2014<sup>[1]</sup>). 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<sup>[106]</sup>). 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.

### *Adaptive capacity*

53. 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 *detailed* 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

54. 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*

#### **Box 2.3. 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<sup>[107]</sup>; Ignaciuk, 2015<sup>[18]</sup>). 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 stabilizing agricultural production (Hansen et al., 2018<sup>[37]</sup>).

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<sup>[108]</sup>; Ignaciuk, 2015<sup>[18]</sup>; World Bank, 2017<sup>[109]</sup>; Janowiak et al., 2016<sup>[110]</sup>). 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 reseedling, 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<sup>[111]</sup>).
- 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<sup>[112]</sup>).
- A review of studies on water harvesting in Sub-Saharan Africa concluded that this strategy could improve farm resilience by stabilizing 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<sup>[113]</sup>).

- 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<sup>[47]</sup>).

56. 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<sup>[28]</sup>), as a paradigm shift from managing their operations for efficiency to managing them for flexibility (Carlisle, 2014<sup>[114]</sup>), through a process of continuous learning (Tendall et al., 2015<sup>[22]</sup>), or through adaptive management approaches that take into account new information to inform further decisions in an iterative cycle (Nelson, Adger and Brown, 2007<sup>[30]</sup>).

57. 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<sup>[115]</sup>). 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.

58. 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 emphasized that on-farm research was a critical laboratory for early climate adaptation innovations, and should be supported (Kenny, 2011<sup>[116]</sup>).
- 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<sup>[117]</sup>).
- 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<sup>[35]</sup>).
- Knowledge generation through farmer field schools was promoted as an effective way to coordinate between producers and researchers, with examples cited in Denmark, France, Italy and the UK (MacMillan and Benton, 2014<sup>[118]</sup>).
- Researchers found that farmer-initiated innovation in Ghana was correlated with improved resilience (Tambo and Wünscher, 2017<sup>[119]</sup>). 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.

59. 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<sup>[120]</sup>). Social networks were found to foster farmer-to-farmer knowledge exchange and innovation (Tompkins and Adger, 2004<sup>[121]</sup>), 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 cooperatively financing and operating a vegetable packing plant (Darnhofer, 2010<sup>[35]</sup>). 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<sup>[49]</sup>).

#### *Private sector measures*

60. 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<sup>[57]</sup>; OECD, 2014<sup>[45]</sup>). Furthermore, insurance can also be leveraged to incentivise adaptation through premium reductions for the implementation of certain good agricultural practices (GIZ, 2015<sup>[122]</sup>; Linnerooth-Bayer and Hochrainer-Stigler, 2015<sup>[67]</sup>).

61. The literature also theorized 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. At present, there is 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<sup>[109]</sup>). 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<sup>[109]</sup>).

62. Outside of an informational and financial role, the private sector can contribute to improved adaptive capacity through global value chains and certifications (OECD, 2013<sup>[123]</sup>; OECD, 2017<sup>[27]</sup>). 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<sup>[124]</sup>). 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<sup>[125]</sup>).

### *Policy measures*

63. 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<sup>[120]</sup>). 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.

64. 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<sup>[120]</sup>). Researchers and policymakers 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<sup>[18]</sup>). 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<sup>[108]</sup>). 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<sup>[18]</sup>). 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.)<sup>[126]</sup>). 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<sup>[127]</sup>).

65. The literature also highlights the importance of information for guiding adaptive investments in the sector. For example, Antle and Capalbo (2010<sup>[128]</sup>) used a stylized agricultural sector model to show the importance of information on investment decisions in adaptation. They emphasized 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<sup>[128]</sup>). 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<sup>[75]</sup>).

66. 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<sup>[97]</sup>), there is particularly a role for government in ensuring that research is downscaled to local conditions (Ignaciuk, 2015<sup>[18]</sup>). 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<sup>[129]</sup>; Nettle et al., 2015<sup>[130]</sup>). 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<sup>[108]</sup>), which will often have to be further tailored to local environments (Collier, Skees and Barnett, 2009<sup>[57]</sup>). 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<sup>[131]</sup>).

67. 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<sup>[57]</sup>). 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<sup>[132]</sup>). 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 policymakers and producers striving to improve farm resilience (Nettle and Paine, 2009<sup>[133]</sup>).

68. 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<sup>[30]</sup>; Ignaciuk, 2015<sup>[18]</sup>; Mathijs, 2017<sup>[134]</sup>). 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<sup>[108]</sup>; Ignaciuk, 2015<sup>[18]</sup>).

69. 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<sup>[135]</sup>; Ignaciuk, 2015<sup>[18]</sup>; Wreford, Ignaciuk and Gruère, 2017<sup>[120]</sup>). 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<sup>[108]</sup>). For example, in an analysis of groundwater use, Li et al. (2014<sup>[136]</sup>) 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<sup>[136]</sup>).

70. 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<sup>[120]</sup>). For example, subsidisation of crop insurance programs 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<sup>[18]</sup>). As such, governments could support adaptive capacity by phasing out insurance subsidies to ensure that farmers make production decisions in response to market incentives.

### *Transformative capacity*

71. 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<sup>[19]</sup>; Mushtaq, 2018<sup>[137]</sup>). 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<sup>[138]</sup>). But looked at through the lens of possibility for the future, transformation can instead be framed as an opportunity for reinvention.

72. 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<sup>[131]</sup>; Panda, 2018<sup>[139]</sup>). 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 policymakers 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<sup>[112]</sup>).

73. 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

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

#### *On-farm measures*

75. 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 customized 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<sub>[15]</sub>). Similarly, in their post-mortem 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<sub>[131]</sub>).

76. 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<sub>[114]</sub>; Rickards and Howden, 2012<sub>[140]</sub>; Sinclair et al., 2014<sub>[15]</sub>; Walker et al., 2004<sub>[24]</sub>). 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<sub>[141]</sub>). Similarly, in their analysis comparing adaptive and transformative tendencies amongst Australian wine grape producers, Park et al. (2012<sub>[112]</sub>) 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 adapters 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<sub>[112]</sub>).

77. As with both the absorptive and adaptive capacities, social capital in the form of networks was found to be important for transformative adopters as well. However, the focus was found to be different. For example, in their analysis of Australian producers, Dowd et al. (2014<sub>[142]</sub>) found that transformative adapters 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<sub>[142]</sub>).

### *Private sector*

78. 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<sup>[124]</sup>). Some authors note that the interruptive nature of transformational change implies that greater coordination 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<sup>[138]</sup>). 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<sup>[19]</sup>).

### *Policy measures*

79. 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<sup>[19]</sup>; Jakku et al., 2016<sup>[131]</sup>). 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.

80. 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<sup>[94]</sup>). 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<sup>[138]</sup>; Juhola et al., 2017<sup>[141]</sup>).

81. Indeed, scholars from the theoretical literature argue that more research considering transformation in the context of resilience is useful to help policymakers and producers take critical decisions about where resources should be invested (Park et al., 2012<sup>[112]</sup>; Anderies et al., 2013<sup>[9]</sup>; Wolfe et al., 2018<sup>[47]</sup>). 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<sup>[140]</sup>).

82. Researchers noted that it may be necessary for knowledge systems themselves to reorganize in order to better contribute to transformative capacity. Cornell et al. (2013<sup>[143]</sup>),



Rickards and Howden (2012<sup>[140]</sup>), Park et al. (2012<sup>[112]</sup>) 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 through 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<sup>[144]</sup>). 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<sup>[145]</sup>). 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<sup>[2]</sup>).

83. 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<sup>[24]</sup>; Colloff et al., 2017<sup>[144]</sup>). In their post-mortem of the Australian dairy sector deregulation, for example, Sinclair et al. (2014<sup>[15]</sup>) 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<sup>[131]</sup>).

84. 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<sup>[140]</sup>). 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<sup>[18]</sup>).

85. 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<sup>[146]</sup>). The North Carolina Swine Floodplain Buyout Program provides one example in this respect. The program 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<sup>[147]</sup>).

### *Gaps in the literature and contribution of this review*

86. 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.<sup>7</sup> 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<sup>[1]</sup>; Hansen et al., 2018<sup>[37]</sup>; Hallegatte, Bangalore and Vogt-Schilb, 2016<sup>[98]</sup>). 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 minimize this possibility, but additional strategies may be useful in other contexts.

87. 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<sup>[16]</sup>). 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<sup>[37]</sup>). More evidence that takes into account these interactions is needed to better inform resilience policymaking efforts.

88. Finally, 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<sup>[13]</sup>). There remain either recent cases highlighting mostly policies

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<sup>7</sup> 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.

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.

89. In spite of these limitations, the literature consistently emphasises common themes that can guide policymakers 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.

### 2.3. Policy implications of the literature review

90. 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. This section considers the policy implications, given the potential to improve resilience outcomes using multiple levers.

91. First, governments have a role to play in planning and coordination processes. In part due to international processes such as the Hyogo and Sendai Frameworks or the U.N. 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<sup>[3]</sup>). In most countries, policymakers 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<sup>[4]</sup>). 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<sup>[148]</sup>). 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.

92. Second, 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<sup>[121]</sup>; Ignaciuk, 2015<sup>[18]</sup>; Bizikova, Waldick and Larkin, 2017<sup>[149]</sup>; Averyt et al., 2018<sup>[54]</sup>; Steiner et al., 2014<sup>[150]</sup>; Colloff et al., 2017<sup>[144]</sup>). In this context, 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<sup>[151]</sup>; Eyzaguirre and Warren, 2014<sup>[152]</sup>). Efforts of these types are already underway in multiple OECD member 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<sup>[25]</sup>; Darnhofer, 2010<sup>[35]</sup>; Engle et al., 2014<sup>[32]</sup>; Keating et al., 2014<sup>[1]</sup>; Tendall et al., 2015<sup>[22]</sup>). 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.

93. 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 investments in risk reduction is 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<sup>[153]</sup>). In cases where traditional cost/benefit assessments have not seemed to be effective in drawing attention to the problem, participatory “serious gaming” 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<sup>[153]</sup>). This approach could be integrated with the more long-term participatory planning processes outlined above.

94. 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<sup>[120]</sup>).

95. 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, the cultivation of entrepreneurship and holistic risk assessment. 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 or fragmentation (Eisenack et al., 2014<sup>[154]</sup>). Previous OECD work on climate change adaptation has offered various insights into potential policy approaches in this context, some of which have also been covered in this review (OECD, 2012<sup>[115]</sup>; Wreford, Ignaciuk and Gruère, 2017<sup>[120]</sup>).

## 2.4. Conclusions

96. 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<sup>[3]</sup>). A holistic approach is necessary for the success of the resilience perspective, because it forces actors and policymakers to consider that their actions may have trade-offs, interaction effects, and unintended consequences.

97. Although the review focused on identifying factors essential to improving resilience capacities, several overarching themes emerged that are relevant to how policymakers integrate resilience into policy frameworks:

- The importance of time frame: 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 under long-term time horizons, and investing in infrastructure that will continue to function under a range of shocks. 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.

- The importance of interactions and trade-offs: 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.
- The importance of following an appropriate process in developing 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.
- The importance of investments in on-farm resilience capacities: 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.
- The complementary role of no-regret policies: 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, coordinating responses, and engendering an overall enabling environment.

### 3. Resilience and the OECD Risk Management Framework

#### 3.1. Introduction

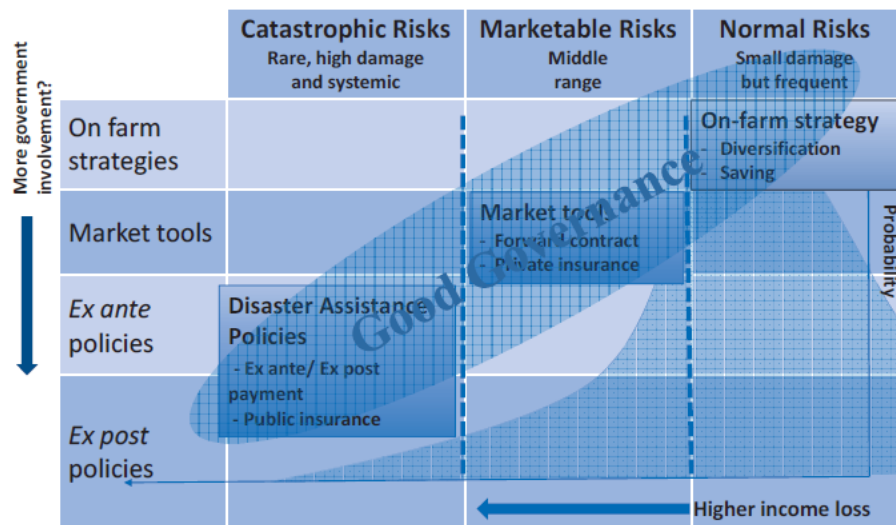
98. The previous chapters have explored the concept of resilience and how it relates to agriculture, and identified a range of policies, practices, and strategies that have been linked to improved resilience. Many of the resilience-enhancing measures identified in the literature review are also best practices for farm risk management generally (OECD, 2011<sup>[17]</sup>). In fact, there is increasing awareness that risk management is a natural entry point for the mainstreaming of resilience strategies (Howden et al., 2007<sup>[108]</sup>; Keating et al., 2014<sup>[1]</sup>; Braimoh et al., 2018<sup>[155]</sup>). 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.

99. 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 programs. To this end, the OECD risk management framework is briefly reviewed before describing how it can be adapted to inform resilience policy.

#### 3.2. OECD risk management framework

100. 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 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<sup>[16]</sup>; OECD, 2011<sup>[17]</sup>). These ideas are represented in Figure 3.1.

Figure 3.1. Optimal pattern of risk management strategies and policies



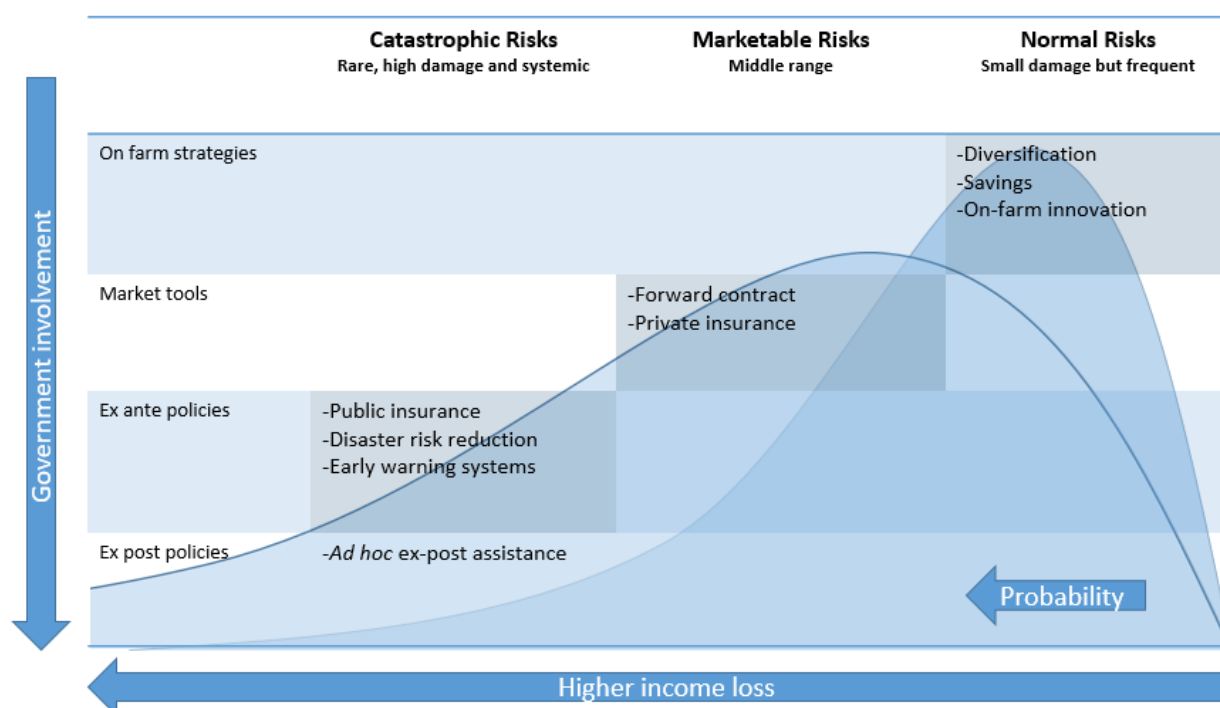
Source: (OECD, 2011<sup>[17]</sup>)

### 3.3. Resilience in the risk management framework

101. 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 the well-known risks at the expense of new risks and uncertainties: farmers and policymakers consider only specific risks, and take measures that only consider the *next* occurrence of a given event. Additionally, 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.

102. Furthermore, 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 (OECD, 2014<sup>[3]</sup>). Moreover, these extreme events are more likely under projected climate change scenarios (OECD, 2014<sup>[45]</sup>). These circumstances can be represented by a shift in the distribution of the impacts of adverse events, with high impact events occurring more frequently (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<sup>[17]</sup>).

103. The challenge, then, 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 survive not only 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.

### *Gaps analysis*

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

- *Ex ante* measures are key to improved resilience – this includes planning for adverse events (so that farmers are able to absorb their impacts), as well as supporting the capacity to implement adaptive or transformative measures designed to reduce or eliminate the risk altogether
- For most risk management tools and policies, there are costs and trade-offs between scales and timeframes that should be acknowledged



- The process for developing optimal policy responses should be collaborative and participatory, involving a wide range of stakeholders
- On-farm strategies can play a critical role in reducing risk exposure to catastrophic events, particularly over the long-term
- The role of government in improving sector resilience is not one of merely providing financial assistance in the wake of disasters – governments should concentrate their efforts on the provision of public goods (such as information and knowledge systems) 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

105. These findings informed the gaps analysis of the current framework. Consequently, the following conclusions were drawn:

- The framework could place greater emphasis on preventative or *ex ante* actions (such as risk mitigation efforts, risk assessment, and research on potential adaptation 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 is not designed 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.

### ***Revised approach***

106. To address these gaps, a revised framework for “Risk Management for Resilience” should emphasise:

1. **Time frame:** *More focus is needed 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 a farm's ability to survive other kinds of shocks, or else it may not provide protection against repeated exposures. 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 not only the likely knock-on effects of their immediate actions, but they will also take into account the possible occurrence of events currently considered to be unlikely in the short-term.

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 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 focus on future time horizons.

**2. 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, adapting, or transforming. Decisions 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.

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.

**3. Participatory collaborative process:** *More focus on coordination and the use of a collaborative approach to define strategies and responsibilities*

The literature suggests that the best approach to ensure that all actors can contribute to the process, consider the likely consequences of certain actions, and suggest possible alternative strategies is through an iterative participatory approach. In such an approach, policymakers, 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 collaborative understanding of the boundaries between the different risk layers – the instances when governments will intervene should be clearly defined and communicated, and farmers can use this knowledge to better prepare their own risk responses for other contingencies. 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.

4. **Investments in on-farm resilience capacity:** *More focus on developing entrepreneurship and human capital*

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 with market tools. While this segmentation is still relevant for resilience objectives, it should not be interpreted too rigidly – different stakeholders play a role in managing a given risk. In particular, farmers can take proactive actions to 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 diversification and savings. 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. This also requires some flexibility, and potentially some risk-taking in order to test new approaches and take advantage of potential opportunities to evolve the farm business in the face of changing circumstances.

5. **No-regret policies:** *More focus on policies that will enable farmers to respond to uncertainty and a changing risk environment, and build sectoral capacities more broadly, including providing information, investing in general services for the sector, and strengthening the enabling environment*

In order for farmers to make informed farm management decisions to build resilience, they need a supportive enabling environment where they can access information and acquire necessary capabilities and skills. 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 programs 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.

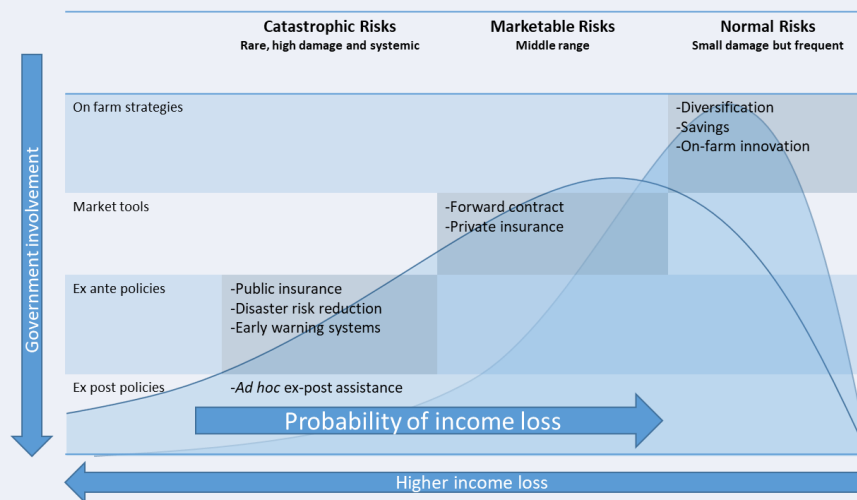
107. Taken altogether, the “Risk Management for Resilience” framework encompasses the original risk management framework, but with a long-term focus, an acknowledgement of the trade-offs inherent in certain policy choices, an emphasis on a participative resilience and risk management policymaking process, investments in farm-level resilience capacity, and enactment of “no-regret” policies, which in sum can lead to improved resilience outcomes. Some guidance into how these five key takeaways can be integrated into the original framework is provided below in Box 3.1.

### Box 3.1. Applying a resilience lens to the OECD risk management framework

As illustrated in Figure 3.2, farmers face an increasingly uncertain environment with a higher probability of experiencing catastrophic events. This increased frequency of higher-impact disasters implies that, under a “business-as-usual” approach where the risk management policy framework is largely focused on reactive measures, disasters will be more costly, farmers will find it increasingly difficult to cope with shocks, and governments will find themselves providing more and more *ex post* assistance to rebuild already susceptible systems.

To avoid this scenario, actors can instead apply a resilience lens to the OECD risk management framework. The first step in doing so is to **refocus the time frame** on which decisions are made. All actors should consider risk management for the long-term, taking into account the likelihood of different kinds of shocks, and repeated or concurrent exposures. This implies a greater focus on *ex ante* policies and prevention. 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. By reducing exposure and planning for uncertainty, actors can rebalance the risk burden to ensure long-term financial sustainability (Figure 3.3).

Figure 3.3. Re-balancing the risk profile



Source: Authors' elaboration, based on (OECD, 2011<sup>[17]</sup>)

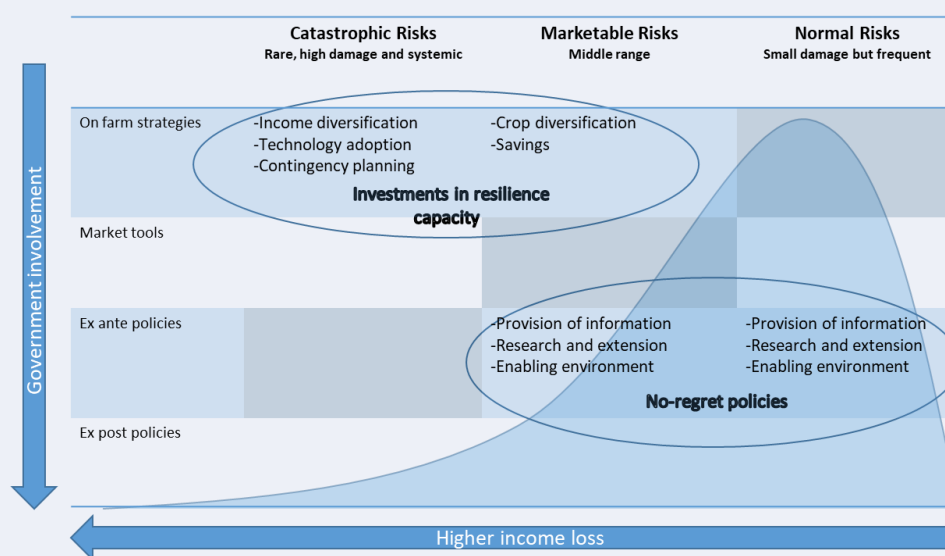
In addition to putting more focus on *ex ante* measures, stakeholders should take into account the **trade-offs** involved in promoting various approaches. Actors must consider that certain investments or policies may imply sacrificing efficiencies or revenues in the short-run for the sake of improved outcomes in future time periods. Stakeholders will also have to consider the relative costs and benefits of positioning their industries to either adapt to future circumstances or else transform in such a way that exposure to the risk is either eliminated or else substantially reduced. This may be complicated by the need to make irreversible investments, for example. Decision-makers also need to consider that focusing on improving the resilience of one actor may come at the cost of reduced resilience for others, and that singularly focusing on improving resilience to a particular risk may actually reduce overall flexibility in such a way that farmers are less equipped to deal with other types of shocks.

Assessing these trade-offs in a holistic way can best be undertaken through a **participatory collaborative process** where all stakeholders can assess available information, weigh the costs and benefits of available measures, rank preferred response options, and come to a common understanding of risk ownership. In this way, the boundaries between the different risk layers can be defined, thresholds for government action can be set, and each actor can make decisions based on this agreed-upon understanding of their individual responsibilities. To be most effective, this process should be iterative, so that actors can periodically re-assess the adequacy of their responses, analyse new information on developing risks, share findings on new approaches to confront risks, and reallocate resources as needed.

Although the primary responsibility for managing risks within each layer can be borne by farmers or government, there are measures that other stakeholders can implement to help reduce risk exposure more broadly. On the one hand, farmers can make proactive **investments in on-farm resilience capacity** that will reduce their overall exposure to shocks, help them to better cope with disasters, and ensure that they have the capacity to make decisions about how to continue their operations in the face of increased general uncertainty. This can involve adopting new technologies, improved contingency planning,

income or crop diversification, increased savings or financial safety nets, development of human capital to be able to better manage risk, and an emphasis on entrepreneurship to be able to take advantage of new opportunities that may result from changing circumstances. At the same time, the government should put renewed emphasis on enacting **no-regret policies** to support the development of improved on-farm capacity to manage risks for the long-term. These policies include providing general information, research into new technologies or risk management strategies, extension and capacity building efforts, and an overall enabling environment to ensure functional services and markets when faced with disasters (Figure 3.4).

**Figure 3.4. Investments in on-farm resilience capacity and enactment of no-regret policies reduce exposure and facilitate more holistic risk management**



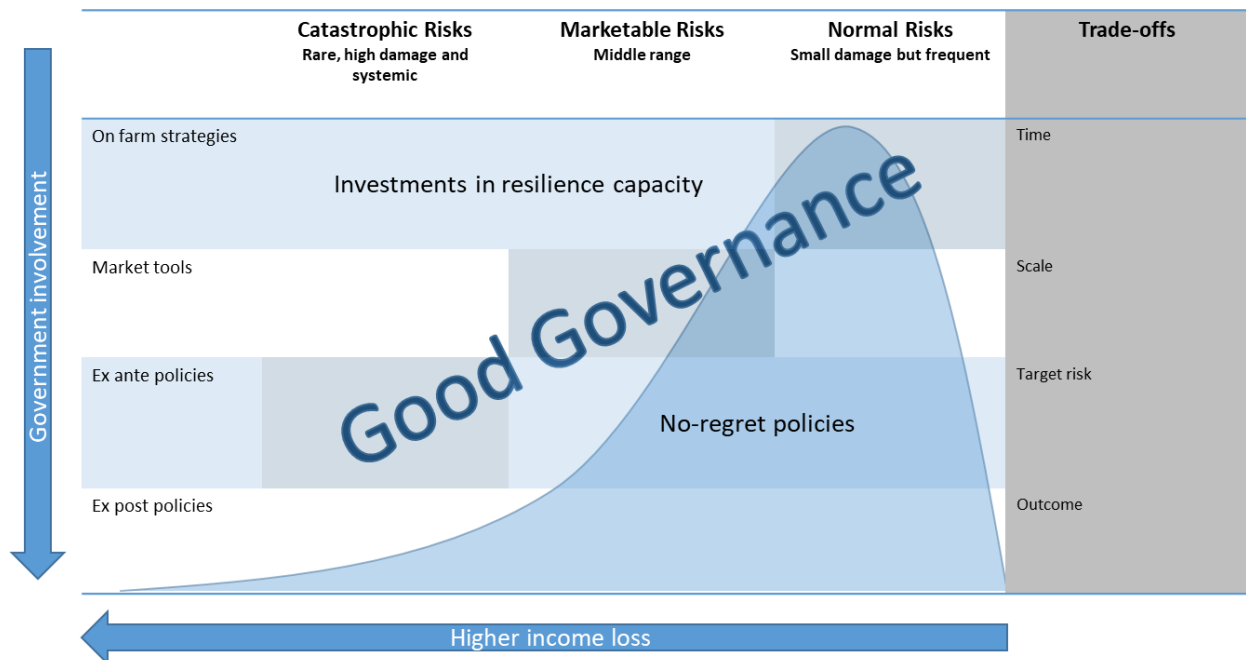
Source: Authors' elaboration, based on (OECD, 2011<sup>[17]</sup>).

108. Further refinement of the framework may be warranted, but key takeaways at this stage include:

- The resilience lens can be applied to the OECD risk management framework as a means for countries to assess how their policy framework might allow farmers to deal with general uncertainty for the long-term
- Applying the resilience lens to the risk management framework means greater emphasis on *ex ante* policies and prevention with a view toward long-term sustainability
- More focus is needed on the trade-offs of different policy options – particularly as they relate to the long-term capacities to adapt and transform
- Stakeholders should consider implementing a collaborative, iterative approach to define risk layers, responsibilities, and optimal responses
- Improved resilience requires proactive investments in on-farm capacity
- Enacting no-regret policies, such as investing in research and innovation, will allow farmers greater autonomy in their farm management decision-making processes

109. Considering the five critical focus areas collectively, the revised framework can be expressed graphically as follows (Figure 3.5).

**Figure 3.5. Risk management for resilience**



Source: Authors' elaboration, based on (OECD, 2011<sup>[17]</sup>).

### 3.4. Summary

110. 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 risk management policy frameworks. Future work in this area will examine how this revised framework can be useful for evaluating resilience policy approaches already underway in OECD countries.

## 4. Country Case Studies

111. This chapter will pilot the revised risk management framework for a resilient agriculture sector via country case studies. Specifically, the case studies will explore how resilience is being mainstreamed into the risk management policy frameworks of selected OECD countries. The case studies will focus on a particular topic area in each country, with an emphasis on what lessons can be drawn for implementing resilience-focused policies more generally in OECD countries.



## 5. Findings and policy conclusions

112. This section will be further developed after the case studies have been finalised. However, some preliminary findings from the work include:

- A long-term perspective will help actors consider the possibility of more remote events and take mitigating actions *ex ante*, while also helping them to better consider the possible consequences of current actions
- Considering the risk landscape holistically, and analysing the trade-offs between policies and resilience measures, will reduce the probability of actors implementing measures that are maladaptive, and instead promote greater flexibility in the face of uncertainty
- The process of developing policy approaches should be collaborative and participatory, and governments should include all stakeholders in the process to determine risk profiles, boundaries between risk layers, respective responsibilities, and optimal holistic risk management responses. Moreover, using this approach in an iterative framework will allow stakeholders to consider new information and shift their approach in response to changing conditions
- Promoting and supporting investments in on-farm resilience capacity, such as the development of entrepreneurship skills, will lead to a sector whose farmers are better able to respond to all risks, preventing the shifting of the risk burden toward governments in the long-run
- Governments should commit to implementing no-regret policies that enable producers to improve their on-farm resilience capacity, including providing information, supporting research and extension, and ensuring a general enabling environment

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