

Solutions for Better Agri-Risk Management

IN THE EUROPEAN UNION



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Abbreviations and Acronyms

AAL	Annual Average Losses
ACP	Africa, Caribbean and Pacific
ARM	Agricultural Risk Management
ASF	African Swine Fever
CAP	common agricultural policy
CCR	Caisse Central de Réassurance (Central Re-Insurance Fund)
CEVI	Catastrophic Events Vulnerability Index
CIAG	Consorzio Italiano Assicuratori Grandine (Italian Consortium of Hail Insurers)
CIRAS	Consorzio Italiano Rischi Agricoli Speciali (Italian Consortium for Special Agricultural Risks)
CLs	Contingent Liabilities
CMO	Common Market Organization
CV	Coefficient of Variation
DEP	Déduction pour Epargne de Précaution (tax-free precautionary savings)
DG AGRI	Directorate-General for Agriculture and Rural Development
DRF	Disaster Risk Financing
EAA	Economic Accounts for Agriculture
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EAP	Expected Annual Loss
EEA	European Environment Agency
EFSA	European Food Safety Authority
ELGA	Hellenic Agricultural Insurance Organization
EU	European Union
FADN	Farm Accountancy Data Network
FAO	Food And Agriculture Organization
GDP	Gross Domestic Product
GVA	Gross Value Added
HPAI	Highly Pathogenic Avian Influenza
IFPRI	International Food Policy Research Institute
IHS	Inverse Hyperbolic Sine
ISMEA	Institute of Agri-Food Market Services of Italy
IST	Income Stabilization Tool
MPCI	Multi-Peril Crop Insurance
MS	Member States
NDVI	Normalized Difference Vegetation Index
NRP	National and Regional Partnership
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PDF	Probable Distribution Function
PPP	Public Private Partnership
PVPP	Production Value at Producer Prices
RDP	Rural Development Program
SFA	State Fund Agriculture
SNIA	National Agricultural Information System of Uruguay
SO	Standard Output
SWOT	Strengths, Weaknesses, Opportunities and Threats
TVaR	Tail Value at Risk
UAA	Utilized Agricultural Area
USDA	United States Department of Agriculture
VaR	Value at Risk
WTO	World Trade Organization

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EXECUTIVE SUMMARY

Globally, the agri-food system is facing an increasingly complex and volatile risk landscape. Traditional risks, related to production, markets, finances, and others, are now compounded by climate change, geopolitical instability, pandemics, and digital vulnerabilities. These evolving threats are intensifying existing challenges, such as droughts and floods, and are undermining farmers' ability to invest, innovate, and sustain productivity. There is increased global attention to these evolving risks and recognition of the importance of responding through proactive, integrated risk management strategies that combine public and private instruments, such as climate-smart investments to de-risk farms, insurance to transfer risks, and disaster relief to alleviate the impacts of adverse events. Despite a global trend of increased public spending on agricultural risk management, significant protection gaps remain.

In Europe, climate-related risks are particularly acute and driven by drought, while new risks are rising. Drought alone accounts for over 50 percent of climate-related agricultural losses and remains significantly underinsured across much of the European Union (EU), see fi-compass (2025). Market and biosecurity risks are growing and leading to billions in losses to the European farmers. Some of these risks are exacerbated by climate change, but others represent new shocks, particularly considering regional geopolitical developments. All call for increased resilience, which must rely on an effective combination of risk mitigation (through preventive actions, such as climate-smart investments, diversified and systemic transformation of supply chains, early warning systems, etc.), risk pooling and transfer (better insurance/mutualization products with more inclusive coverage, innovative tools at country and regional level, etc.), and risk coping (swifter and more targeted ex-post response).

Despite its geographic and market strengths, the EU's agri-food system faces challenges due to fragmented risk management policies and delivery approaches. The EU benefits from significant agri-climatic diversity and a deeply integrated food market, which together enhance its systemic resilience to shocks. Its varied agro-ecological zones allow for natural risk dispersion, while the single market enables swift redistribution of agricultural goods and inputs during localized disruptions, even though individual impacts may vary. However, these strengths are undermined by the fragmentation of agricultural insurance markets and risk management policies across Member States. While the common agricultural policy (CAP) provides a shared and strong framework, implementation policies and capacities vary widely, resulting in inconsistent coverage and subsidy levels. This patchwork approach may limit the EU's collective ability to respond to climate shocks and market disruptions.

Against this background, this study explores how agricultural risk management (ARM) instruments have been adopted across the EU, and how their uptake can be improved post 2027. The study focuses primarily on risk transfer and coping mechanisms, while leaving room for a longer-term approach to a more integrated, long-term risk management strategy. It identifies a gap between the recognized need for effective ARM and the actual implementation of CAP-supported tools across Member States. To address this, first, the study employs cluster analysis to group countries with similar risk profiles, then it uses econometric modeling to understand adoption drivers over two budget cycles, then it conducts qualitative deep dives to assess policy use and financial exposure in five selected countries and finally it provides actuarial analyses in the deep-dive countries to understand the values at risk and the eventual protection gaps. Ultimately, this work aims to inform future EU and Member State actions and deliberation, by recommending ways to strengthen agricultural risk responses and close financing gaps through diversified risk management tools.

Historically, the evolution of ARM within the EU's CAP reflects a gradual shift from market-price support mechanisms toward structured, proactive tools aimed at managing production and income

risks. Initially, CAP relied on price stabilization tools, but reforms since the 1990s introduced direct payments and later explicit ARM instruments such as insurance subsidies, mutual funds, and income stabilization tools (IST). The 2014–2020 CAP marked a turning point with a dedicated risk management toolkit under Pillar II, though uptake varied widely across Member States. Mid-term reforms in 2017 improved flexibility and incentives, yet risk management tools in general remained underutilized. The 2023–2027 CAP continued this trajectory, consolidating risk tools and introducing innovations like redirecting a portion of direct payments to risk management programs and establishing an agricultural reserve. Looking ahead, the post-2027 CAP proposal tabled by the European Commission in July 2025 proposes mandatory ARM implementation and enhanced flexibility, alongside a new Unity Safety Net for market stabilization and complementary crisis payments for disaster recovery. These developments aim to embed risk management more deeply into EU agricultural policy, balancing preventive and reactive approaches to build farm resilience.

To better understand the uptake of CAP-funded ARM instruments, the study uses cluster analysis to group and select deep-dive EU Member States based on five key variables: water stress, utilized agricultural area, agriculture’s share in GDP, farm structure, and yield volatility. Based on this, five distinct country segments were identified, each with unique risk exposure and structural characteristics. These clusters help streamline policy analysis and inform targeted recommendations. For deeper insight, five countries, Bulgaria, France, Latvia, Italy, and Slovakia, were selected for qualitative and quantitative deep dives, reflecting a range of experiences with CAP-funded risk management tools and diversity of agricultural structures across the EU.

Recognizing that risk management uptake depends on a complex interplay of factors, econometric analysis helps understand the main drivers of the ARM uptake under the CAP during 2014–2022. Understanding these drivers is crucial for designing policy interventions, which encourage the uptake of practices that not only mitigate risks but also promote long-term resilience in agriculture. In parallel, each context might require tailored approaches to address specific barriers and leverage local drivers effectively. These aspects were examined in detail for five countries: Bulgaria, France, Latvia, Italy and Slovakia. The econometric analysis looked retrospectively at the use of ARM instruments under the CAP during the previous programming cycle, based on actual spending data provided by the governments of the five countries. It also looked at an expanded set of all 10 EU countries that utilized CAP ARM tools during 2014–2022, even though it could not be replicated with all the explanatory variables. Notably, data regarding state aid used in response to natural disasters affecting agriculture was not readily accessible for all 10 countries throughout the period.

The econometric analysis points to a few key variables that are significantly associated with CAP ARM uptake.

- **Firstly, there appears to be a trade-off between ex-post disaster relief and the uptake of ARM tools in the EU, as farmers anticipating compensatory state aid may be less inclined to invest in preventive or market-based risk strategies.** This dynamic, influenced by moral hazard, can distort insurance markets and reduce the attractiveness of ARM instruments. To address this, clearer rules are needed to delineate public and private compensation roles, which could improve insurance availability and affordability. Harmonization between EU-level crisis payments and national disaster funds is also essential, particularly as Member States develop mechanisms for non-insurable risks.
- **Secondly, the output-to-input ratio, which serves as a proxy for farm profitability and efficiency, is negatively and strongly associated with ARM uptake.** Countries with higher ratios tend to have more financially resilient farms, making them less likely to invest in formal risk management tools such as insurance or mutual funds. Across both sets of countries analyzed, the highest output-to-input ratios are found among small and/or usually highly specialized farms. Across the deep-dive countries, the smallest farms in economic terms, specializing in wine, horticulture, and olives (for Italy and France), have the highest output to input ratios. Some large farms exhibit high ratios as well, but these holdings are also strongly specialized in high-value products, e.g. wine (France), dairy (Slovakia), or horticulture (Bulgaria, Latvia). This finding underscores the importance of tailoring insurance products and covering protection gaps that affect specialty crops.
- **Thirdly, water stress is another critical factor positively influencing ARM adoption.** In regions where agriculture faces high water scarcity, the risk of yield losses due to droughts or irregular precipitation is significantly elevated. This heightened exposure often drives demand for climate-related

insurance products and other risk transfer mechanisms. However, the relationship is not always linear; some highly water-stressed countries may lack the institutional capacity or insurance culture to support widespread ARM uptake, highlighting the need for targeted support and capacity building.

- **Lastly, the share of direct payments in farm income is negatively associated with ARM uptake.** Direct payments, currently the main income support tool under the CAP, are a safety net that helps farmers absorb income shocks. Small and less specialized farms rely heavily on direct payments for liquidity, as documented by various studies, which makes the continuation of this support tool vital for them in a post-2027 CAP. For a diversity of reasons widely addressed in literature (e.g., higher transaction and participation costs, liquidity constraints, and income diversification as a form of self-insurance), small and less specialized farmers are also less likely to take up insurance, which may explain the negative relationship observed, and underscore the importance of better targeting small holdings with CAP risk management instruments.

A deep dive and actuarial analysis provide further insights into five EU countries. All five countries (Bulgaria, France, Italy, Latvia, and Slovakia) face rising agricultural risks, with drought emerging as the most pervasive threat. Prolonged dry spells have caused steep output losses in recent years. For example, France's extreme droughts in 2019 and 2022, and Italy's once-in-50-year drought in 2017 sharply reduced crop yields. Bulgaria and Latvia likewise suffered multi-year drought episodes, while Slovakia's case includes localized floods, hail, and wild animal damage. Biosecurity risks have grown, with African Swine Fever outbreaks forcing mass culling in Bulgaria, Latvia, and Slovakia, and Highly Pathogenic Avian Influenza surges hitting Italy and France's poultry sectors.

Structurally, the farm sector composition in these five countries shapes risk exposure and management capacity. France and Italy have the largest and most diversified production bases, while Bulgaria and Latvia show a polarized structure with a handful of large enterprises producing the bulk of output alongside many small holdings. Slovakia's sector is the most consolidated, with large corporations accounting for a significant portion of farmland and output. Larger commercial farms are more likely to insure and invest in mitigation, whereas small farms often lack resources and historically relied on ex-post assistance. Cross-country differences in farm size and specialization translate into different vulnerabilities and capacities.

Insurance uptake has expanded in all five countries over the past decade, supported by substantial public subsidies, yet it remains far from universal. Public financing is critical to these insurance systems. All five countries now leverage CAP Pillar II support in their 2023–2027 Strategic Plans to co-finance insurance premiums. France, Italy and Latvia have also utilized CAP ARM funds during the 2014–2022 period, while Bulgaria and Slovakia have programmed such measures but have not implemented them.

Beyond insurance, mutual funds and disaster reserves are emerging as complementary and increasingly integrated tools. Italy and France have pioneered multi-tiered risk management systems, now being emulated by others. France created a three-tier scheme in 2022, linking farm self-resilience, subsidized insurance, and a public National Solidarity Fund for catastrophic losses. Italy launched AGRICAT in 2023, a national mutual fund for catastrophic risks, financed by a mandatory levy on direct payments and rural development funds. Bulgaria is in the process of establishing an Agricultural Mutual Fund by deducting a percentage of all farmers' direct payments into a pooled fund, matched by EU/national funds.

Disaster payments, mainly financed through state aid, but also increasingly from the CAP in recent years, continue to play a role, though governments are trying to phase them into more structured approaches. While disaster reserves provide a framework to deliver such payments in a predictable way, many ad-hoc compensations still rely on non-dedicated public resources. There is a clear trend toward formalizing and expanding these support measures under the CAP framework. Predictable, pre-funded tools (insurance, mutual funds, and reserves) are preferable to reactive aid, which can strain national budgets and potentially discourage farmers from other forms of protection.

Cross-country, the effectiveness of ARM varies, but the direction of change is similar. France and Italy have built the most comprehensive ARM systems, combining wide insurance coverage with layered public support for risk management. Bulgaria, Latvia, and Slovakia have put key building blocks in place under the CAP. Notably, the actuarial analysis shows that all five countries still face substantial "uninsured" risk for catastrophic events. Addressing these will require continued reforms, including potentially adjusting EU rules, expanding eligible instruments, and building greater farmer awareness.

A set of recommendations aims to make the EU ARM system more agile in face of evolving risks. Recommendations 1-5 aim to provide concrete solutions for expanding the scope of the current ARM tools, through greater coverage, promotion of innovative products, improved access for small farmers, and adaptation/extension of the existing CAP tools. Recommendations 6-9 aim to build a strong foundation for making risk management at EU and Member State level more effective, through increasing transparency, facilitating knowledge-sharing and pooling/building data systems that are conducive to increasing the evidence base for the benefit of all relevant sector risk stakeholders.

RECOMMENDATION 1: Expand the scope of insurance and other ARM tools and promote innovation in their design. In the face of rapidly evolving agricultural risks and market uncertainties, farmers need a broader and more innovative toolkit to safeguard their livelihoods. Recommendation 1 calls for **expanding the scope of insurance and other ARM instruments and promoting innovation in their design** to ensure that EU's risk management support keeps pace with these challenges. This entails widening the types of losses and products covered by support – for example, **making revenue-based insurance products eligible for support** alongside traditional production or income loss coverage – and developing **clear guidelines for index-based insurance solutions** to facilitate adoption of modern, data-driven tools. It also means **investing in research, development, and pilot testing new risk management instruments** (such as weather-indexed funds or novel financial instruments) to address emerging issues like climate volatility and accompany farmers in their transition to more resilient production systems. Finally, the framework must become more adaptable, with **regulatory flexibility to accommodate innovative instruments and lower loss thresholds** to keep up with emerging risks that fall outside traditional schemes.

RECOMMENDATION 2: Lower insurance barriers and transaction costs to expand small-farm uptake. Small farms face disproportionate barriers to insurance due to high fixed costs, limited accessibility and product options, and complex subsidy procedures. Recommendation 2 proposes targeted reforms to make insurance more accessible and affordable for small holdings. This includes increasing premium support for small contracts, recognizing farmer aggregations as eligible intermediaries to streamline applications, and applying public subsidies upfront to ease cash flow constraints. These measures aim to reduce transaction costs, improve service delivery, and ensure that small farms are no longer excluded from the benefits of agricultural risk management.

RECOMMENDATION 3: Re-confirm and strengthen provisions and assistance in implementing mutual funds. Mutual funds offer a valuable alternative to insurance, especially for risks that are uninsurable or inefficiently covered. Recommendation 3 calls for reaffirming their role in the CAP and simplifying their design and implementation. It proposes EU-level technical assistance, clear operational guidelines, and expanded coverage to include revenue losses. By leveraging the CAP Network and building on Member State experiences, mutual funds can evolve from fragmented pilots into scalable, resilient schemes that complement insurance and enhance farmers' protection against diverse risks.

RECOMMENDATION 4: Harmonize support for agricultural risk management tools under a dedicated CAP framework. Fragmented support across various CAP instruments (both under Pillar I and II) undermines the efficiency and uptake of risk management tools. Recommendation 4 advocates for a harmonized framework that aligns subsidy rates, eligible costs, and operational mechanisms across comparable instruments programmed under the CAP Strategic Plans and sectoral interventions, namely insurance, mutual funds, income stabilization tools, and related schemes. This includes enabling support for fund capitalization and operating costs, clarifying boundaries between instruments, and streamlining access and reimbursement processes. A unified approach will reduce legal uncertainty, improve delivery performance, and ensure consistent support for agricultural resilience across the EU. While harmonization primarily concerns EU-level regulations, effective implementation by Member States will be key to ensure coherence and avoid market fragmentation.

RECOMMENDATION 5: Clarify the regulatory framework for the adoption of co-insurance and co-re-insurance pools in agriculture in the EU Member States. Co-insurance and co-reinsurance pools can enhance risk-sharing and market stability, but legal ambiguity has hindered their adoption in the EU. Recommendation 5 calls for the European Commission, in collaboration with the European Insurance and Occupational Pensions Authority (EIOPA), to clarify the regulatory framework governing such pooling arrangements. By distinguishing EU-level and national responsibilities and providing clear guidance, Member States will be better equipped to implement collaborative insurance models that expand coverage and improve financial sustainability in agricultural risk management.

RECOMMENDATION 6: Improve transparency and data collection of the national and EU-funded disaster relief mechanisms for farmers. Ad hoc disaster aid has become a growing component of agricultural support, yet data on these measures remains fragmented and difficult to retrieve. Recommendation 6 proposes a structured approach to track and publish information on national and EU-funded relief mechanisms. To improve transparency in the state aid database, better classification and reporting are needed, and the European Commission can play a key role in enhancing this process in close collaboration with the Member States. Additionally, the European Commission could gather data into a single repository and produce exhaustive reports on risk management-related instruments and financing at both national and EU levels, to be published at least every two years.

RECOMMENDATION 7: Provide Technical Assistance for medium- to long-term projections of climate change and other hazards' impact on risks, including country risk profiling. Effective risk management begins with understanding future hazards. Recommendation 7 emphasizes the need for EU-level technical assistance to develop agro-climatic models and conduct national risk assessments. Among others, through targeted technical assistance, the Commission could help Member States estimate production losses due to adverse climate events (including their sanitary repercussions) under current and future climate scenarios. These tools will enable Member States to estimate losses under various climate scenarios, price ARM instruments accurately, and design targeted adaptation policies. A common framework for risk profiling would guide and encourage consistency and help integrate climate resilience into CAP programming.

RECOMMENDATION 8: Set up formal means and opportunities for information sharing and knowledge transfer to support stakeholders in the Member States to design and implement ARM tools. Low uptake of advanced ARM tools often stems from limited technical capacity at the national level. Recommendation 8 calls for structured EU-led initiatives to support knowledge transfer and stakeholder engagement. This includes technical assistance platforms, peer learning forums, and harmonization of disaster fund rules. By equipping Member States with the expertise and tools needed to design and implement effective ARM programs, the EU can foster broader adoption and more resilient agricultural systems.

RECOMMENDATION 9: Streamline ARM-relevant data collection, reporting and use across the EU and at Member State level. Robust data systems are essential for effective agricultural risk management. Recommendation 9 proposes a comprehensive effort to consolidate ARM-relevant datasets, improve interoperability, and refine CAP monitoring indicators. Member States are encouraged to enhance public data access, strengthen early warning systems, and collaborate with insurers to share loss and claims data. These improvements will reduce uncertainty, lower costs, and enable the development of more precise and inclusive risk management tools.

1 RISING AGRI-FOOD RISKS IN EUROPE AND AROUND THE WORLD

Agriculture is an inherently risky activity that has become even riskier in recent years; new risks are adding to the traditional ones. Risks to farm businesses can be related to production, market, or price, social (including labor), financial, and institutional (Finger et al., 2022). While traditional risks across any of these categories tended to be localized and recurrent, allowing farmers and policy makers to draw on historical experience to manage them, new risks are gaining prominence. These include climate change-induced extremes that far exceed normal weather fluctuations, geopolitical disruptions like trade conflicts or war that shock input and output markets, global pandemics affecting labor and supply chains, and even digital vulnerabilities as agriculture becomes more technology-dependent. Not only are new risks adding layers of uncertainty, but evidence shows they are also exacerbating traditional risks – for example, climate change is making droughts and floods more frequent and severe. These combined risks could reduce the well-being of farmers, their incentives to produce, to invest and to innovate and ultimately affect the resilience capacities of farm businesses and farming systems (Meuwissen et al., 2019). Further, high uncertainty could be a significant obstacle to a successful and sustainable farm sector transition.

The global agri-food system is increasingly exposed to a complex array of risks that threaten its stability, productivity, and sustainability. According to the OECD (Glauber et al., 2021), climate change has intensified the frequency and severity of weather-related shocks, such as droughts, floods, and heat-waves, which directly impact agricultural yields and supply chains. These risks are compounded by structural vulnerabilities in farming systems, including market volatility, biosecurity threats, and the growing interdependence of global trade. The OECD emphasizes the need for agricultural risk management policies to move beyond reactive disaster aid and instead adopt proactive, layered strategies that integrate risk prevention, mitigation, and transfer mechanisms.

The World Bank (2021-2025) further highlights how geopolitical instability, pandemics, and macro-economic disruptions are reshaping the risk landscape for agriculture. The recent World Bank global knowledge exchange series underscores the fragility of food systems in low- and middle-income countries, where limited access to finance, insurance, and infrastructure exacerbates farmers' exposure to shocks. It calls for integrated risk management frameworks that combine public and private instruments, such as insurance, social protection, and climate-smart investments, to build resilience across the value chain. The World Bank also stresses the importance of data systems and institutional coordination to ensure timely and targeted responses to emerging risks.

FAO's analysis (2023) adds a food security dimension to the discussion, noting that the agri-food system must contend with both acute crises and long-term stressors. The report identifies rising input costs, land degradation, and shifting consumption patterns as key drivers of systemic risk. It advocates for a transformation toward more inclusive, diversified, and sustainable food systems that can withstand disruptions while ensuring equitable access to nutritious food. FAO emphasizes that risk management must be embedded within broader development strategies, linking agricultural resilience to environmental stewardship, social equity, and economic viability.

Globally, public spending on agricultural risk management (ARM) is on the rise, to match the new challenges. Global spending on agricultural risk management has risen sharply in recent years, reflecting

the growing frequency and severity of climate-related and market shocks. According to the OECD report by Glauber et al. (2021), countries such as Canada, the United States, and the European Union (EU) are leading in public expenditure on risk management tools, including subsidized insurance, disaster relief, and income stabilization programs. The United States, for example, allocated nearly USD 12 billion in 2022 to its federal crop insurance program, driven by its extensive coverage of yield and revenue risks across major commodities. Canada has developed a layered approach combining insurance, savings accounts, and disaster assistance, while the EU is increasingly integrating risk management into its CAP. These countries lead due to their large-scale farming sectors, exposure to climate extremes, and policy frameworks that prioritize farm income stability and resilience.

Europe's risk map is changing as well. European farmers are exposed to market risks mainly through increased price volatility, and to production risks mainly through more frequent and stronger climate events (Tangermann, 2011; European Commission, Directorate-General for Agriculture and Rural Development, ECORYS, Wageningen Economic Research, 2017). Changes in the policy framework, such as new sanitary, animal welfare or environmental requirements, impact farmers through additional compliance and operational costs and, therefore, represent policy-induced risks that farmers need to address (European Commission, 2025).

The EU's agri-food system is increasingly exposed to climate-related risks that threaten food supply. According to the European Environment Agency (EEA, 2022), over 60 percent of agricultural land in southern Europe is at high risk of desertification due to prolonged droughts and soil degradation. In 2022 alone, extreme drought conditions affected more than 45 percent of EU territory, leading to crop yield reductions of up to 30 percent in corn and sunflower across key producing regions (JRC MARS Bulletin, August 2022). The European Climate Risk Assessment (EEA, 2024) further points out that climate risks are expected to severely impact food production in Europe, and primarily in its southern countries. The main impact is expected to be felt through crop failures and yield reductions. Climate-driven impacts are expected to be less severe on livestock and aquaculture systems than on crops. These events are becoming more frequent and intense, with climate models projecting a 20–50 percent increase in drought severity by 2050 under current emission trajectories (EEA, 2021). Such climatic volatility undermines farm incomes and increases the need for robust risk management strategies.

Most recently, the European Investment Bank (EIB) fi-compass (2025) estimates that losses from agricultural climate risks in the EU are intensifying. The current annual average losses (AAL) are estimated at EUR 28.3 billion, or about 6 percent of total crop and livestock production, and are driven primarily by drought, frost, hail, and excess precipitation. Drought alone accounts for over 50 percent of climate-related agricultural losses and remains significantly underinsured across much of the EU. In a catastrophic year, the EIB contends that losses could reach EUR 57.5 billion, while only 20–30 percent of climate-related damages are currently covered by insurance, leaving a protection gap of 70–80 percent. Looking ahead to 2050, crop losses are projected to rise by 42–66 percent, potentially pushing total AALs to EUR 40 billion annually, with drought risks expanding into northern and western regions and frost losses increasing for high-value crops due to earlier biological springs.

Market and geopolitical risks also pose significant challenges to the EU agri-food system. The invasion of Ukraine disrupted grain exports and fertilizer supply chains, causing input prices to spike by 80–150 percent in some EU Member States between early 2022 and mid-2023 (World Bank, 2023; DG AGRI, 2023). These shocks exposed the EU's dependence on external suppliers for key agricultural inputs and highlighted vulnerabilities in food logistics and trade. Additionally, the COVID-19 pandemic revealed structural weaknesses in labor availability, particularly in horticulture and livestock sectors, where seasonal workers are essential. The European Commission estimates that labor shortages during the 2020 lockdowns led to losses of EUR 3–4 billion in perishable crop sectors (EC COM (2020) 324 final). These disruptions underscore the need for diversified supply chains and contingency planning.

Biological and biosecurity risks are also rising, with increasing outbreaks of animal diseases and pest infestations. Between 2019 and 2023, the EU reported over 1,500 cases of African Swine Fever (ASF), leading to the culling of more than 1 million pigs and economic losses exceeding EUR 2 billion (EFSA, 2023). Similarly, the spread of *Xylella fastidiosa* in southern Europe has devastated olive groves, with Italy alone losing over 20 percent of its olive production since 2015 (FAO, 2021). Europe is now experiencing its most severe avian influenza epidemic on record, with over 2,500 confirmed Highly Pathogenic Avian Influenza (HPAI) outbreaks in poultry since 2021 and more than 50 million birds culled across 37 affected European countries (EPRS, 2023). This unprecedented outbreak – which unusually persisted through the summer of 2022 and continued

through 2023 – has devastated poultry farmers, resulting in billions of euros in losses from mandatory flock culling and farm closures, and it contributed to egg and poultry prices soaring. These risks are exacerbated by global trade and climate change, which facilitate the movement and establishment of invasive species.

Agri-climatic diversity and deep food market integration are EU's key strengths in managing its agri-food risks. Europe covers a wide range of agro-ecological zones range from the temperate maritime systems in the west, ideal for pasture and cereals, to the Mediterranean zones suited for olives, grapes, and horticulture, and the continental zones of Central and Eastern Europe that support large-scale grain and oilseed production. Mountainous regions and boreal zones in the north add further complexity, supporting forestry, livestock, and niche crops. As such, the EU benefits from natural risk dispersion, as adverse weather or pest outbreaks rarely affect all its regions simultaneously. This geographic heterogeneity acts as a buffer, allowing surplus production in one area to offset losses in another. Additionally, the EU's integrated single market facilitates the free movement of agricultural goods, labor, and inputs across Member States, enabling rapid redistribution of supply during localized disruptions. This internal solidarity, supported by common regulatory frameworks and coordinated risk management tools under the CAP, enhances the EU's capacity to absorb shocks and maintain stability in the food system.

Fragmentation of the European agricultural insurance market and risk management policies are two of its core weaknesses. While the CAP provides a shared foundation, EU countries differ significantly in their capacity or choice to implement risk management tools. Some have robust budgets and technical expertise, while others lack institutional infrastructure or experience. Some tap into the CAP framework, while others choose to rely on their national systems. This disparity results in a patchwork of approaches, with some Member States offering comprehensive insurance subsidies and mutual funds, while others rely heavily on ad hoc disaster aid or have minimal coverage. Similar fragmentation affects the agricultural insurance market in the EU. Insurance offerings vary widely between Member States in terms of coverage, subsidy levels, and product availability, with some countries having well-developed multi-peril crop insurance systems and others offering limited or no formal insurance options. This uneven landscape reflects disparities in economic and market structures, national budgets, institutional capacity, and technical knowledge, resulting in inconsistent access to protection for farmers. The lack of a unified insurance and risk management policy framework also hampers cross-border coordination and risk pooling, weakening the EU's collective resilience to climate shocks and market disruptions.

Policy changes are further accelerating the transition of the EU agri-food sector, while trying to adjust to the new landscape. In an era of greater market orientation of the CAP, European farmers must develop strategies to address higher price volatility and growing pressures on income stability (Barral and Detang-Dessendre, 2023). These pressures add to the growing climate and market risks, contribute to the changing risk structure for farmers, while bringing about production losses and exacerbating price volatilities (Antón et al., 2013; Webber et al., 2020; Barral, 2023). The recent integration of the European Green Deal and its Farm to Fork and Biodiversity strategies into the 2023-2027 CAP (European Parliament, 2023) have led to adjustments in agricultural production practices in response to the new regulatory environment. These changes have raised significant concern amongst farmers about their capacity to adjust and the resulting impacts on their long-term economic viability. While the agricultural ambitions of the Green Deal have since been recalibrated, the trajectory of sustainable requirements stemming both from legislators and from consumers, has been set, and will continue to shape the farm system.

Risk-proofing the agri-food sector is a core priority of the EU's Vision for Agriculture and Food. As unveiled earlier in 2025, the EU is shifting toward a proactive approach that integrates climate adaptation and resilience, digital innovation, and robust risk management tools. This includes strengthening the CAP to support farmers in managing climate-related, market, and biosecurity risks, while promoting practices that enhance environmental sustainability and food system resilience. The EU also emphasizes the importance of diversified production systems, improved crisis preparedness, and strategic investments in research and innovation to ensure long-term food security and economic viability across Member States.

Yet, despite the availability of dedicated risk management instruments under the CAP, such as insurance schemes, mutual funds and income stabilization tools, their uptake by farmers remains lower than expected. This gap is concerning, given the systemic nature of the risks and the substantial public expenditure allocated to these tools. The low adoption rate suggests that the current framework may be too complex, inconsistently implemented, or not adequately tailored to the diverse needs of farmers across Member States. Furthermore, the interplay between different CAP and/or national interventions, such as direct income support and disaster aid, may unintentionally discourage the use of ex-ante risk management tools. This situation

calls for a more holistic analysis to understand the barriers to uptake and to improve the integration and effectiveness of risk management strategies, ensuring the long-term resilience of the EU's agri-food system.

Given the agricultural sector's vulnerability to a wide range of losses from natural hazards, disaster risk financing has emerged as a critical tool in safeguarding the agricultural sector against the growing frequency and severity of natural hazards. The effectiveness of this approach is founded on core principles, including the provision of timely funding, the strategic layering of financial instruments, and the use of robust data analytics. Ensuring that financial resources are available promptly after a disaster, governments and financial institutions can reduce the economic impact through swift recovery efforts. By integrating these principles, the resilience of the agricultural sector and the recovery processes of affected farmers can be improved.

However, research indicates that large segments of agricultural value chains lack sufficient financial protection. This gap highlights the need for a more structured approach. International experience demonstrates that structured, layered financing approaches, which combine different financial tools to cover various levels of risk can effectively mitigate losses. Adopting such mechanisms contributes to fiscal stability and sustainable rural development. Furthermore, this makes a compelling case for prioritizing disaster risk financing within agricultural policy to safeguard the sector's future.

Against this background, this study aims to shed light on the uptake of ARM instruments in the EU so far and inform future policies. In doing so, it adopts a holistic approach on ARM in the EU. There is a gap between the perceived need for a better functioning ARM and the implementation of CAP ARM instruments in the Member States. The study attempts to contribute to filling this gap and assessing the integration between CAP ARM and other CAP and national interventions and instruments (i.e., direct payments; market measures; investments aiming to improve resilience such as those on climate smart agriculture practices and technologies; national disaster aid; nationally funded farm insurance; etc.) in a context of changing risks and greater uncertainty. First, it leans on a cluster analysis to identify groups of EU countries that share common structural and risk features. Second, it uses econometric analysis across a panel of five selected countries to better understand what drove ARM instrument adoption under the CAP over the last two EU budget cycles. Third, it uses qualitative deep dives to reveal how risk management policy instruments are used in five selected countries and estimates the contingent liabilities arising from agricultural production shocks, while proposing illustrative examples of a portfolio of financial instruments to reduce their associated financing gap. Lastly, based on this body of knowledge and global experience, it will recommend actions that the EU regulators and Member States alike can consider for improving their response to agricultural risks in the coming years.

2 MAKING SENSE OF EUROPE'S AGRICULTURAL (RISK) DIVERSITY

Risks affecting the agri-food system can be classified in various ways. Depending on where they manifest, they can be grouped into *production, market or enabling environment risks* (World Bank, 2016). Production risks include e.g., weather and climate events, pest and disease outbreaks, and typically result in yield reductions, though they may also affect product quality and disrupt the flow of goods and services. Market risks include e.g. changing supply or demand conditions, both for inputs and outputs, and either locally or globally, as well as exchange and interest rate volatility, etc. They affect price, quality, availability and access to necessary products and services. Enabling environment risks include changes in government or business regulations, the macroeconomic environment, political risks, conflict, trade restrictions, logistics, etc. Depending on their scale, risks can be *idiosyncratic* (affecting individual supply chain participants), *covariate (systemic)* within the chain (affecting multiple supply chain participants), or *covariate outside the chain* (affecting chain participants and the broader economy). Finally, depending on their impact, risks can be *normal* or *catastrophic*. A normal risk applies usually to adverse events with a low expected loss (either probability of occurrence or the value of the loss), whereas a catastrophic risk carries high expected loss, especially a high potential value loss.

Response to risks depends on their nature and may be carried out by different stakeholders (i.e., producers, agri-businesses, public institutions). A common classification (World Bank, 2016) includes three response categories: (i) *risk mitigation (ex-ante)*, particularly useful for risks that occur with high frequency but relatively low impact, is usually done at farm level but can also involve public action (e.g., early warning systems, large irrigation infrastructure, etc.); (ii) *risk transfer (ex-ante)*, applicable for risks that cannot be fully mitigated, involves the transfer of the potential financial consequences of particular risks from one party to a willing third party, usually for a fee or premium; and (iii) *risk coping (ex-post)*, applicable to risks that cannot be mitigated or transferred, and helps stakeholders better absorb or recover from impacts, through e.g., compensations, social safety net programs, buffer funds, strategic reserves, etc.

Public and private actors have developed various risk management tools to handle the above risks and their individual characteristics. The core ingredients are the same in any country and in any economic environment. However, the design of the tool and its commercial form may differ due to local demand characteristics, culture and local history, sector organization and public incentives. Among other things, farm structure is very important for the formulation of risk management policies, and it may also partly explain the current policies and their uptake. This is why our analysis will factor it in, both in the definition of clusters and in the understanding of the uptake of current risk management tools in the EU context.

We use cluster analysis to group the EU countries according to key agricultural risks and structural features. The main goal with the cluster analysis is to identify sufficient commonality across the diverse set of EU member states to streamline the analysis of the risk management instrument uptake and effectively inform policy recommendations. Cluster analysis groups observations by similarities across different identifying commonalities and characteristics.

The variables used for the cluster analysis reflect these combined elements. Drought is one of the main hazards affecting farm production in Europe, and the variable we selected to characterize it across the EU is the (1) level of water stress in agriculture (2021). We then used two variables to reflect the exposure of

the EU agricultural sectors to the impacts of various risks, namely (2) the utilized agricultural area (UAA), as of 2023, and (3) the share of the agricultural sector in each member state's economy, as of 2023. A higher agricultural area or a higher contribution of the sector to the economy are associated with higher exposure to risks. We then considered (4) farm structures, described through the distribution of agricultural standard output by size classes (and specifically the share of output in holdings above EUR 100,000 in 2020), as an indicator of vulnerability in face of sector risks. We assume that farmers of greater economic size are more likely to be better equipped to handle risks and therefore less vulnerable. Lastly, we considered (5) yield volatility, measured through the coefficient of variation for yields for selected commodities¹ over 2015-2024, as indicating the impact of risks in the agricultural sector. All data, except for the water stress in agriculture, was obtained from Eurostat. Water stress in agriculture was collected from FAOSTAT and corresponds to the sector component of the indicator collected globally to measure water stress against the United Nations' 2030 Agenda for Sustainable Development, specifically Goal 6.

Our cluster analysis relies on K-means clustering - an unsupervised machine learning algorithm that groups observations by minimizing the Euclidean distances between them. Akin to the other data reduction techniques like factor and principal component analysis, it leverages insights from the Pythagorean theorem to solve for the shortest distance between two data points (length of the hypotenuse) (Wu and Wu, 2012). Practically, K-means clustering minimizes the within cluster sum of squared errors (SSE). Considering this, the algorithm relies on randomly assigned "k" initial parameters (Pham et al., 2006). These parameters are obtained either by randomly choosing points in the "Euclidean space" defined by all "n" variables, or by sampling "k" points of all available observations to serve as initial parameters (Kanungo et al., 2000). It then iteratively assigns each observation to the nearest center and calculates the new center for each cluster as the centroid mean of the clustering variables for each cluster's new set of observations (member states - MS). K-means re-iterates this process, assigning observations to the nearest center. At this point, some MS change clusters and move to new clusters (Steinley, 2006). This process repeats until a new iteration no longer re-assigns any observations to a new cluster, indicative of model convergence.

Unlike other clustering methods, K-clustering requires the a priori specification of the number of expected clusters, k, which should be conceptually driven and based on well-laid down ideas that determine the cluster variables to be included (Pham et al., 2006). These variables are all expected to be continuous. As highlighted above, the choice of the five variables to characterize the different clusters is very much in order and in line with all these tenets. We performed clustering using different initial group centers such as k-unique random observations with the specification of random number seeds, first k observations, last k observations and k random centers chosen from within the range of the data (Kanungo et al., 2000; Pham et al., 2006; Wu and Wu, 2012). Empirically, we performed these estimations in STATA version 18 and conducted different post estimation techniques to generate the SSE totals and select the best estimation run. Besides relying on the SSE, we also computed the Variance Ratio Criterion, also known as the Caliński and Harabasz pseudo-F index, which is a measure of best clustering properties and distinctiveness as it compares between-cluster variance to within-cluster variance. A larger value implies the best run better cluster separation where data points within clusters are closely related, and the clusters are well separated from each other.

To confirm the robustness of our clustering analysis, we performed some sensitivity analyses using different cluster solutions and sets of clustering variables. As part of the sensitivity analysis, we also standardized the variables to enable comparison between them and reduce threats of multicollinearity while enabling efficiency in model convergence. All these batteries of robustness checks and sensitivity analyses confirm the strength of the cluster analysis and its validity for inference.

We estimated outputs for several clusters but ultimately adopted the output for five clusters, judged to be relevant for this study. They distinguish some specific features across EU and help facilitate the interpretation of findings, see Table 1. The resulting segments are described in Table 2 and illustrated in Figure 1. The matrix graph in the appendix shows considerable uniformity and similar sizes - suggesting optimal clustering performance.

¹ Wheat, barley, maize, potatoes, sugar beet, rapeseed, tomatoes, apples and grapes.

TABLE 1 Output for Five Clusters

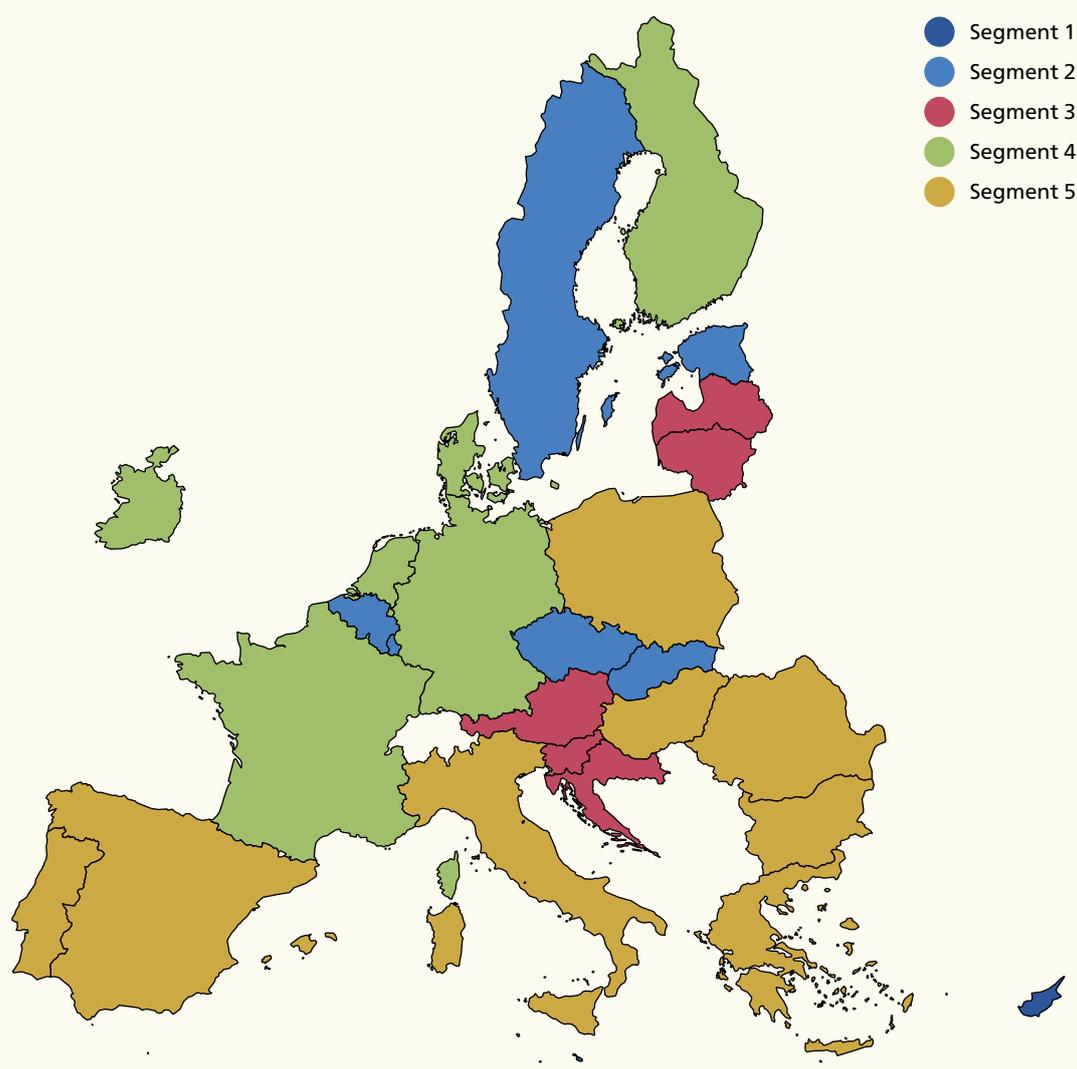
Mean/Centroid	UAA	Standard output distribution	CV crop yields	Agriculture as a share of the GVA in the economy	Water stress in agriculture
Segment 1	3.00	33.00	48.00	39.00	52.00
Segment 2	54.00	38.00	121.00	136.00	40.00
Segment 3	47.00	109.00	82.00	60.00	33.00
Segment 4	102.00	46.00	28.00	103.00	88.00
Segment 5	172.00	154.00	99.00	40.00	164.00
Average	75.60				
Respondents	Number	%	SSE/Segment		
Segment 1	2	7.41	1638		
Segment 2	6	22.22	1638	SSE Total	9195.00
Segment 3	5	18.54	1638		
Segment 4	6	22.22	1638		
Segment 5	8	29.63	1643		
Total	27	100.00			

Source: World Bank staff calculations.

TABLE 2 EU Member States per Segment

Segment 1	Cyprus (CY), Malta (MT)
Segment 2	Belgium (BE), Czechia (CZ), Estonia (EE), Luxembourg (LU), Sweden (SE), Slovakia (SK)
Segment 3	Austria (AT), Croatia (HR), Lithuania (LT), Latvia (LV), Slovenia (SI)
Segment 4	Germany (DE), Denmark (DK), Finland (FI), France (FR), Ireland (IE), Netherlands (NL)
Segment 5	Bulgaria (BG), Greece (EL), Spain (ES), Hungary (HU), Italy (IT), Poland (PL), Portugal (PT), Romania (RO)

Source: World Bank staff calculations.

FIGURE 1 Map of the Five Country Clusters, Based on Risks and Structural Features

Source: World Bank.

The specified segments are coherent in terms of the characteristics of the respective EU Member States, as follows:

- **Segment 1:** This cluster covers the countries with the smallest UAAs in the EU and a relatively low share of agriculture in total GDP; hence their exposure to agricultural risks is rather low. However, both Cyprus and Malta are suffering from comparatively high levels of water stress and climate impacts on agriculture, manifested through a notable yield variability. The relatively high shares of small and medium holdings in these farming systems indicate their heightened vulnerability to shocks.
- **Segment 2:** Belgium, Czechia, Estonia, Luxembourg, Sweden, and Slovakia stand out in terms of their low levels of water stress in agriculture. UAAs are at the low end of the spectrum among the EU. Large farmers dominate, which should indicate reduced vulnerability and better resilience in the face of shocks. However, high levels of crop yield variability suggest that these farmers remain strongly impacted by climate shocks.
- **Segment 3:** Austria, Croatia, Lithuania, Latvia, and Slovenia are experiencing low to moderate levels of water stress and rank at the low-end towards the middle of the range when it comes to overall UAA and share of agriculture in GDP. They are dominated by larger farmers, by economic size. Except for Austria, they are experiencing relatively high yield volatility, suggesting important impact of shocks at the farm level.

- **Segment 4:** The segment consists of Germany, Denmark, Finland, France, Ireland, and the Netherlands, and includes some of the largest agriculture producers in EU, evidenced through their high UAAs and/or share of agriculture in the economy. Except for the Netherlands, water stress is moderate to high; however, the impact of shocks on yield variability is relatively low, suggesting already high levels of resilience. This cluster is somewhat diverse in terms of farm structures, with small or mid-sized farmers more prevalent in some of the countries.
- **Segment 5:** This is the most exposed, vulnerable, and impacted cluster, containing Bulgaria, Greece, Spain, Hungary, Italy, Poland, Portugal, and Romania. Water stress is significant in most countries and at the high-end of the range among the EU. The agriculture sector is comparatively important in most economies, suggesting that shock impacting farming may have strong repercussions on the domestic economies. Altogether, these countries hold important shares of the EU UAA, which makes exposure high, both for individual countries, and for the group or even for the entire EU. The relatively high prevalence of small and medium-sized farmers is a source of increased vulnerability. Crop yield variability is generally high (except for Italy and to some extent Hungary), indicating strong impacts of shocks at the farm level.

TABLE 3 Summary of the Five Country Cluster Features

Country clusters	Hazards: water stress in ag	Exposure: UAA and % of ag in GDP	Vulnerability: % of large farms (economic size)	Impact: yield volatility
Malta, Cyprus	Very high	Low	High	High
Belgium, Czechia, Estonia, Luxembourg, Sweden, Slovakia	Low	Low	Low	High
Austria, Croatia, Lithuania, Latvia, Slovenia	Low/ Moderate	Low/ Moderate	Moderate/ High	High
Germany, Denmark, Finland, France, Ireland, Netherlands	Moderate/ High (except NL)	High	Moderate	Low
Bulgaria, Greece, Spain, Hungary, Italy, Poland, Portugal, Romania	Very high	High	High/ Moderate	High (except IT)

Source: World Bank.

Considering cluster features, we select five countries to conduct deeper qualitative and quantitative analyses. These are Bulgaria, France, Latvia, Italy and Slovakia. Their selection aims to reflect the diversity of structural and risk landscapes reflected in the clusters above, but also additional considerations. The choice of countries specifically considers their participation in the CAP ARM toolkit and favors Member States that have programmed CAP-funded risk management measures after 2014. At the same time, the selection aims to strike a balance between countries who have used CAP-funded risk management extensively (e.g., Italy, France) and those who attempted to but faced some challenges (e.g., Bulgaria, Slovakia). The diverse set of experiences and perspectives thus gained will be reflected in the following chapters.

3 EUROPE'S AGRI-RISK MANAGEMENT TOOLS AND THEIR UPTAKE

Agri-Risk Management Instruments in the Common Agricultural Policy

During the early CAP (1960s-1990s), price support was used as a risk management tool. In the decades after 1962, the CAP relied on market-price support as the main risk management mechanism. Tools like intervention buying, export refunds, and guaranteed prices stabilized farm incomes, mainly by shielding EU farmers from volatile world markets. By the 1990s, these costly measures were scaled back in favor of direct payments. The 1992 McSharry reform began decoupling support from production, shifting more market risk to farmers while compensating them with fixed payments (which themselves acted as an income safety net). As the CAP moved toward a more market-oriented system, awareness grew that farmers would need new instruments to manage yield risks, such as crop failures due to weather or pests, and income volatility, mainly from price swings. This led the European Commission (EC) to explore explicit risk management tools alongside traditional safety nets.

The drive to integrate risk management into the CAP gained momentum in the early 2000s. In 2005, the Commission issued a Communication on Risk and Crisis Management in Agriculture, outlining options such as subsidized insurance, mutual funds, and savings accounts. Sectoral reforms introduced specific risk management instruments for the first time: the 2007 reform of the Fruit and Vegetables and Wine Common Market Organizations (CMOs) introduced EU-funded mechanisms for prevention and crisis management (Regulation (EC) No 1234/2007). Producer organizations in those sectors could now get CAP support for measures such as crop insurance premium subsidies or setting up mutual funds to compensate members for production losses. The scope was limited to fruit, vegetables and wine, but it marked CAP's first incorporation of modern insurance-based tools.

The 2008 Health Check reform extended risk management support to all farmers via a new provision in Pillar I: Article 68 of Regulation (EC) 73/2009. This allowed Member States to divert up to 10 percent of their national direct payment envelope to specific needs, including contributions to crop insurance premiums or mutual funds for animal or plant diseases and environmental incidents. In practice, only a few countries used Article 68 for insurance subsidies (e.g. Italy and France channeled a portion of direct aids into their national crop insurance programs). This represented a shift from ad-hoc disaster aid toward more structured, ex-ante instruments. Still, uptake and implementation remained a minor element of the CAP, with utilization limited and uneven: most Member States continued to address farm risks through national schemes and crisis aid rather than EU-funded insurance tools.

The 2014-2020 CAP was the first to introduce a comprehensive risk management toolkit (Regulation 1305/2013). The 2013 CAP reform was a turning point, establishing a dedicated risk management toolkit in Pillar II (Rural Development). Regulation (EU) No. 1305/2013, Article 36-39, set out a toolkit of measures that Member States could include in their Rural Development Programs (RDPs), comprising three main instruments:

- **Support for insurance premiums (Article 37)** — public co-financing for crop, animal, or plant insurance against economic losses caused by adverse climatic events, diseases, or pest infestations. The CAP would reimburse a share of farmers' premium costs (initially up to 65 percent), aiming to make insurance affordable and attractive.
- **Support for mutual funds (Article 38)** — financial contributions to help establish and administrate mutual funds that provide pay-outs to farmers for production losses caused by climatic events, animal/plant diseases, or environmental incidents. These are reserve pools, often managed by producer organizations or cooperatives, that operate on the principle of collective self-insurance.
- **Income Stabilization Tool - IST (Article 39)** — an innovative mutual fund-based scheme to compensate farmers for severe income drops, irrespective of the cause of the loss. The IST would compensate farmers if their annual farm income fell by more than 30 percent compared to the historical average, covering up to 70 percent of the income shortfall.

These measures were voluntary for Member States to implement and subject to certain conditions to comply with the World Trade Organization (WTO) Green Box rules (e.g., minimum loss thresholds, calculation of losses, etc.). In parallel, the reform updated state aid rules to complement the CAP toolkit, meaning that governments could more easily fund schemes outside the CAP. In effect, Member States had two frameworks: the new CAP risk management toolkit (also known as Measure 17), or continued reliance on national funds under looser state aid rules.

The rollout of the 2014-2020 CAP risk toolkit was varied and led by insurance. About two thirds of Member States activated insurance support (Article 37) in their RDPs, whereas very few pursued IST or mutual funds. By 2020, 18 Member States had notified use of crop insurance subsidies via the CAP, though the scale of funding differed greatly (ranging from significant budgets in Italy, France, and Germany to very small pilots in others). However, many countries - including Spain, Austria and Poland - opted not to use RDP funds for insurance, either because they had substantial national insurance subsidies outside the CAP (as in Spain's case) or because an insurance culture was lacking. Some countries opted to use CAP funds to support mutual funds, such as France. In contrast to insurance, the IST saw almost no uptake.

TABLE 4 Adoption of risk management tools in the EU during the 2014-2022 period

Spending in EUR million, by financial year

	2015	2016	2017	2018	2019	2020	2021	2022
Estonia						0.01	0.01	0.06
France			100.14	197.63	130.62	136.95	153.78	160.96
Croatia			2.18	7.47	11.91	17.07	18.84	25.25
Hungary			12.37	13.03	15.45	15.46	19.38	32.63
Italy			90.32	250.36	407.70	319.63	205.64	541.50
Lithuania			0.38	2.17	2.30	1.96	3.23	4.08
Latvia		1.74	2.42	2.97	7.46	11.63	7.33	15.93
Netherlands		7.78	9.02	10.92	11.03	9.10	13.88	17.48
Portugal	5.21	6.45	8.81	8.35	10.92	9.93	11.19	15.11

Source: European Commission.

The Omnibus 2017 reforms provided mid-term improvements. Midway through the 2014-2020 period, the EU legislator acknowledged the toolkit's under-utilization and adjusted the rules to boost attractiveness. The Omnibus Regulation (EU) 2017/2393 — a CAP amendment package — introduced several important flexibilities:

- **Sectoral ISTs:** It became possible to create mutual funds that stabilize incomes in a particular agricultural sector (e.g. dairy, sugar, fruits) rather than the whole farm. These sectoral ISTs can trigger payouts when sector income drops by at least 20 percent (a lower trigger than the 30 percent for general IST). This change, championed by farm organizations, was aimed at making IST more relevant and manageable, since farmers often experience income shocks in one segment of their farm, and a 30 percent whole-farm loss proved too high a bar when direct payments buffer income.
- **Insurance threshold and subsidy rate:** For Article 37 insurance, the minimum loss threshold to receive indemnities was reduced from 30 percent to 20 percent of average annual output. This means insurance can pay out more moderate losses. Additionally, the maximum public subsidy for premiums was raised from 65 percent to 70 percent, allowing deeper support.
- **Mutual fund support:** The reform clarified that annual contributions to mutual funds and initial capital stock are eligible for support. This helps mutual funds build reserves over time.
- **Streamlining:** Administrative rules were simplified to ease implementation, such as combining financial instruments with risk measures.

These changes took effect in 2018 and were immediately reflected in some RDP modifications. Italy, for instance, launched a sector-specific IST for fruit and vegetables, followed by apples and then milk. Nonetheless, the overall uptake of IST remained extremely limited until 2020. Omnibus also expanded the crisis toolkit in Pillar I, but its major impact on risk management was making insurance and mutual funds more farmer friendly. By lowering deductibles and raising subsidies, the EU aimed to counter farmers' hesitance to insure.

In addition to its preventive tools under Pillar II, the 2014–2020 CAP came equipped to handle impact ex-post. The exceptional measures under Articles 219–222 of the Regulation (EU) No. 1308/2013 (the CMO Regulation) are EU-level interventions designed to address sudden and severe disruptions in agricultural markets and are, by nature, temporary and designed to address a specific problem. These include market disturbances, animal diseases, plant pests, loss of consumer confidence, specific problems that threaten the viability of agricultural sectors and severe imbalance in markets. The measures range from financial aid and private storage schemes to temporary exemptions from competition law for producer organizations.

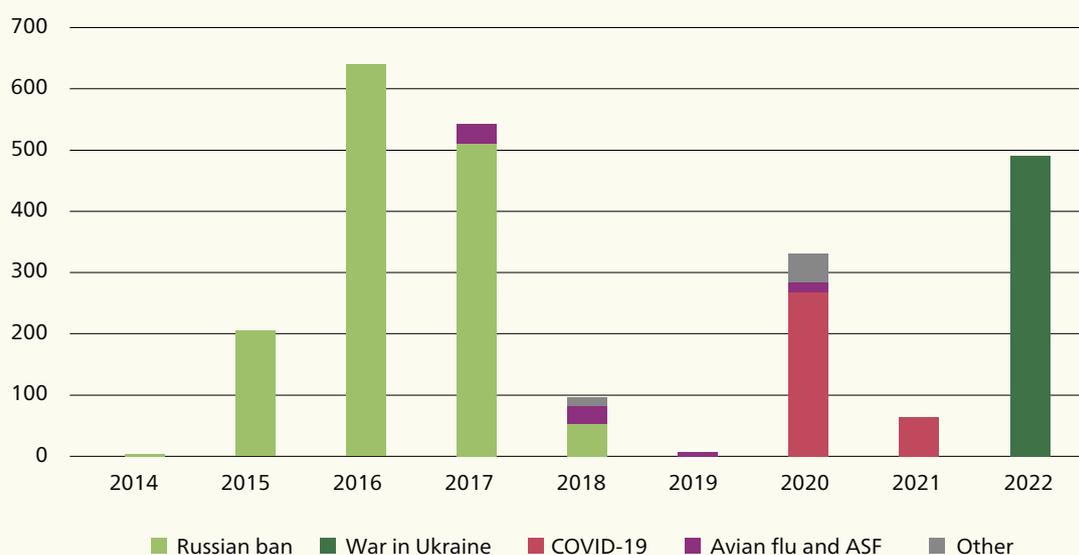
Before 2023, exceptional measures could be funded from CAP Pillar I, including from a crisis reserve, whose activation and funding involved the application of financial discipline. In other words, if activated, the crisis reserve would involve cuts in the direct payments received by farmers and its use would hinge upon approval by the Council and European Parliament. It is therefore not surprising that, since its creation in 2014, the crisis reserve was never used until 2022, when the EU decided to respond to the major market disruption caused by the situation in Ukraine. In previous years, the exceptional measures were financed through other resources available under the European Agricultural Guarantee Fund (EAGF), without activating the crisis reserve.

Between 2014 and 2022, 55 crisis measures were adopted, totaling EUR 2.4 billion from the EU budget (Figure 2). National top-ups were allowed in some cases. The largest EU-budget allocations responded primarily to the Russian import ban (59 percent over 2014–2017), to the situation in Ukraine (21 percent in 2022), and to the COVID-19 crisis (14 percent, over 2020–2022). Fruit and vegetable producers, dairy farmers, wine growers, and livestock sectors were among the most supported. Notable Member State beneficiaries include Greece, Spain, Italy, Poland, France, and the Baltic States.

The 2023–2027 CAP continued integrating and expanding risk management tools (Regulation 2021/2115). In the latest CAP reform, the risk management toolkit remains a crucial, though still optional, component, now embedded in each country's CAP Strategic Plan. Regulation (EU) 2021/2115 (the CAP Strategic Plans regulation) consolidates the prior measures into a single intervention: Article 76, Risk Management Tools. This essentially carries forward the trio of eligible tools - insurance premium support, mutual funds for production losses, and the income stabilization mutual fund - with similar rules as before, except for the added possibility of insurance covering income loss. All 28 strategic plans (Belgium submits two CAP Strategic Plans) were approved in 2022, and around two-thirds of countries have opted to continue or introduce CAP-funded insurance or mutual fund schemes.

FIGURE 2 Distribution of EU-funded emergency payments by main crisis event

Million EUR, 2014-2022



Source: Compiled from European Commission (2024)

Notable developments in this period include:

- **Possibility to use direct payments to boost risk management funding:** Article 19 of Regulation (EU) 2021/2115 allows Member States to assign up to 3 percent of their direct payments allocation to contribute to a farmers' risk management tool. This innovative approach leverages Pillar I funds for risk sharing, effectively supporting a solidarity-based mutual fund fed by direct payment deductions. Only three Member States are experimenting with this modality, i.e. Bulgaria, Italy and Romania (see Bulgaria, Italy).
- **Establishment of an agricultural reserve:** Regulation (EU) 2021/2116 provided for the setting up of an agricultural reserve, replacing the previous crisis reserve and removing some of the constraints in its utilization. Endowed with a budget of at least EUR 450 million annually between 2023 and 2027, the agricultural reserve is funded by first carrying over undisbursed funds from the previous year's reserve, then by available resources under EAGF and, if needed, and only as a last resort, by applying financial discipline.

The European Commission's proposals for the post-2027 CAP include a broader and strengthened risk management toolkit. In July 2025, the EC proposed the CAP post-2027 legislative package, including a regulation for the EU support to the CAP for 2028–2034 (COM(2025) 560 final). The CAP will be integrated into the National and Regional Partnership (NRP) Plans, supported by the NRP fund envelope. The two existing funds, also referred to as the first pillar and second pillar, will be merged into a single, coherent policy framework. This proposal builds on the current toolkit but introduces significant changes to ensure broader uptake, robust funding, and a preventive approach to risk management. Member States must explain how the NRP Plan will contribute to improving farm resilience and management of risks at farm level. Key provisions and differences from the 2023–2027 framework are outlined below:

- **Making risk management support mandatory for Member States:** Every Member State must implement a risk management intervention in its CAP plan, according to Article 12 of the draft regulation, unless they demonstrate the existence of national systems. This marks a shift from the optional nature of the 2014–2027 toolkit. Member States must either use CAP funds for risk management or have a strong national policy in place. This ensures that farmers in every EU country have access to at least one formal risk management tool.

- **Continuity of core instruments with improved flexibility:** The proposal carries forward the 20 percent loss threshold rate for CAP risk tools. Member States have enhanced design flexibility to fit their context, including the ability to cover both production and income losses. There is no pre-defined list of risks or recognition procedures, simplifying implementation.
- **Linking payments to risk-reducing actions:** The proposal ties the support rates of crisis relief payments to climate change adaptation and farm-level risk reduction. Higher support rates are offered for farmers who adopt approved risk mitigation practices. Furthermore, transition payments of up to 200,000 EUR in lump sum are provided to farmers to help them shift to more sustainable farming models. The CAP aims to create a culture of preparedness, encouraging farmers to actively manage risk rather than just react to crises.
- **Member State flexibility versus accountability:** Member States design their risk management programs but are judged on performance. The draft Performance Regulation emphasizes meeting objectives like farm income stability. Annual performance reviews will hold countries accountable if they underperform.

They also include a revisited approach to disaster relief mechanisms. This may reflect on the experience gained with the utilization of the agricultural reserve in the last few years, when the bulk of the resources was used for alleviating the consequences of adverse weather phenomena, even though this was not its original aim. With the ambition to clearly differentiate between instruments aimed at dealing with the consequences of the regular market disturbances and those resulting from natural disasters and plant and animal diseases, the Commission proposed, already in the framework of the CAP simplification package, published in May 2025, to limit the use of the agricultural reserve strictly to market related disturbances. In the same vein, and as a part of its comprehensive response to crises and mounting market uncertainties, the Commission first foresees, in its post-2027 CAP proposal, the establishment of a new instrument, named Unity Safety Net, replacing the current agricultural reserve, but doubling its resources. The instrument announced already in the Commission's Vision for Agriculture and Food (published in February 2025) is set at EUR 6.3 billion for the 7-year period (EUR 900 million per year in contrast to EUR 450 million available annually under the current reserve) within the newly proposed unallocated share of the national envelope, called EU Facility. The Unity Safety Net should be used exclusively for the purpose of stabilization of agricultural markets, including those caused by issues related to animal or plant health, which impact the prices of agricultural products. The measures through which the Unity Safety Net should be implemented are, in the essence, the traditional CMO measures, public interventions and private storage, as well as the exceptional measures pursuant to Articles 219 to 222. The proposal emphasizes the fact that it will not be possible to utilize the resources of the Unity Safety Net for compensating direct farmers losses due to adverse weather phenomena, animal diseases or plant pests.

The post-2027 proposal envisages in parallel the possibility for Member States to also swiftly and progressively mobilize resources for crisis payments to farmers that are affected by natural disasters, adverse climatic events or catastrophic events, including for measures adopted to eradicate or contain a plant disease or pest, and measures adopted to prevent or eradicate animal diseases. The same flexibility applies to supporting on-farm investments in the restoration of the agricultural activity, which aim at ensuring continuity of the agricultural activity of the affected farmers. As such, the Member States will have the option to amend their National and Regional Partnership Plans for up to 1 percent of the EU contribution to the Plan. In cases of crises of such severity that these amounts would not be sufficient to cover all the expenses, the Member States could request a further amendment of the Plan, spending up to 2.5 percent of their unprogrammed flexibility amount.

Following the approach already taken with the simplification proposal, a more flexible calculation of losses is foreseen, as well as further incentivization of farmers' participation in risk management tools, like insurance premiums, mutual funds and other similar tools and instruments. To this end, it will be possible to calculate losses both at holding level and at the level of the holding's activity in the sector, as well as in relation to the specific area concerned.

General Drivers Behind Agricultural Risk Management Uptake

Risk management uptake is influenced by a complex interplay of economic, environmental (including climate), social, psychological, informational, and policy-driven factors. Understanding these drivers is crucial for designing policy interventions, which encourage the uptake of practices that not only mitigate risks but also promote sustainability in agriculture. In parallel, each context might require tailored approaches to address specific barriers and leverage local drivers effectively. These aspects will be examined in detail for five countries: Bulgaria, France, Latvia, Italy and Slovakia.

Economic incentives play a central role in shaping farmers' decisions. Farmers respond to market and policy signals, and risk management choices are no exception. A recent publication by the International Food Policy Research Institute (IFPRI), Swinnen et al. (2025), stresses that basis risk, the difference between insurance payouts and actual losses, is one of the most prominent factors to undermine uptake. In other words, farmers adopt risk management tools when they perceive that economic benefits outweigh costs, and, in this context, institutional trust and perceived reliability of risk management instruments also matter. Farmers are more inclined to participate when they believe the tools are effective and payouts are timely (Glauber et al., 2021).

Public policies can alter incentives, both positively and negatively. The same study, Swinnen et al. (2025), highlights that there is a case for public intervention when managing agricultural risks. Unlike other sectors, farming has its specific challenges when it comes to the nature of its risks. These risks are often difficult to know and price (e.g., time-series data on individual farms is difficult to obtain), frequently affect many farmers at the same location simultaneously (are covariate), and moral hazard is often present. As such, private insurance tends to be limited in size, products offered and perils covered, and expensive, in part due to adverse selection. Most governments around the world are providing some form of agricultural insurance subsidies to encourage greater risk management uptake (International Finance Corporation, 2017). Huirne et al. (2000) further highlight that farmers' decisions are shaped by the availability and structure of policy support, such as subsidies or insurance schemes offered under the CAP. However, if not properly designed, such subsidies may inadvertently lead to the opposite effect. At the same time, disaster relief assistance can displace insurance uptake by creating expectations of government bailouts that reduce farmers' incentives to participate in formal risk management schemes. According to OECD (Glauber et al., 2021), ad hoc compensations, especially when not clearly defined beforehand, can lead producers to underinsure or avoid investing in other risk-reducing measures, such as crop diversification or improved input management. This displacement effect is particularly strong when disaster payments overlap with insured losses, resulting in overcompensation and moral hazard.

BOX 1 Global examples of tension between ex-ante and ex-post risk management measures

United States: Frequent ad hoc disaster bills in the 1980s–90s led many U.S. farmers to expect free bailouts, undermining crop insurance enrollment. Studies show producers underinsured or took fewer risk-mitigation measures when they anticipated generous federal disaster aid. This Samaritan's dilemma prompted reforms (in 1994 and 2000) to expand insurance and curtail routine emergency payments, but large relief packages in recent years (e.g., 2019 flood aid) still risk discouraging insurance uptake. The U.S. experience illustrates how **guaranteed ex-post assistance can crowd out demand for ex-ante insurance.**

India: The prevalence of **government relief programs and loan waivers** for crop losses has at times dampened participation in India's crop insurance schemes. For example, state and central authorities frequently announce compensation packages from disaster relief funds after poor monsoons or unseasonal rains. This ex-post financial support – while crucial for smallholders – can create expectations of “free” assistance and reduce farmers' incentive to pay premiums under the Pradhan Mantri Fasal Bima Yojana insurance program. Surveys of Indian farmers confirm that some opt out of crop insurance, assuming the government will step in if calamity strikes. Thus, **reliance on ad hoc compensation has hindered insurance uptake** in India, prompting recent efforts to better integrate relief payouts with insured farmers and strengthen enforcement of mandatory coverage in credit-linked farming.

Socio-economic characteristics, such as farm size, wealth and diversification strategies, also influence adoption. Larger, more commercially oriented farms tend to be more proactive in managing risk (Glauber et al., 2021) but the relationship between farm size and propensity to adopt insurance or other risk management strategies can be ambiguous. Larger operations typically draw on a larger asset base, which, on the one hand raises their stakes, but, on the other hand allows them to either purchase insurance more easily, or to cope with damage better (Velandia et al., 2009). A United States Department of Agriculture (USDA) study focusing on farmers in the United States (Farrin et al., 2016) concludes that the relationship between farm wealth and the adoption of agricultural insurance is nuanced and dynamic. Wealthier farmers tend to rely more on savings and self-insurance, reducing their demand for formal crop insurance, especially when they can accumulate wealth over multiple seasons. Conversely, low-wealth farmers often cannot afford insurance unless they have access to savings, which are necessary to overcome their liquidity constraints and increase insurance uptake. Another study by van Asseldonk et al. (2016) analyzes the adoption rates of various risk management strategies, such as insurance contracts and income diversification, across EU Member States. It finds significant variations in adoption rates and identifies farm size as a critical determinant, with larger farms more likely to adopt both agricultural insurance and income diversification strategies. Finally, Lefebvre et al. (2014) examine factors affecting Bulgarian farmers' decisions to adopt agricultural insurance. The study concludes that farm size and location are primary determinants, and, again, larger farmers are more likely to be insured than smaller or medium holdings. It also finds that farmers with diversified activities and stronger value chain links through contractual agreements with retailers or processors are more likely to purchase insurance.

Similarly, farm specialization plays a major role in the adoption of agricultural insurance. This is rooted in the fact that diversification can serve as a substitute for formal insurance, by countering risk concentration. Overall, literature from Europe and beyond consistently indicates that highly specialized farms, with concentrated risk exposure, exhibit stronger demand for insurance, whereas more diversified farms tend to adopt insurance more selectively. For example, using U.S. farm-level data, Ashok et al. (2006) found that farmers without off-farm income (i.e., more specialized, reliant solely on crop revenue) are significantly more likely to purchase revenue insurance, whereas those with diversified income sources show lower insurance uptake. Also, a micro-level analysis of French farms by Enjolras and Sentis (2011) found that larger farms with higher risk exposure (often due to specialization) had significantly higher insurance participation, while smaller farms, with mixed production or off-farm income, were less insured. However, this can be further nuanced. For instance, Knapp et al. (2021) analyzed Swiss farms and concluded that: (i) on-farm diversification activities are positively associated with insurance uptake; (ii) off-farm diversification activities are negatively associated with insurance uptake, whereas (iii) farmers with higher financial reserves are less likely to buy insurance.

Behavioral and social factors further shape adoption patterns. Studies show that farmers' risk perceptions, past experiences with adverse events, and attitudes toward uncertainty significantly affect their willingness to engage in risk management (Kuhlman et al., 2014; Finger et al., 2012). Trust in intermediaries (Giampietri et al., 2020; Trestini et al., 2018a) and institutions (Lefebvre et al., 2014) as well as aspirations (Tabe-Ojong et al., 2024) positively affects adoption intention. Perceived risk frequency positively affects adoption (Giampietri et al., 2020). Peer influence and advisory services also play a role. Farmers who are part of cooperatives or receive targeted extension support are more likely to adopt structured risk tools. In these cooperatives, farmers are usually exposed to reference farmers and role models that could improve their agency and incentivize them towards better adoption and use (Tabe-Ojong et al., 2023). Moreover, these cooperatives could serve as information hubs addressing probable adverse selection and improving the flow of knowledge and information. This is particularly relevant because farmers associated with cooperatives already share mutual interests, thus enhancing the credibility of collective initiatives (Trestini and Chinchio, 2018). Additionally, cooperative administrations play a crucial role in ensuring the reliability and transparency of shared economic data, which reinforces trust among members and enhances the effectiveness of information exchange (Bijman, 2016; Kalogiannidis et al., 2024).

In the end, risk management instruments need to be integrated into a coherent framework, where public support is essential for helping small farmers and handling catastrophic risks. Looking at global experience, Hazell and Timu (2024) conclude that private unsubsidized agricultural insurance can only play a limited role in meeting the full spectrum of farmers' risk management needs. While commercially viable for intermediate risks faced by value chain-linked commercial farmers, it is generally too costly and narrow in scope to serve smaller farmers without public support. The paper emphasizes that insurance

should be integrated into broader risk management strategies, with differentiated approaches for small-holders and commercial farms. It recommends targeted subsidies for catastrophic risks, enabling policy environments, and leveraging digital innovations and intermediaries to reduce costs and improve delivery.

We use econometric analysis to understand the main drivers of the ARM uptake under the CAP. We conduct the econometric analysis on the five selected countries (Bulgaria, France, Latvia, Italy, and Slovakia) and look retrospectively at the use of ARM instruments under the CAP during 2014–2022, based on actual spending data provided by the governments of the five countries. We rely on the body of literature summarized above, to inform the choice of explanatory variables and the hypotheses we test.

The variables we chose reflect the variety of factors influencing risk management uptake, as literature suggests. The public policy variables rely on actual expenditures, originating both from EU and national budgets and provided by the governments of the five selected countries. Using this data, we constructed specific dependent variables to serve the purposes of this study. Our explanatory variables reflect different dimensions: (1) policy signals (state aid, share of direct payments in farm income), (2) sector structural features and risk exposure (water stress, utilized agricultural area, share of agriculture in the economy, agriculture as a share of the food value chain); (3) farm characteristics and choices (share of large farms, land under climate mitigation contracts, farm output to input ratio, off-farm income diversification), and (4) observed effects (coefficient of variation for some crops such as apples, grapes, maize, potato, and rapeseed). Structural data, reflecting sector exposure to risks and farm-level features that are likely to impact risk management uptake, were collated from Eurostat, FADN, or the Agri-Food Data Portal managed by the European Commission. Lastly, the indicator on water stress, as the main hazard impacting EU agriculture, was obtained from FAOSTAT. For more details, see Appendix 2.

Data constraints limit the choice of variables and the scope of the analysis overall. While the European agri-food sector is facing multiple risks, there is little data to describe the nature and impact of these risks or the exposure to them (e.g., agricultural areas under irrigation, water stress or affected by drought, floods or other calamities, animals vaccinated, animals culled due to disease outbreaks, number of farmers affected, value of losses encountered, sectoral analyses assessing different crop reactions and vulnerabilities, etc.). Moreover, there are no standards at EU level to streamline measurements of yield losses, nor EU level methods for data integration and assimilation, including a central repository of related information, even if it exists. Even at the national level, such information is sparse, usually collected by private companies or insurers, and usually not publicly available. These constraints affect the ability of the authorities to tailor their measures based on scientific evidence and limit the possibility to adequately assess financing needs from a policy perspective.

Similarly, the accessibility of the public expenditure data, although subject to transparency, presents another hurdle. While the EU Commission's Agri-Food Data Portal contains information about programmed CAP expenditure, it does not show actual spending either in aggregate, or by annual breakdown. Transparency is even more limited in relation to state aid. Even if all state aid measures (except de minimis) must be notified and are supposedly reflected in the State Aid Scoreboard, there have been challenges with the accessibility of the data collected. It is difficult to select and extract programs of interest in the agricultural sector (e.g., compensations to farmers following calamities) due to non-existence of aggregate data, as well as limitations related to language, program description, and classification. Considering the substantial increase in the number of agriculture related state aid schemes that the European Commission approved in the last few years, the availability and accessibility of the relevant data present an increasingly important factor for conducting a comprehensive analysis of the sector.

Table 5 presents the econometric results of the drivers of public expenditures on CAP-funded ARM and CAP plus nationally funded ARM. These estimates are based on the Tobit model and the correlated random effect model which we use to control for time invariant unobserved heterogeneity. Since we can only account for unobserved factors that do not change over time, our findings reflect correlations rather than causation.

TABLE 5 Drivers of Public Expenditure on Agricultural Risk Management in the Five Deep-Dive Countries (2014-2022)

Independent variables	Dependent variable (1): CAP-funded ARM	Dependent variable (2): CAP-funded and nationally funded ARM
State aid (disaster relief)	-0.185***	-0.174***
	(0.034)	(0.032)
Direct payments in farm income	-2.047***	-2.113***
	(0.725)	(0.691)
Share of large farms	2.189***	2.069***
	(0.509)	(0.485)
Land under climate mitigation contracts	27.472***	28.495***
	(4.087)	(3.895)
Water stress	20.050***	20.432***
	(5.441)	(5.186)
Utilized agricultural area	-0.169***	-0.170***
	(0.019)	(0.018)
Agriculture in the economy	-27.628***	-23.880**
	(10.591)	(10.095)
Farm output to input ratio	-145.031***	-138.136***
	(49.853)	(47.515)
Agriculture in the food value chain	5.588***	4.792***
	(1.222)	(1.165)
Off-farm income diversification	-3.950***	-3.970***
	(1.283)	(1.223)
Constant	244.394***	244.394***
	(58.701)	(58.701)
Observations	45	45
Number of countries	5	5
Year FE	Yes	Yes
Country FE	Yes	Yes

Notes: In all models, we control for the coefficient of variation of crops such as apples, grapes, maize, potato, rape-seed, tomato and wheat. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Analytical estimates indicate a possible trade-off between ex-post state aid disaster relief and ARM expenditure. In other words, as disaster relief increases, expenditure on ARM tools tends to decline, possibly because such aid may render market-based risk management options less attractive. This pattern may also be influenced by moral hazard: when farmers expect state aid, they may be less motivated to adopt preventive ARM strategies. In parallel, given the precedence of providing state aid, farmers might anticipate receiving it and therefore choose not to adopt expenditure ARM. It is important to recognize that state aid can function as a strategic risk management instrument, a role that became especially evident during the COVID-19 pandemic when governments across Europe intervened to support vulnerable sectors.

This finding exhibits the occurrence of complex implementation issues and the need for better articulation between risk transfer and risk coping instruments at national level. As already noted, if farmers expect that governments would cover large losses, they might reduce their ARM uptake (or/and investments in prevention), relying on ex-post payouts instead. This could distort insurance markets with private

insurers withdrawing coverage or raising premiums. Hence, there is a need for clear rules on the application of public versus private compensation. Such clear rules could even lead to increased insurance availability; if private insurers anticipate that extreme losses would be borne by public funds, they may even lower premiums or/and take on riskier covers.

At the same time, the EU-level crisis payments need to be well aligned with the national ones and be carefully designed to avoid distortions. As already shown, many Member States are developing disaster funds to support the private or public-private insurance system or to support farmers for non-insurable risks. These disaster funds are supposed to act within the catastrophic risk layer. At the same time, there is increased focus at the EU level to operate and fund crisis response mechanisms. The Unity Safety Net, replacing the agricultural reserve post-2027, counts on doubling its resources. Building effective and efficient national and European risk management for this layer requires harmonizing the respective rules of management (e.g., regarding loss thresholds, calculation of reference prices, or share of reference prices in production costs or crop values). Such rules would help ensure fair competition among Member States but also facilitate the transfer of catastrophic risks (e.g., five-year losses for current or future climate scenarios) to traditional or alternative reinsurance if the Member States choose so.

In the longer term, various solutions can be envisaged to expand the capacity of the European disaster risk financing tools. For example, *fi-compass (2025)* provides three complementary recommendations aiming to strengthen the EU's capacity to manage catastrophic agricultural risks. First, the EU could expand the capacity of its central emergency fund (or its agricultural reserve, at present) by transferring risk to capital markets through instruments like catastrophe bonds or reinsurance, particularly for large-scale disasters affecting multiple Member States. Second, Member States could be supported in developing additional parametric catastrophe insurance (e.g., macro-index insurance for droughts or floods), with partial EU co-financing to complement national systems. Third, in the longer term, the EU could establish a Multi-Sovereign Agriculture Insurance Risk Pool, modeled after the African Risk Capacity (ARC), to aggregate national level covers and benefit from diversification across countries. Box 2 presents examples of existing regional pools for catastrophic risks.

BOX 2 Regional pools for catastrophic risks

Regional pools for catastrophic risks are financial entities that allow countries to transfer part of their exposure to disaster events through insurance solutions that benefit from risk pooling and diversification. Key examples include the African Risk Capacity (ARC), the Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC), the Pacific Catastrophe Risk Insurance Company (PCRIC), and the Southeast Asia Disaster Risk Insurance Facility (SEADRIF). Such regional pools offer member countries covers against losses caused by events like tropical cyclone winds, excess rainfall, earthquakes, droughts, and floods.

These pools typically operate based on parametric insurance products, in which payouts are triggered by pre-defined indexes on selected variables (e.g., windspeed or rainfall levels). Well-structured parametric insurance products allow to reduce the time required to issue payouts, making them rapidly available for post-disaster recovery.

Through such catastrophe risk pools, countries have the option to pool risks in a diversified portfolio, retain some of the risk through joint reserves and capital, and transfer excess risk to the reinsurance and capital markets (GFDRR, 2017).

This approach is consistent with the risk-transfer layer proposed in the actuarial analyses carried out for the five country cases examined (Chapter 4). In the illustrative disaster risk financing strategies proposed, countries would purchase covers for their Value-at-Risk exposure falling between 5% and 1% exceedance probability levels. Thanks to the pooling and diversification effect, such covers could turn out more cost efficient if provided by an EU Regional agricultural risk pool and Appendix 3 provides a quantitative example of the benefits of supra-national risk pooling for the cases examined in this study.²

The benefits of supra-national/regional risk pooling are further evidenced by our complementary actuarial analysis covering the five deep-dive countries. According to this, diversification across agricultural products and countries significantly reduces insurance costs. Pooling agricultural risks across products and countries results in substantial reductions in technical premiums – up to 25 percent at the product level and approximately 12.5 percent at the aggregate level. This is due to imperfect correlations in production losses and aggregate national losses, which allow for risk spreading and lower simultaneous extreme payouts.

² For more information on regional risk pools see, for example, World Bank Group, 2017; Nature Communications, 2022.

The stage and structure critically influence the efficiency of a Supranational Risk Transfer Mechanism. The effectiveness of the risk transfer mechanism depends on when aggregation occurs—whether at the value, loss, or payout level—and whether diversification effects are considered. Designs based on product-level aggregation yield different payouts and consequently different premium structures than those based on country-level or supranational aggregation, highlighting the importance of actuarial design in optimizing financial protection (see Appendix 3 for details).

Supranational mechanisms enhance resilience across countries. By aggregating risks at a supranational level, the mechanism enables broader coverage and more efficient capital allocation, especially in scenarios where localized events do not affect all countries simultaneously. This structure supports regional solidarity, strengthens climate risk preparedness, and supports systemic shock absorption in the agricultural sector.

We observe a negative relationship between the share of direct payments in farmers' incomes and the adoption of ARM tools. Direct payments, currently the main income support tool under the CAP, help farmers absorb income shocks. Small and less specialized farms rely heavily on direct payments for liquidity, as documented by studies such as Fi-Compass (2022) and the European Parliament (2020), which makes the continuation of this support tool vital for them in a post-2027 CAP. Small and less specialized farmers are also less likely to take up insurance, which may explain the negative relationship observed. In contrast, larger farmers, by economic size, which are already better insured, do not seem to be affected by a tradeoff between direct payments and ARM, as shown next. This leaves the middle-sized farms as the critical group associated with this potential displacement effect.

We observe a positive relationship between the preponderance of large farmers and ARM uptake. Larger farms with higher economic performance and cash flows are typically prioritized when developing strategies for managing risk, as their scale exposes them to greater risks and uncertainties. Farms with a substantial standard output often face amplified exposure to various market and production risks, possibly arising from the fact that increased output is frequently accompanied by a heavier reliance on market prices and a broader scope of operations. Such dependence means that these farms are particularly susceptible to fluctuations in market prices, outbreaks of disease, and adverse weather and climatic conditions. As the stakes grow higher with larger investments and more extensive operations, the necessity for effective risk management becomes even more pronounced (Severini et al., 2021). However, in the case of smaller and medium-sized farms, it seems that ARM uptake would be improved if financial, knowledge, structural, and institutional barriers can be overcome.

The CAP post-2027 proposals significantly enhance support for small and medium-sized farms to overcome risk management barriers through targeted financial, knowledge, structural, and human-focused measures. Financially, these initiatives include an enhanced Unity Safety Net and lump-sum transition payments, higher co-financing for young and small farmers. All these would reduce insurance and mutual fund costs, while a single EAGF/EAFRD fund with degressive payments redirects 15-20 percent more funds to smaller operations. Knowledge and trust gaps could be addressed via knowledge sharing and technical assistance platforms, for climate/yield data and “starter packs” with training and mentoring, under the EUR 865 billion Partnership Fund. Structurally, simplified governance with flexible loss thresholds and the EU Facility Tool supports tailored resilience investments, cutting administrative costs. Human and legal risks are mitigated through generational renewal strategies, including EUR 3,000 lump sums for family farms and social conditionality for fair labor standards (European Commission, 2025; Council of the EU, 2025).

The analysis reveals a significant positive correlation between the adoption of on-farm climate mitigation strategies and the uptake of ARM. This finding suggests that these approaches do not operate in isolation but rather work in tandem, reinforcing one another. When farmers engage in climate mitigation commitments and other sustainable practices (such as cover cropping, conservation tillage, or organic farming), supported financially through the CAP, they may become more inclined to also invest in robust risk management measures to further safeguard their farm operations and agricultural investments. As a result, the financial incentives provided by these adaptation programs may serve as both motivation and means for farmers to enhance their resilience, allowing them to allocate resources toward integrated strategies that address climate risks from multiple angles.

One of our most significant findings is the clear positive relationship between water stress and the adoption of ARM strategies. Water stress, recognized as a major abiotic challenge for farmers, has profound implications for agricultural productivity and sustainability. With the ongoing and intensifying threat of

climate change, farmers are increasingly confronted by extreme conditions - rising temperatures, persistent droughts, and the growing scarcity of water resources. These environmental pressures bring heightened risk and uncertainty to farming operations, often leading to considerable negative impacts on crop yields and livelihoods. Considering these escalating risks and potential damages, the importance of investing in ARM strategies becomes an essential one for farmers seeking to safeguard their livelihoods while building resilience and improving their welfare. ARM offers tools and approaches that allow farmers to better navigate the unpredictability brought on by environmental stressors like water scarcity, helping them mitigate losses and maintain stability in their operations. Therefore, it is evident that water stress acts as a critical exogenous driver, compelling farmers to seek out and utilize risk management solutions. Within this context, in EU agriculture, adverse selection in crop and weather insurance, particularly for water stress, occurs when farmers in drought-prone areas are more likely to purchase insurance due to their high exposure, skewing the risk pool as low-risk farmers opt out of premiums based on average risks, and leading to low uptake rates.

BOX 3 When insurable becomes uninsurable. Perspectives from Morocco and Greece.

Morocco: Morocco has been developing a multi-risk crop insurance program for many years as part of the Green Morocco Plan (2008-2018) and then the Green Generation Strategy (2020-2030). The insured area covers more than one million hectares of various crops throughout the country. However, the system's environment has changed significantly since the early 2020s. Climate change has worsened, leading to a significant increase in the frequency of droughts throughout the country. Production costs covered by the MRC have increased significantly in the international context. With the increase in claims frequency, insurance premiums have risen sharply, leading to very high budgetary requirements given the subsidy rate. International reinsurers first raised their rates and then discussed withdrawing their participation in Morocco. Reform has become necessary for the survival of the insurance system.

Actuarial studies on historical data combined with all the ongoing climate change studies have led to a segmentation of the Moroccan territory into two zones, a so-called insurable zone and a non-insurable zone. The insurable zone is requiring some MRC contract adjustments but also forms of adaptation of production methods to return to international standard insurance parameters. The non-insurable zone is now covered by a public fund compensating farmers according to an experimental climate index developed by the Moroccan National Institute for Agricultural Research. Support for farmers on the choice of production and production methods is also planned.

Everything is now in place for optimal coverage of climate risk, i.e., maintaining a strategic level of national production but also controlling the budgetary financing of the subsidies required for both zones. However, efforts to adapt production techniques must be constant to properly stabilize the pure risk premium in both zones.

Greece: According to a World Bank (2021) report, the Greek agricultural risk management system, centered on the Hellenic Agricultural Insurance Organization (ELGA) insurance scheme (a compulsory mutual fund) and government disaster aid, faces significant challenges due to increasing frequency and severity of extreme weather events driven by climate change. Financial sustainability is strained by rising claims from production losses, with a growing, volatile catastrophic risk layer that the system cannot absorb without premium hikes. Risks are highly concentrated in perils like hail, frost, excess rain, and windstorms (over 90 percent of claims) and in specific crops and regions (six regions account for over 50 percent of claims), leading to unequal net benefits where most farmers overpay relative to fair premiums. Additional issues include inefficiencies in service delivery, administrative processes, and a lack of focus on long-term structural resilience against market and climatic volatility, as identified in a SWOT analysis highlighting needs for equity, efficiency, and new tools.

Study proposals include reforms which should adopt a two-tier approach to enhance viability and resilience. Tier One prioritizes strengthening ELGA through climate-resilient investments, differentiated premium rates by crop/region risk to reduce cross-subsidization, financial measures like subsidies or reinsurance, higher deductibles, and operational improvements such as better claims management and actuarial capacity. Tier Two involves diversifying with complementary tools like income stabilization and index insurance, introduced via producer organizations or private sectors, to address income volatility while building on ELGA's core coverage.

We observe a slightly negative correlation between UAA and the adoption of ARM tools. At first glance, this finding may seem counterintuitive, as one might anticipate that larger farm areas—often associated with increased production—would expose producers to greater risks and uncertainties, thereby prompting a higher reliance on ARM strategies. However, the observed negative relationship is possible and not without some justification. One plausible interpretation is that larger agricultural holdings are often characterized by more sophisticated and diverse production structures (such as in Slovakia, for instance). This diversification inherently acts as a form of risk mitigation, reducing the farm's vulnerability to shocks and lessening the perceived necessity for external ARM tools.

Farm output to input ratio is negatively associated with the use of ARM strategies. The negative relationship between the output-to-input value ratio and farm insurance uptake in the selected five countries indicates a counter-intuitive behavioral and structural dynamic but observed in some of the literature

referenced above. Farms with higher margins (more efficient operations) exhibit lower uptake of insurance. While, more broadly, this may be due to perceived self-sufficiency, overconfidence in stability, or viewing premiums as an avoidable cost despite underlying risks such as weather volatility in high-value sectors, a deeper look into the farm profiles in the five countries analyzed provides important insights. In this case, the smallest farms in economic terms, specializing in wine, horticulture, and olives (for Italy and France), have the highest output to input ratios. Some large farms exhibit high ratios as well, but these holdings are also strongly specialized in high-value products, e.g. wine (France), dairy (Slovakia), or horticulture (Bulgaria, Latvia). This finding underscores the importance of tailoring insurance products and covering protection gaps that affect specialty crops. It also emphasizes the importance of removing obstacles that affect small farms' access to insurance, where high-margin small farms underinsure against shocks, while low-margin operations face affordability barriers.

The share of agriculture within the overall food value chain demonstrates a positive relationship with the adoption of ARM strategies. In other words, as agriculture occupies a greater share of the food value chain, the tendency for stakeholders to implement ARM measures also increases. This correlation makes logical sense and aligns with previous observations: when the agricultural sector is prominent, it is more exposed to a wide range of risks and uncertainties. Producers facing heightened vulnerabilities, are therefore more inclined to invest in risk management approaches to safeguard their operations. This result reflects the reality that a robust agricultural sector amplifies the need for tools and strategies that can mitigate the unpredictability inherent in food production and distribution. As such, an increase in the sector's share within the chain naturally prompts higher ARM uptake, as stakeholders seek stability amidst changing market conditions, weather patterns, and other external challenges. Ultimately, the expansion of agriculture's role in the food value chain serves as a catalyst for greater engagement in risk management, reinforcing the sector's resilience and adaptability for the future.

The analysis reveals a notable negative correlation between off-farm income diversification and ARM uptake. This outcome is quite intuitive, as diversification itself acts as a form of risk mitigation for farmers, allowing them to spread potential losses across multiple income streams. By engaging in various non-agricultural activities, farmers reduce their reliance on farm incomes and hence, are less eager to adopt ARM measures. In some cases, it might be possible that alternative (off-farm) incomes outside farming activities might enable farmers to more confidently engage in ARM strategies. However, it seems unlikely that farmers engaged in off-farm activities are linked to significantly competitive forms of farming.

To further test the robustness of our econometric analysis and the validity of our findings, we expanded our analysis beyond the five deep-dive countries. In this format, we included all 10 EU Member States that have utilized CAP funds during the 2014-2022 period to promote risk management tools, i.e.: Estonia, France, Croatia, Hungary, Italy, Latvia, Lithuania, the Netherlands, Portugal and Romania. We replicated the econometric model for this panel but excluded the state aid variable due to insufficient publicly available data across the new country set. The results are laid out in Table 6.

TABLE 6 Drivers of Public Expenditure on Agricultural Risk Management in an Expanded Set of 10 EU Countries (2014-2022)

Independent variables	Dependent variable: CAP-funded ARM (including national co-financing)
Direct payments in farm income	-7.369***
	(2.700)
Share of large farms	-0.332
	(0.602)
Land under climate mitigation contracts	1.319
	(1.055)
Water stress	17.432***
	(4.167)

Independent variables	Dependent variable: CAP-funded ARM (including national co-financing)
Utilized agricultural area	-0.006***
	(0.002)
Agriculture in the economy	60.774**
	(26.013)
Farm output to input ratio	-990.498***
	(186.084)
Agriculture in the food value chain	3.304
	(3.109)
Off-farm income diversification	1.750
	(1.456)
Constant	-2,513.225***
	(576.818)
Observations	90
Number of countries	10
Year FE	Yes
Country FE	Yes

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The key explanatory variables (farm output to input ratio, water stress, and share of direct payments in farm income) hold true. The farm output to input ratio, which is indicative of farmers' profitability and liquidity, is strongly and negatively associated with ARM uptake. This means that more efficient farmers are less likely to adopt ARM under the CAP. Across the 10-country set considered, the farms with the largest output to input ratios are small, mixed, or permanent crop farms, geographically concentrated in Romania and Portugal. These farms combine low input costs with either diversified or high-value output, resulting in exceptional efficiency. Larger farms and those focused on field crops or milk production generally have lower ratios, reflecting different production structures and market conditions. This finding confirms that insurance gaps are typically found in smaller holdings, producing specialty goods. Water stress remains a significant and positive indicator of ARM adoption. Countries experiencing greater water stress are more likely to opt into the CAP ARM toolkit. The share of direct payments in farm income remains strongly and negatively associated with ARM uptake. It is important to note that the holdings with the largest share of direct payments in income are typically smaller field crop or mixed farms (under 25,000 euros of standard output) in Eastern Europe. This highlights the importance of these payments for the economic viability of the smallest agricultural holdings, beyond just risk management. Several other explanatory variables preserve their relationship with ARM uptake but lose statistical significance or retain small, almost negligible coefficients (e.g., integration of farming production into the food chain, share of UAA in total land, land under climate mitigation contracts).

Only three explanatory variables display ambiguous results: the share of agriculture in the economy, the share of large farmers and off-farm income diversification but the last two are not statistically significant including land under climate mitigation contracts. Indeed, the share of agriculture in the economy can go both ways. Countries with large shares of primary agricultural production may experience higher exposure to risks but may also have lower capacity to adopt and implement advanced risk management instruments. In turn, several countries with strong agri-food systems representing only a small share of the national economy (e.g., Italy, France) are enjoying sophisticated risk management systems and are utilizing the specific CAP resources greatly. While typically large farmers are better insured than the others, the specific large farm profiles that associate with the choice of country sets appear to matter. Across the expanded set of Member States, the profiles of large holdings reflect much greater diversity, with

implications to both the risk exposure (and propensity to use insurance under CAP financing) and availability of tailored insurance products. They tend to specialize in field crops, mixed systems and, in some cases dairy (Baltic States, Croatia, Romania, Hungary), in a broad range of commodities (France), in wine and permanent crops (Italy), horticulture, milk, granivores (the Netherlands), or field crops, wine, horticulture (Portugal). Finally, off-farm income diversification loses its significance as an explanatory variable in the expanded country case analysis. That said, it is important to recognize that despite the ambiguous results, the estimates are not statistically different from zero as their p-values are large.

4

A DEEPER LOOK AT AGRI-RISK MANAGEMENT IN FIVE COUNTRIES

The deep dive analysis covers Bulgaria, France, Latvia, Italy and Slovakia, and explores in detail the ARM features and dynamics observed in these countries since 2014. The analysis starts with an overview of the main sector and risk features in each country, provides a description of the risk management instruments that are available to farmers, both public and private, and focuses on how public policies, financed both under the CAP framework and national sources are contributing to better risk management outcomes.

For each country, we conducted an actuarial analysis, which produces an initial evaluation of the Contingent Liabilities (CLs) and a gap analysis based on a prototype Disaster Risk Financing- DRF strategy. Given the fact that comprehensive data on each country's existing DRF strategy ("status-quo") and the decision-maker's preference regarding the preceding order of the financial instruments to conduct its gap analysis was not discussed, the analysis identifies gaps based on a new DRF strategy whose instruments may be used to complement, rather than replace, current national approaches.

The analysis identified two key sources of contingent liabilities (CLs) for which the EU provides support to their Member States: one is related to production loss, and the other is related to income loss. Given the time and data constraints, this report focuses on the former, with the intent of extending the analysis to include income loss and providing financing solutions for future work.

To structure the assessment, the analysis was disaggregated by agricultural sub-sector, with separate evaluations conducted. We produced distinct analyses for crop and animal production, given their specific hazards. For the crops analysis: we developed a representative "Crop Portfolio" for each country, and prioritized crops both in terms of Crop Area and the Production Value at Producer Prices (PVPP). With respect to animal analysis, we focused on Cow Milk production, given its economic importance.

For Slovakia, Latvia, and Bulgaria, the Crop Portfolio is composed of six to eight crops, while for Italy and France it accounts for twenty-five and twenty-six, respectively. For Slovakia, Latvia and Bulgaria, the Crop Portfolio accounted in 2023 for at least 75 percent of the total production. In turn, in Italy the portfolio represents 60 percent of the production value and 66 percent of the crop area. Finally, in France, the selected crop portfolio covers around 90 percent of the total production. Cow Milk in 2023 represented between 28.5 percent (Bulgaria) and 49 percent (Latvia) of the PVPP of animal production.

Bulgaria

The agri-food sector holds strategic economic and social functions in Bulgaria. On average, agriculture, forestry and fishing contributed 4.4 percent to the country's economy during 2010-2023. When also considering food, beverages and tobacco, the agri-food system's contribution to the economy amounted to 7 percent over the same period. Despite a relative decline over time, the agri-food sector remains essential for ensuring food, supporting household incomes and contributing to the economic and social stability of the rural areas. The sector exhibits a polarized structure: many small farms with limited land resources coexist with a few large farms holding most agricultural land. In 2020, farms generating over 250,000 euros

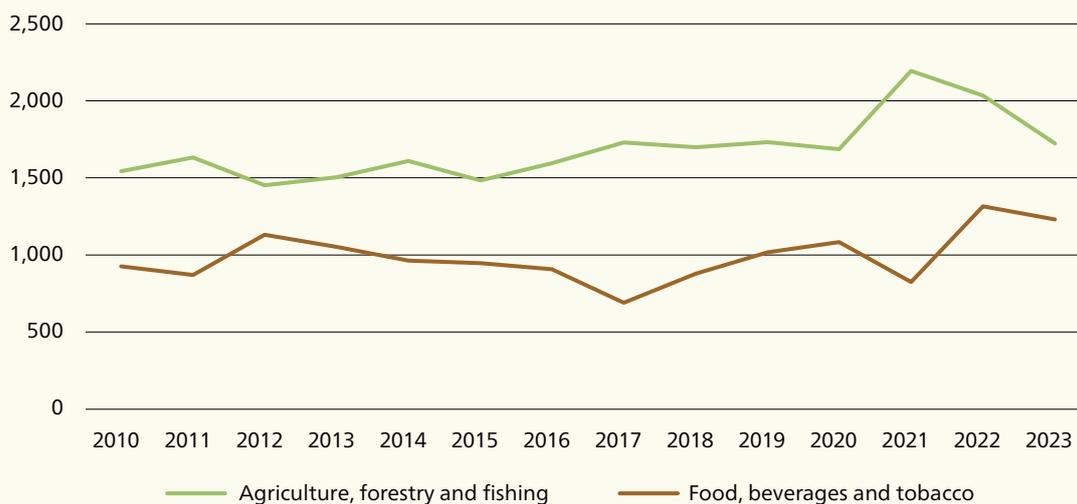
in standard output represented 2 percent of the total farm population but occupied 56 percent of the utilized agricultural area and generated 59 percent of the sector's output. In contrast, 53 percent of all agricultural holdings fell below 4,000 euros of standard output.

FIGURE 3 Evolution of real and nominal value added in Bulgarian primary agricultural production and food processing,

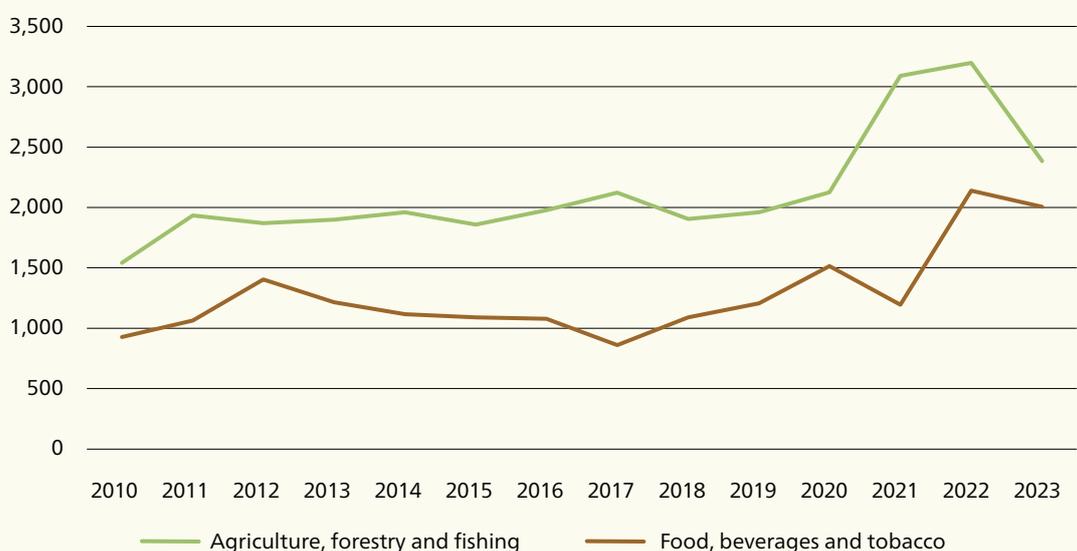
Using NACE classification, Rev.2

Million euros, chain-linked volumes 2010, and current prices, 2010-2023

a. Real



b. Nominal



Source: Eurostat.

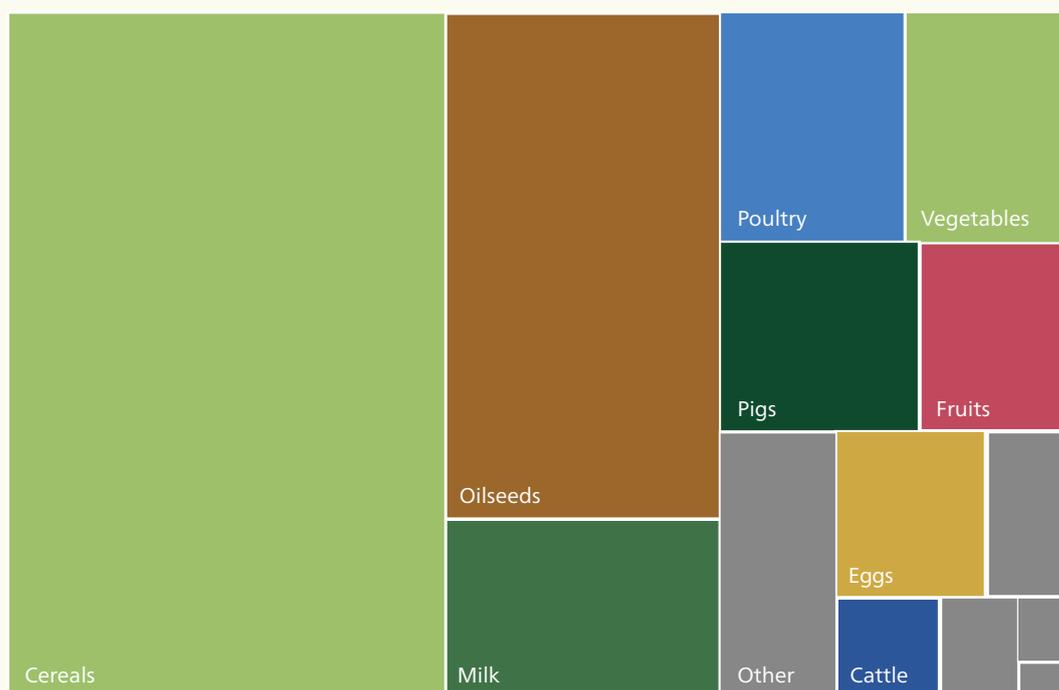
Crops dominate the Bulgarian farming sector, while livestock saw a sharp decline in the recent years.

Cereals and oilseeds accounted together for 60 percent of Bulgaria's agricultural production value (at producer prices) in 2023. Vegetables and fruits are also important and hold about 10 percent of the agricultural output. The crops to livestock output ratio, in constant 2010 producer prices, has increased consistently since 2010, despite some annual fluctuations. Crops now generate about three times more output than the animal sector. Bulgaria's livestock population decreased by 11 percent from 2010 to 2020, with 1,026,174 livestock units recorded in 2020. The number of livestock farms also declined. There is a trend toward concentration, with fewer but larger farms raising more animals, which enhances economies of

scale but increases risks of infectious diseases spreading, unless strict farm management practices apply. European investment has modernized high-productivity farms, lowering costs. However, the livestock sector contends with labor shortages, complex supply chains, and high production costs, reducing competitiveness. While cattle numbers have remained relatively stable with a slight annual decrease of up to 1.5 percent, pig farming has recovered and grown by 17 percent after African swine fever outbreaks, supported by sector industrialization and investment. Poultry farming remains highly mechanized and efficient. Conversely, sheep and goat populations have declined significantly over the last decade, by 24 percent and 50 percent respectively.

FIGURE 4 Composition of Bulgarian agricultural output, using the Economic Accounts for Agriculture

Million euros, producer prices, 2023



Source: Eurostat.

The Bulgarian agri-food sector is very sensitive to climate change and adverse weather conditions.

The climate change scenarios for Bulgaria indicate an increased frequency of climatic adverse events, such as long droughts, heat waves, heavy rainfalls, and floods. The increase of air temperature, large temperature fluctuations, and changes in precipitation patterns (primarily, intense rainfall and hailstorms) are results of climate change in the country. According to observations by the National Institute of Hydrology and Meteorology, the period from 1961 to 1984 was dominated by average and very wet years, followed by a prolonged drought lasting until 1994. The subsequent period includes wetter years (1998, 2005, 2006, 2010, 2014, 2015, 2018), as well as average and dry years (2000, 2001, 2011, 2019, 2020, 2022, 2023) (NIMH, 2023).

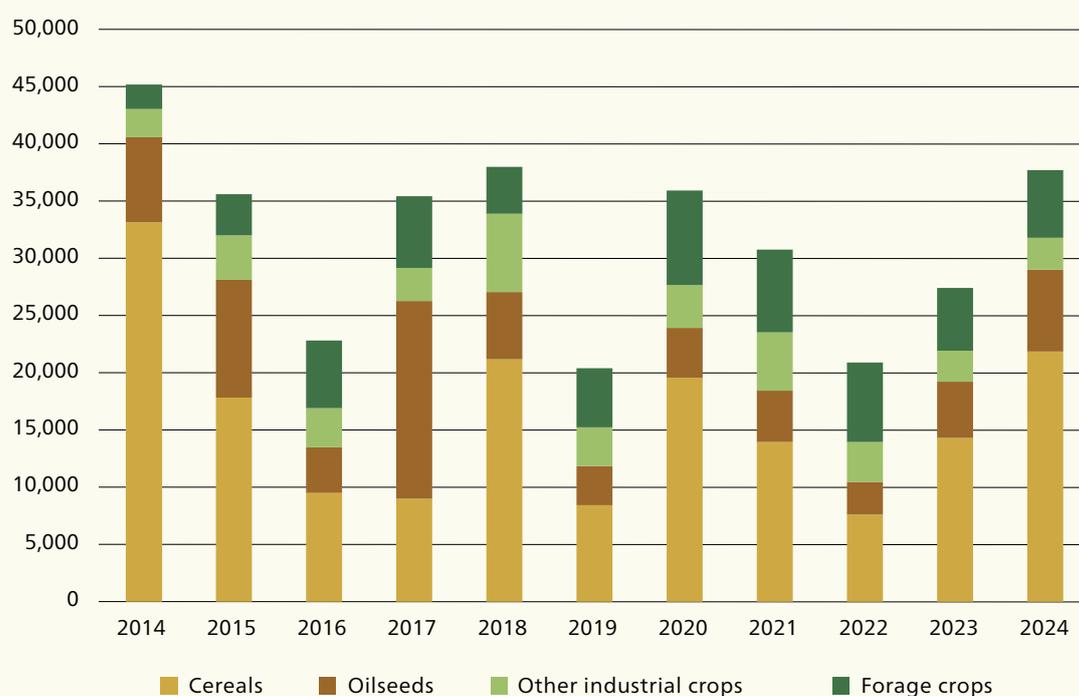
³ Because of Bulgaria's agro-climatic conditions, increased drought stress and a shortened active growing season have had negative impacts on both crops and grasslands, while also contributing to a higher incidence of plant and livestock diseases.

Plant diseases and adverse climatic events, such as drought, frost, hail, flooding, and storms, have caused significant agricultural losses, resulting in approximately 347,000 failed hectares over the last decade. Wheat and oilseed crops are most affected, accounting for 50 percent and, respectively, 20

³ Bulgaria has recorded numerous extremely hard rainfall events since 2000, especially in 2005 and 2014, causing severe damage and loss of life. Floods, as extreme hydrological events, have been and continue to be one of the most important natural hazards, causing human casualties and economic losses.

percent of the affected area. Drought and hailstorms accounted for 45 percent and 25 percent of the failed areas, respectively. For hailstorms, as well as for floods and windstorms, the damage is usually limited and localized to specific regions. Sharp temperature fluctuations in early spring have particularly impacted on perennial stone fruits, nuts, seeds, rapeseed, and wheat. Climate change, globalization, and insufficiently adapted agricultural practices influence the spread of plant diseases, which increase plant vulnerability and uncertainty of occurrence.

FIGURE 5 Failed areas in Bulgaria due to natural hazards, by key crops, hectares, 2014-2024



Source: Ministry of Agriculture and Food of Bulgaria.

The livestock sector has also been hit by a resurgence of infectious diseases. Several widespread disease types (African swine fever, lumpy skin disease in cattle) had never been reported in Bulgaria until the last decade, when they hit the animal industry and caused production, economic, financial, ecological, and social losses and constraints. An outbreak of African swine fever occurred in 2019–2020, a large-scale outbreak of Bluetongue disease occurred in 2014, and there are frequent outbreaks of avian flu, among many other hazards for Bulgarian livestock. About one million animal deaths were estimated from 2019 to 2024. Disease persistence is expected due to intensive farming, climate fluctuations, and feed price volatility linked to geopolitical uncertainty.

In the recent years, the Bulgarian agriculture has faced significant external shocks, including the COVID-19 pandemic, disruptions in global supply chains, and the situation in Ukraine. Current uncertainties about the multilateral trade system and relations are an additional source of risk. Since 2019, farmers have been faced with rising prices for essential inputs such as feed, electricity, fuel, fertilizers, and others, along with heightened uncertainty in agricultural and commodity markets. High production costs translated into sharp increases in the prices of agricultural output, which are visible in the 2021 and 2022 agricultural output values, followed by a drastic decline in 2023.

Structural and macroeconomic factors are an additional source of vulnerability for the Bulgarian agri-food sector. The former include: the decline of the working-age population and persistent de-population in rural areas, fragmentation of agricultural holdings, insufficient production diversification, technological modernization and innovation. Macroeconomic trends, such as inflation, reduced purchasing power of the population, price volatility, and others, further amplify these vulnerabilities.

Agricultural insurance in Bulgaria is a nascent but increasingly important tool for managing the volatile risks faced by farmers. Extreme weather (droughts, frosts, hailstorms) and animal disease outbreaks (e.g. African swine fever, avian flu) have hit Bulgaria's farm sector repeatedly in recent years. Traditionally, Bulgarian farmers have relied on ad hoc government disaster aid or absorbed losses themselves, resulting in low formal insurance uptake and a culture of expecting ex-post relief. However, aligning with EU policy trends, Bulgaria has begun to strengthen its agricultural insurance system through public subsidies and new risk-sharing mechanisms.

The core of Bulgaria's agricultural insurance market is crop insurance covering losses from natural perils. Farmers can purchase named-peril policies (e.g. hail-only coverage) or multi-peril crop insurance (MPCI) that bundles multiple climate risks. Common hazards insured include hail, spring frost, excessive rain, storms, flooding, and drought, among others. However, drought coverage has traditionally been limited – under current schemes, drought is only fully compensated in cases of 100 percent crop loss (reflecting the difficulty of assessing partial drought damage). Most insurers tend to offer yield-based indemnity insurance, where payouts are triggered by measured yield loss on the farm.

Only a minority of farmers, typically larger, more commercial operations, participate. As of 2022, about 20 percent of Bulgaria's arable land was insured against one or more perils. Major field crops (wheat, maize, sunflower) compose the bulk of the insured area (these are grown on large scales and are susceptible to hail and drought), while perennial crops (fruits, vineyards) also see insurance uptake due to their high value and vulnerability to frost or hail. Small subsistence farmers typically do not participate in insurance. Their farm sizes fall below eligibility threshold, or they perceive insurance as too costly relative to their small output. Instead, they bank on disaster aid or simply replant next season. This creates a coverage gap – precisely the farms often most vulnerable to shocks (smallholders) are the least insured, a known challenge in the system.

Insurance for livestock (covering risks like disease, mortality, or loss of animals) is technically available but extremely limited in practice. In 2022, livestock insurance premiums were only about 0.05 percent of total non-life insurance premiums in Bulgaria – a negligible market presence. Private insurers have shown little interest in offering livestock coverage, largely because epidemic diseases can cause catastrophic losses that are hard to insure commercially. Some policies exist for specific purposes (e.g. insuring high value breeding animals or providing coverage for accidents), but coverage for diseases (such as foot-and-mouth or swine fever) is scarce. Instead, livestock farmers rely on state compensation schemes: the government fully reimburses farmers for animals culled in outbreaks of certain contagious diseases (100 percent loss coverage funded by the state budget). This effectively serves as a public “insurance” for major livestock diseases, albeit outside the private insurance market. Because of this robust state safety net and insurers' reluctance, Bulgarian farmers have not developed a habit of purchasing livestock insurance on their own, and the share of insured animals is near zero.

Unlike some countries experimenting with revenue insurance (covering price as well as yield risk) or index-based insurance (payouts based on weather indices or satellite data), Bulgaria currently does not offer these advanced products under its agricultural insurance system. The entire focus remains on traditional yield-based indemnity insurance for crops. Market risks (like price drops) and wider income variability are not covered by insurance products in Bulgaria – farmers bear those risks or mitigate them via forward contracts or diversification. Nonetheless, there is growing interest at the policy level in exploring such innovative tools. EU-level analyses have recommended expanding the insurance toolkit to include revenue insurance and index insurance where feasible. For example, index insurance for drought could be a useful innovation in Bulgaria's context, since current insurance only compensates drought when losses are total. While no index-based schemes are operational yet, Bulgarian authorities and the EU are examining how to enable these products (e.g., by refining regulations so that index insurance can qualify for subsidies).

A mix of private insurers and brokers sell agricultural policies to farmers. Unlike some countries with specialized agriculture insurers or pools (e.g. Spain's Agroseguro), Bulgaria's market is served by general insurance companies offering farm coverage as a small line of business. About 35 insurers and 300 brokers are estimated to operate in the market. In fact, agriculture accounted for only 0.6 percent of total gross written premiums in Bulgaria's insurance sector in 2022. This underlines that only a few insurers participate actively, and those that do treat it cautiously. The Financial Supervision Commission regulates insurance activity, and the Financial Supervision Commission and National Statistical Institute collect and compile industry statistics. There is no dedicated agricultural insurance pool; companies compete (though the low market size means competition is limited). Loss adjustment is typically done by insurer-appointed experts, with payouts based on measured damage to the insured crop.

TABLE 7 Volume of non-life insurance premium income in Bulgaria

Million euros, 2014-2024

Type of insurance	2017	2018	2019	2020	2021	2022
Agriculture (total)	9.1	13.6	9.0	7.3	10.1	9.7
Of which, livestock	0.7	0.7	0.7	0.5	0.6	0.8
Total, non-life insurance	894.1	1,067.5	1,233.9	1,246.9	1,355.6	1,526.7

Source: Financial Supervision Commission of Bulgaria

Government support is crucial to agricultural insurance in Bulgaria, making premiums affordable and guiding the development of new tools. Over the past decade, the country transitioned from a purely national subsidy scheme to effectively integrating with the EU's CAP support framework in 2025 (while state aid continued covering the gap in 2024).

Until 2024, Bulgaria's insurance subsidies were provided as national state aid (not financed by CAP rural development funds). Under this scheme, the government (through the State Fund Agriculture, SFA, or the country's CAP Paying Agency) paid a percentage of farmers' insurance premiums. Generally, 65 percent of the premium was subsidized for most crops, while for cereal grains, the subsidy was slightly lower, covering up to 50 percent of the premium. The rationale was that grain crops already benefited from direct payments and some on-farm risk diversification (multiple fields), so a lower rate sufficed. A condition of this state aid was that the farmer had a signed insurance contract – effectively, the state aid reimbursed part of that contract's cost. This scheme was notified under EU state aid rules and had to adhere to ceilings (e.g., only losses above a certain threshold could be covered, and avoid over-compensation to remain WTO-compliant).

The state aid scheme significantly lowered farmers' cost of insurance and increased accessibility to insurance. However, this program was funded from Bulgaria's national budget, meaning its scope was limited by fiscal constraints. In years with large disasters, the government also resorted to ad hoc compensation for uninsured losses – for example, between 2020 and 2024, about EUR 20 million was paid out to crop farmers as disaster relief (outside of insurance).

TABLE 8 State aid programs relevant for agricultural risk management in Bulgaria

Million euros, 2014-2024

Type of program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Compensations	8.8	12.7	10.5	19.7	23.2	20.0	24.0	19.7	19.8	32.9	35.0
Insurance subsidies	0.3	0.6	0.7	0.6	0.6	0.6	0.5	1.0	0.9	0.5	1.6
COVID-19							26.9	37.2	73.4	-	-
Ukraine									217.5	217.7	333.9
Other ARM-measures	13.4	16.8	9.3	4.5	11.5	18.6	32.8	11.2	15.8	28.7	11.8
Total	22.4	30.0	20.6	24.8	35.3	39.2	84.1	69.1	327.3	279.8	382.3

Source: Ministry of Agriculture and Food of Bulgaria.

In addition to insurance schemes, Bulgaria implemented extraordinary instruments to mitigate the economic impacts of two crises: the COVID-19 pandemic and the situation in Ukraine. Measure 21 ("Extraordinary temporary support for farmers and SMEs particularly affected by the COVID-19 crisis") was aimed at maintaining the liquidity of agricultural holdings and limiting the effects of market disruptions.

Its total budget amounted to 42.8 million EUR, jointly financed by the European Agricultural Fund for Rural Development (EUR 36.4 million) and the national budget (EUR 6.4 million). In parallel, additional liquidity support amounting to EUR 137.4 million, was provided through state aid under the temporary COVID-19 framework.

After 2022, Bulgaria implemented Measure 22 (“Exceptional temporary support for farmers and SMEs particularly affected by the impact of Russia’s invasion of Ukraine” – Art. 39b) to compensate for increased costs of energy, fuels, fertilizers, feed, and other inputs. The aid targeted vulnerable sectors, i.e., livestock, crop production (including cereals and vegetables), and dairy production, with a particular focus on small and medium-sized farms. The total public funding amounted to EUR 31.8 million, of which EUR 27.1 million was provided by EAFRD and EUR 4.7 million from the national budget. Additionally, state aid amounted to EUR 762.2 million and its objective was to stabilize production and offset the increased costs. These interventions were also implemented within the framework of the “Temporary Crisis and Transition Framework, to Support the Economy Following Russia’s Aggression against Ukraine” (the “Crisis Framework”, which allowed Member States to provide exceptional support in the context of the situation in Ukraine.

Furthermore, state aid from the national budget was provided to cover irrigation water expenses for crop producers. It amounted to EUR 10.9 million and covered up to 80 percent of the irrigation costs.

For both temporary measures, funding was extended as a lump sum payment and grant, with the primary aim of preserving liquidity and production capacity, preventing market imbalances, and mitigating economic disruptions. The measures under the RDP and the state aid provided are temporary, rapidly accessible, and crisis-oriented, with the primary objective of quickly supporting liquidity and maintaining the production capacity of agricultural holdings, addressing market imbalances, and protecting the operations of farmers from economic shocks and the consequences of the situation in Ukraine.

De minimis and state aid support, as well as the RDP program measures contributed to loss mitigation and the preservation of agricultural production. Nevertheless, their effectiveness was temporary and reactive, focused on short-term compensation rather than on building sustainable risk management mechanisms or reducing the sector’s future vulnerability. Beyond their economic significance, they also carry political value due to their rapid and visible effect in compensating for crisis events affecting many producers.

Until 2024, Bulgaria lacked a structured system for preventive and ex-post risk management in agriculture. Farms relied primarily on ad hoc interventions, temporary European crises frameworks, and national financing, which highlighted the sector’s dependence on post-crisis financial support. This gap was addressed with the introduction of a specialized instrument for insurance premium financing and the establishment of a mutual fund within the CAP Strategic Plan for 2023–2027. The new approach aims to replace temporary state aids and de minimis schemes with a longer-term and sustainable risk management mechanism, integrating preventive and structured tools for protecting agricultural producers. In this way, Bulgaria ensures a smooth transition from reactive and temporary measures to a structured and sustainably financed system for agricultural risk management.

Starting in 2023, Bulgaria included a dedicated insurance premium support intervention in its CAP Strategic Plan for 2023–2027, under Article 76 of Regulation (EU) 2021/2115. This shifted the primary funding source to the EAFRD, with national co-financing, and replaced the earlier state aid entirely. The subsidy can now cover up to 70 percent of the eligible insurance premium cost, aligning with the maximum allowed by CAP rules. Bulgaria indeed set its support at this upper limit to maximize farmer benefit and is an increase from the previous state aid support. The eligible risks are defined as “adverse climatic events” – essentially weather-related disasters like hail, frost, storm, flood, drought, etc. These match the EU’s definition for subsidized insurance. Notably, coverage of losses due to plant or animal diseases can also be eligible in CAP terms, but Bulgaria’s plan focused on climatic events for insurance (since animal diseases were handled separately by the Bulgarian Food Safety Agency). The first call for applications under this measure was launched in March 2025 with a budget of EUR 10 million. The lag until 2025 was due to the administrative setup and Ordinance issuance required to implement the new measure.

A standout feature of Bulgaria’s approach in 2023–2027 is the planned Agricultural Mutual Fund (AMF), an innovative public-private fund to compensate farmers for catastrophic losses not covered by insurance. Under Article 76 of Regulation 2021/2115 (and Article 19 for financing), Bulgaria will deduct **1.5 percent of all farmers’ Pillar I direct payments** to finance the Mutual Fund (the CAP allows up to

3 percent to be deducted). This effectively means every farmer contributes a small share of their income support into a collective risk pool. Bulgaria is one of the first EU countries to use this CAP provision. The deductions are matched by EAFRD and national funds, making it hybrid financing. The Mutual Fund is intended to pay compensation when farmers suffer extreme losses from natural disasters that might not be fully covered by standard insurance – e.g. a devastating regional drought, or a spring frost wiping out an entire orchard crop. It will only compensate for losses exceeding 20 percent of average production (as per CAP rules), and only for certain events: frost, storm/heavy rain, flooding, hail, and drought (drought being only if total crop failure). To encourage insurance, the fund has a two-tier payout: farmers who are insured get up to 80 percent compensation of their loss value, while uninsured farmers get only up to 40 percent compensation for the same loss. This substantial difference (essentially a 50 percent penalty for not having insurance) is designed to incentivize participation in insurance and ensure the Mutual Fund supplements rather than replaces insurance.

The AMF is still in development. As of mid-2025, a general concept had been presented to farmers' associations, but details (farmers' premium contributions, governance, payout rules) were to be set in secondary legislation. The fund will be housed within the SFA but managed separately (ring-fenced account and oversight). The target annual budget is around EUR 25–26 million, combining the 1.5 percent direct payment contributions (about EUR 11.5 million/year projected), EAFRD co-funding (about 10 percent) and national co-funding (about 45 percent), plus farmers' contributions. Once operational (expected 2026 or 2027), the AMF will replace some existing state aid, notably state aid for lost crop areas due to extreme events. As participants in a government-supported mutual risk pool, farmers will need to meet membership conditions (e.g. all contributions paid, proof of loss, etc.) to receive payouts. The scheme's success will depend on implementation capacity and farmer trust, as such funds are new in Bulgaria where there's low propensity to cooperate in risk sharing historically.

The recent years mark a notable shift away from publicly funded, unscheduled disaster aid. Over 2020–2023, Bulgaria spent significant sums on ad hoc compensation for drought and frost damage to crops (for example, paying nearly EUR 900/ha for lost yields in severe cases). This was unpredictable for both government and farmers. With the new CAP tools, the expectation of automatic aid is being phased out: officials signaled that farmers who do not insure or participate in the Mutual Fund may no longer be fully bailed out for foreseeable risks. This policy stance has started to sink in, nudging more farmers toward insurance. The Mutual Fund's advent can reinforce this, once it is functioning.

Against this background, we conducted an actuarial analysis to quantify the risks the Bulgarian agriculture is facing and design an illustrative financial strategy to enhance the country's resilience against them. We focused on a representative portfolio of seven key agricultural products (six crops and cow's milk), which together represent about 88 percent of the total crop area and 80 percent of the production value at producers' prices (PVPP) for crops. The portfolio has a total production reference value of nearly EUR 3.6 billion, representing about 3.8 percent of the national GDP.

Bulgaria's agricultural portfolio has an expected annual loss of approximately EUR 160 million, or 4.4 percent of its total value, due to yield volatility. Some products are riskier than others; for instance, grain maize accounts for 20 percent of the portfolio's value but contributes 38 percent of the expected losses, indicating its high vulnerability. In extreme events, the potential losses are much higher: there is a 1 percent probability (a 1-in-100-year event) that portfolio-level losses could exceed EUR 777 million.

Historical data from 2000 to 2023 shows that yields often deviate from their expected trends, with recent years like 2020, 2022, and 2023 showing significant production losses due to adverse weather. However, not all crops are affected equally by the same events. This imperfect correlation between products creates a "diversification benefit." When one crop fails, others may still perform well, which helps to cushion the overall financial impact on the sector. This diversification significantly reduces the sector's total contingent liability, i.e., the potential financial obligation the government might face in a crisis. For example, in a 1-in-100-year event, the potential loss without diversification would be EUR 1,115 million. With diversification, this is reduced to EUR 777 million, creating a diversification benefit of EUR 338 million. Recognizing this effect allows for more accurate risk assessment and more efficient financial planning.

To manage these contingent liabilities, we developed an illustrative layered financial strategy, combining different financial instruments to cover losses of varying severity. This approach enhances fiscal resilience by ensuring funds are available when needed.

Layer 1. Risk Retention for Frequent Events: The first layer is designed to cover more frequent, less severe losses. It consists of EUR 535 million in pre-arranged capital, intended to handle events that occur as often as once every five years. This layer is composed of two parts:

- (i) An annual budget allocation of EUR 285 million for immediate support to farmers. It is comparable to Bulgaria's existing state aid programs, which averaged around EUR 330 million over the last three years, including insurance subsidies and extraordinary support related to the developments in Ukraine and COVID-19. This means the illustrative budget is well aligned with current government spending levels for agricultural support.
- (ii) A supplementary reserve fund of EUR 250 million is designed to provide additional resources for less frequent but more severe events that exceed the annual budget. Its proceeds can be carried over from year to year and invested in high-quality financial instruments, earning interest and ensuring that funds are available when needed for major shocks. - Together, the two risk retention instruments—the annual budget and the reserve fund—are intended to cover losses with an annual probability of up to 95%. Specifically, the budget allocation targets losses with up to a 20% exceedance probability, while the combined resources of the budget and reserve fund are aimed at covering losses with up to a 5% exceedance probability (roughly a 1-in-20-year event).

Layer 2. Risk Transfer for Severe Events: For less frequent but more severe events (e.g., those expected to occur between once every 20 and once every 100 years), the illustrative strategy includes risk transfer instruments, such as index-based insurance. The total coverage limit for this insurance is EUR 388 million, with an estimated annual technical premium of EUR 17.7 million, which represents about 4.57 percent of the coverage limit. This cost is in line with Bulgaria's current budget for subsidizing agricultural insurance premiums, which allocates EUR 10 million annually and can subsidize up to EUR 14.3 million in eligible premiums at a 70 percent subsidy rate.

A key difference between the national-level insurance in the illustrative strategy and the existing individual farmer insurance programs is the level at which risk is managed. The national-level insurance is designed to protect the government's budget against systemic, widespread agricultural shocks, triggering payouts based on national average yield data and providing rapid liquidity to the government. In contrast, the existing subsidized insurance programs allow individual farmers to insure their specific farm-level production losses, addressing individual risk rather than systemic risk. While both approaches are complementary, the national-level insurance manages fiscal exposure at the sovereign level, whereas farm-level insurance supports individual producers.

To conclude, this illustrative strategy significantly enhances Bulgaria's capacity to manage agricultural shocks by ensuring that financial support can be deployed quickly without resorting to reallocating the national budget during a crisis. However, even with this strategy, a residual risk remains. For catastrophic events that exceed the capacity of the combined financial instruments (events with a 2.84 percent annual probability or rarer), an unfunded "financing gap" would emerge. For example, in a 1-in-100-year event with losses of EUR 777 million, there would still be a financing gap of about EUR 187 million after all instruments are used. This highlights that while the strategy provides substantial protection, it does not eliminate all risk, and the government would still face fiscal pressure in the most extreme scenarios. Finally, the analysis notes the need for further investigation into how this illustrative strategy would interact with Bulgaria's existing agricultural support and insurance subsidy programs to ensure a cohesive and cost-effective national risk management framework.

In summary, while the CAP has steered Bulgarian agriculture toward greater resilience, and risk management instruments are also contributing to this aim, significant gaps remain. The sector continues to suffer from an absence of a comprehensive risk management strategy, limited research on internal and external risks, and insufficient knowledge transfer and best practice sharing. Insurance uptake is hampered by mismatched premiums, low awareness, and a lack of reliable information and data systems. These issues are compounded by a weak insurance culture and limited risk perception among farmers, with ex-post disaster relief prevailing over proactive, market-oriented solutions. Addressing these challenges requires a coordinated effort to improve data provision, build knowledge and capacity, develop effective risk management instruments, and raise awareness among all stakeholders about the necessity of insuring against the full spectrum of agricultural risks.

France

France's agri-food production system is Europe's largest, accounting for about 17 percent of the EU's agricultural gross value added (2022). France has about 360,000 farms (2023), mainly family holdings, managing about 28 million hectares, 15 million cultivated and 13 million of grassland (or 18 percent of EU farmland). Most of these holdings are medium or large: 26 percent generate between 25,000 and 100,000 euros of standard output, while 51 percent generate more than 100,000 euros. A robust agribusiness network – including cooperatives and about 44,000 food-processing firms – adds value to farm produce. The food and beverage industry is France's largest industrial employer, generating over EUR 370 billion in sales (of which about EUR 80 billion export) and underpinning the agri-food sector's central role in the economy.

The sector is highly diverse yet consolidated, with major outputs in grains (wheat, maize, barley), wine, dairy and livestock (cattle, pigs, poultry). France ranks first in the EU for cereal, sugar, beef, and wine production. France typically runs a positive agri-food trade balance, which amounted to EUR 6.5 billion surplus in 2023. High-value exports of wine, spirits, grains, and dairy products consistently outpace imports in these categories. France's wine and spirits alone earned about EUR 13.7 billion in exports.

FIGURE 6 Composition of French agricultural output, using the Economic Accounts for Agriculture

Million euros, producer prices, 2023



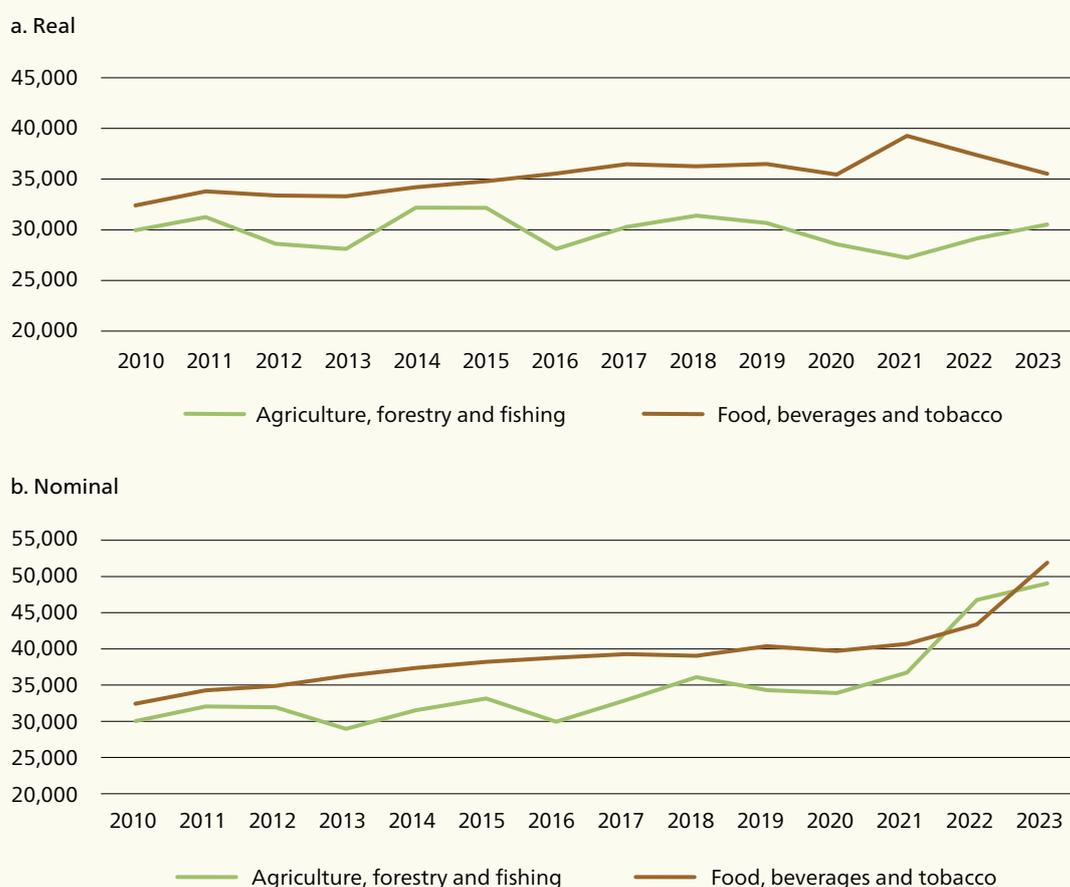
Source: Eurostat.

Since 2010, France's agri-food production value has been expanding. While primary production remained relatively stable in real terms, despite some annual fluctuations, the food industry increased consistently and gained 10 percent between 2010 and 2023, driven by high-value products such as wine and dairy. Several structural changes contributed to these developments. The farming sector has consolidated – the number of holdings fell by nearly 30 percent from 2010 to 2023 as smaller farms exited and the average farm size grew from 54 to 75 ha. Productivity gains have helped sustain output growth with a smaller workforce. Major crop outputs have generally plateaued at high levels: France's cereal harvests remain around 65–70 million tons annually (a quarter of the EU production), and sugar beet production jumped in the late 2010s after the EU sugar quotas ended. The livestock mix has shifted slightly – poultry numbers rose, and dairy farms expanded output after the EU milk quotas were lifted in 2015, even as beef cattle herds contracted modestly. In nominal terms, the global commodity price spikes in 2022–2023 lifted farm revenues and outputs, especially via grain exports.

FIGURE 7 Evolution of real and nominal value added in French primary agricultural production and food processing

NACE classification, Rev.2

Million euros, chain-linked volumes 2010, and current prices, 2010-2023



Source: Eurostat.

However, over the past decade, French agriculture has faced an array of hazards, led by increasingly extreme climate events, which have constrained its output volumes. France has endured major droughts (notably in 2011, 2015, 2019, 2022, and 2023) as well as episodes of excessive rainfall (e.g. spring floods in 2016 and 2024), devastating frosts (especially the April 2021 freeze that ravaged fruit and wine grape yields), and summer hailstorms/thunderstorms. These extremes have repeatedly depressed output: for example, the 2016 rains led to France's worst wheat harvest in 30 years, and the 2021 late frost decimated stone fruit and grape production (prompting a nationwide disaster declaration). Table 9 shows the footprint that the four main types of climate risks have had on the payouts insurers made to the farming sector over 2016-2022, noting that the range of commodities to be insured changed over the years.

TABLE 9 Distribution of insurance payouts for the four main climate risks in France, 2016-2022

Type of climate risk	Loss (by hazard)	Loss (cumulative)
Drought	30.1	30
Frost	22.4	53
Hail	22.2	75
Excess water	16.9	92

Source: calculations based on statistics provided by agricultural insurance industry

Economic and biosecurity hazards have likewise buffeted French farming in recent years. Global market volatility – swings in commodity supply, demand, and trade – has introduced major income uncertainty. The early 2010s saw price spikes (e.g. cereals in 2011–12) followed by a slump: the end of EU milk quotas in 2015 and Russia’s ban on EU food imports in 2014 led to overproduction of pork and dairy, causing a collapse in farm-gate prices by 2015–2016. French pork producers lost a key export market (Russia), and milk prices fell below production cost, sparking farmer protests and EU emergency aid. Although markets later rebounded (record-high grain prices in 2022, etc.), input cost surges – especially related to the situation in Ukraine – created new stress as fertilizer and energy prices hit record levels, squeezing margins. Meanwhile, periodic sanitary and phytosanitary crises have struck the sector. France’s poultry industry was hit by the worst-ever avian influenza outbreaks in 2015 and again in 2021–22. Crop health threats have also emerged: notably in 2020 a widespread virus yellows outbreak (exacerbated by the EU ban on neonicotinoid insecticides) ravaged the sugar beet crop – yields plummeted by an estimated 30 percent (70 percent in some areas), jeopardizing France’s sugar output. These hazards have not only caused immediate production losses but also highlighted structural vulnerabilities. Farm incomes have become more volatile year-to-year, prompting calls for stronger safety nets.

Overall, the last two decades underscore that French agriculture faces a dual challenge: coping with increasingly erratic climate conditions and navigating global market and disease-related shocks – all of which have tested the sector’s resilience and driven an evolution in risk mitigation strategies.

France has a strong tradition in agricultural risk management and has tapped into the newer EU risk management tools extensively. As such, it has long addressed agricultural income risk through instruments tailored to the nature (market, climate, sanitary), intensity (normal to catastrophic), and structure (idiosyncratic to systemic) of risk. Looking at the nature of the risks:

- **Market Risk.** Has historically been managed through public intervention, but, following the 1992 McSharry CAP reform, France relaunched futures market activity (rapeseed, soft wheat, corn) via the Paris Commodity Exchange (MATIF). A study (Begue Turon, 2016) for the Ministry of Agriculture and Food Sovereignty (MASA) found that it took two decades for field crop and feed companies to effectively use futures and Over the Counter (OTC) derivatives (options, structured forwards).
- **Climate Risk.** Primarily concerns drought, frost, hail, and excess water (Table 9). Coverage has been provided for over a century via traditional insurance, supplemented since 1984 by the National Guarantee Fund for Agricultural Calamities, a disaster fund which, in 2010, became the National Fund for Agricultural Risk Management. In 2005, France introduced the Multi-Climate Risk (MCR) policy, subsidized to cover 13 climate risks. MCR insurance has grown with France’s choice of activating, in 2015, EAFRD funding under Article 37 of the EU Regulation No. 1305/2013. Several forms of public-private partnership have been adopted to expand its use while controlling public spending but were completely reorganized in 2023 under the 2022 Insurance Reform Act No. 2022-298 (see below). Hail-storm policies remain unsubsidized. Both policies cover about 4.5 million hectares each, or some 60 percent of total agricultural land. It should be noted that agricultural insurance subsidies are not currently available in the French outermost regions for numerous technical reasons. The Fonds de Secours pour l’Outre-Mer (FSOM) is still active, but specific provisions for these regions are being taken to allow the development of subsidized crop insurance.
- **Sanitary Risk.** Historically addressed via mutual funds. In particular, the Sanitary and Environmental Mutual Fund (FMSE), created in July 2012 by farmer unions, obtained approval from the Ministry a year later to be managed and financed according to the rules of Article 70 of Regulation (EU) No. 73/2009. The FMSE is mandatory for all animal and plant health issues. Therefore, almost all French farmers are covered⁴, which is a benefit that was explicitly recognized in past program evaluations. Its main implementation challenge, however, was the compulsory 30 percent threshold for losses, which is too high to effectively contain contagious diseases or many adverse sanitary events that require prompt and extensive action. This led to growing disengagement from EAFRD funding and increased reliance on national funding. Adding to this the double administrative burden requiring applications

⁴ The FMSE has jurisdiction over the entire metropolitan territory, and if the Board of Directors so decides, over the whole territory, including Guadeloupe, Guyana, Martinique, Réunion, Mayotte and Saint-Martin. To date, the FMSE does not actually operate in these outermost regions, as some specific characteristics prohibits still their integration into the FMSE. Discussions are underway to overcome these difficulties.

to be prepared both for EAFRD financing and for guarantees under the National Guarantee Fund for Agricultural Calamities, France eventually decided to remove the mutual fund from the CAP supported framework in June 2025.

France had limited results when trying to use the EU risk management toolkit to deal with revenue risks. While French insurers have successfully innovated in index-based grassland insurance, following the introduction of insurance subsidies under the CAP framework in 2015, they have failed in revenue insurance projects (2008-2010) for main crops, despite demand. The key reason was the interpretation of Article 70 of EU Regulation 73/2009 regarding whether an insurance contract on revenue may or may not be subsidized. The corresponding Article 37 of EU Regulation 1305/2013 confirmed this constraint. Later Article 76 of EU Regulation 2021/2115 may have relaxed the constraint by stating that Member States may grant support for different types of risk management tools, including income stabilization tools for insurance schemes and mutual funds. But the article still maintains ambiguity on revenue insurance, and even on income insurance, and needs to be clarified before any further investment from insurers.

It experienced a similar outcome, though for different reasons, with the Income Stabilization Tool. The sugar sector, led by the Confederation of Sugar Beet Growers, initiated the creation of an IST in 2018, following the 2017 Omnibus Regulation. The project focused on designing an income index per hectare of sugar beet, considering the volatility of sugar and ethanol prices on futures markets, establishing a standard level of direct aid per hectare, and determining real-time production costs. Despite being registered in the French National Strategic Plan 2023-2027 with a proposed budget of EUR 1.5 million, the project failed to materialize, due to difficulties in delegating responsibility for implementation to the regions and in coordinating regional funding and implementation stages planned by the sugar sector. This highlights the complexity of introducing new risk management instruments and the challenges posed by diverse actors and funding sources.

Overall, the tools utilized to respond to agricultural risks in France evolved over time. In addition to ex-ante transfer instruments and ex-post disaster payments (Table 10) Table 11, France has also extensively relied on various soft ex-post measures. Since 1932, France has used special interest-subsidized loans, tax reductions (e.g., such as on land taxes), and relief on social security payment obligations to support farmers after severe losses. Finally, farmers can benefit from tax-free precautionary savings (or DEP, for *Déduction pour Epargne de Précaution*), to increase the level of equity in the farm financial structure. The relative shares of each type of intervention have changed over the last decade, reflecting an evolution in both risk and policy landscapes. Climate risk insurance has increased steadily over this period, but the level of ex-post compensation, both disaster payments and accompanying soft measures, dropped precipitously in 2022, after a previous steady increase.

TABLE 10 State aid programs relevant for agricultural risk management in France

Million euros, 2014-2024

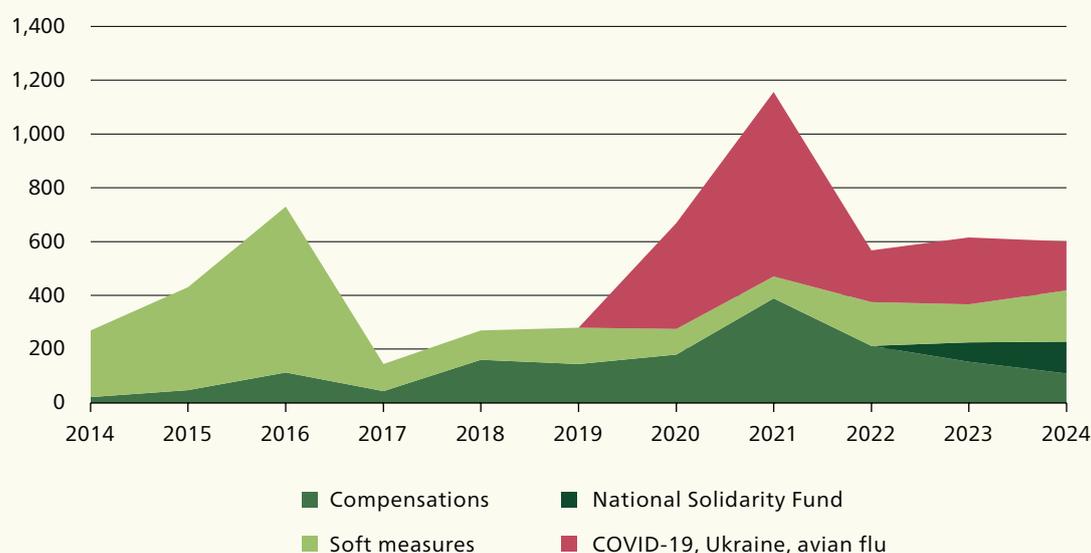
Type of program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Compensations	21.7	47.6	113.5	44.3	160.7	144.8	180.0	389.0	212.0	153.0	110.0
National Solidarity Fund										72	118
COVID-19*											
Ukraine							393.6	685.6	192.5	248.3	182.7
"Soft measures" *	248.3	382.4	616.5	100.7	109.3	135.2	95.0	81.0	163.0	142.0	190.0
Total	270.0	430.0	730.0	145.0	270.0	280.0	668.6	1,155.6	567.5	615.3	600.7

Source: MASA, France;

Note: * World Bank estimates.

FIGURE 8 Evolution of financial support for the main types of risk instruments used in France

Million euros, current prices, 2014-2024



Source: Calculation based on reports from the Commission of National Agricultural Accounts.

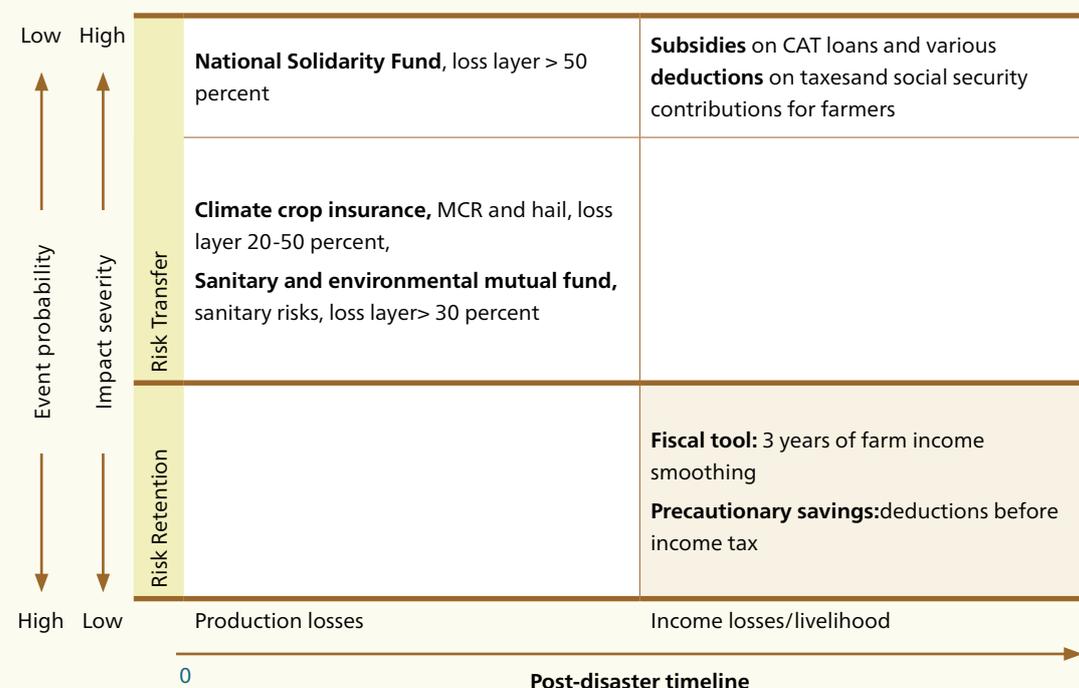
The French agricultural risk management system came to a turning point in 2022. In response to growing risks and new challenges in recent years, France's public and private risk management systems have been strained, as the national agricultural disaster fund and crop insurers have shouldered mounting indemnities. The loss ratios of the MCR contracts exceeded 100 percent over 2005-2020 (88 on period 2005-14 and 118 on period 2015-24), leading to increasing financial losses for insurers (Fédération Française des Sociétés d'Assurance). Farmer uptake has stagnated despite several reorganizations of public support for subsidizing MCR insurance premiums, including differentiated subsidy rates upon the level of capital insured. The increase in insurance premiums, net of subsidies, is limited by adverse selection. Agro-climatic models in France predict a sharp increase in agricultural losses in the future climate without adapting the production system (Caisse Centrale de Réassurance, CCR). Against this background, a reform of the climate insurance system was both urgent and necessary.

A sweeping reform of the agricultural management system took place in 2022. France passed the Insurance Reform Act No. 2022-298 in March 2022. Its objective was to improve farmers' climate risk coverage by increasing insurance uptake across all sectors, particularly in the fruit and fodder production sectors. The law also allocates the rights and responsibilities of the stakeholders: farmers, insurers, and public authorities. Importantly, it also defines three risk layers:

- **Layer 1 – Normal Risks** (0–20 percent loss): Managed by farm reserves, which can be boosted during favorable years owing to the tax-fere precautionary savings. DEP reserves were estimated at EUR 1.5 billion in 2024 by Credit Agricole. In addition, farmers can benefit from investment aid for crop protection equipment to improve the resilience of their farms through the CAP.
- **Layer 2 – Serious Risks** (20–50 percent loss): Covered by MCR insurance. As mandated through an agreement with MASA, insurers must offer fair premiums to all farmers. Following the reform, the government increased the subsidy rate from 62 percent to 70 percent.
- **Layer 3 – Exceptional Risks** (50–100 percent loss): Covered by public intervention via a newly established *Indemnité de Solidarité Nationale* (ISN), sometimes called National Solidarity Fund (NSF), as a part of the *Fonds National de Gestion des Risques Agricoles* (FNGRA). The 50 percent loss threshold applies to main crops, industrial crops, and viticulture, but there is a lower, 30 percent, threshold for arboriculture, fodder production, and certain specialty crops to reduce the pure risk premium and stimulate uptake. Insured farmers, holding MCR policies, receive 100 percent compensation for the losses

above the threshold (90 percent public, 10 percent private, from insurers). However, uninsured farmers receive only partial and declining compensations: 45 percent in 2023, 40 percent in 2024, and 35 percent in 2025. This creates an incentive to insure. With the ISN/NSF established, the role of the National Fund for Agricultural Risk Management shifted from covering exceptional losses of uninsurable crops to covering only losses from damage to on-farm property during an exceptional climatic event (e.g., flooding).

FIGURE 9 Structure of France's risk management system after the 2022 reform



Source: Based on various MASA documents; Notes: ISN/NSF covers extreme production losses and is managed, as a part of FNGRA, by the Central Reinsurance Fund; it is currently financed with a maximum of 120 million euros from an overhead premium on farmers' indemnity insurance contracts and the rest as required by the national budget; FNGRA covers extreme production losses on fixed assets for any catastrophic event and is managed by the Central Reinsurance Fund; it is financed from overhead premium on farmers' indemnity insurance contracts.

The 2022 reform produced immediate effects. First, it led to a significant increase in farm insurance uptake in France, especially in fruit trees and fodder production, with higher coverage rates and insured capital for both elements that can be subsidized or not (deductible buyback, average yield buyback, quality losses, etc.). The MCR coverage rate now includes 5.4 million hectares out of a total cultivated area of 15.2 million hectares, with notable increases in insured hectare rates for fruit trees and grassland between 2022 and 2023. Second, subsidies rose by 143 percent, from EUR 195 million (2022) to EUR 344 million (2023), due to higher coverage rates, increased premium rates, and a lower compensation trigger threshold (20 percent instead of 25 percent).

TABLE 11 Premium volumes and rates in France, 2022 and 2023

Million EUR and percent

	MCR uptake	Hail uptake	Insured capital (MCR)	Insured capital (MCR), eligible for subsidy	Full premium rate	Subsidized premium rate
2022	31.2%	25.2%	9,028	8,749	5.0%	3.9%
2023	35.2%	29.2%	11,384	10,708	5.5%	4.6%

Sources: Fédération Française des Assureurs and CODAR (Commission chargée de l'orientation et du développement des assurances garantissant les dommages causés aux récoltes)

Premium rates increased on average for main crops and viticulture, but with decreasing rates for arboriculture and grassland, where catastrophic risks are now covered by the NSF (Table 12), (Kapsambélis D., 2023). The rate increase is due to the rising risk faced by insurers for main crops and wine, specifically for the loss layer of 20-50 percent. However, insurers only cover the 20-30 percent loss layer for arboriculture and grassland, with the FSN compensating for frequent high losses. Consequently, risk premiums for these productions are lower than before the reform. This is important because it raises the question about how insurers will maintain affordable premium rates amidst climate changes, which necessitates stabilizing the pure premium and reducing the loading factor. It also highlights the challenge that FSN is facing about managing to compensate for high losses incurred by the fruit and grassland sectors. The response to these issues may involve considering traditional or innovative reinsurance methods (such as catastrophe bonds) at the national or European level.

TABLE 12 Premiums per key crops, before and after the reform, EUR/hectare, 2022-2023

Year	Main crops	Wine	Fruit trees	Grassland
2022	69	495	1,294	35
2023	84	582	1,119	28
2024	86	576	1,077	28

Source: statistics provided by CODAR

A co-reinsurance pool, one element of the reform, still needs to be set up. The 2022 law provides for the establishment of a co-reinsurance pool, rather than a co-insurance pool. The statutes and regulations of this pool, called “France Agriculimat”, have been validated in September 2025 by the French Competition Authority. The ambition of the France Agriculimat group is crucial for the future of the national insurance system. The group aims to reduce the pure risk premium through increased pooling of climate risk by sharing insurers’ data on claims experience, increase the competitiveness of the insurance sector by reducing barriers to entry (such as the cost of information), and improve the insurability of all agricultural operations and crops, including smaller ones. Additionally, the group aims to reduce loading rates through initial internal reinsurance within the group and by delegating the negotiation of residual risk to traditional or alternative private reinsurance (such as cat bonds).

The financial outcome of the insurance reform will be validated by future experience. Over the two years, 2023 and 2024, insurers’ surplus to premium (S/P) ratio improved, and the NSF was only lightly used. But the agroclimatic study of the French Central Reinsurance Fund (Kapsambelis 2023) shows two potential challenges linked to climate change: (1) an increase in the frequency of losses in the 20 to 50 percent layer for main crops with a risk of deterioration of the insurers’ S/P and (2) an increase in the frequency of losses in the 50 to 100 percent layer for grasslands (drought) and fruit trees (frost, hail) with a risk of high compensation by the NSF.

Against this background, we conducted an actuarial analysis to quantify the risks the French agriculture is facing and design an illustrative financial strategy to enhance the country’s resilience against them. We conducted an in-depth analysis on a portfolio of twenty-six key crops and cow milk, which together account for almost 90 percent of the total area and production value of vegetable products. This portfolio represents a total production value of nearly EUR 69 billion. The analysis reveals that the sector faces an expected loss of approximately EUR 2.2 billion annually, which is 3.21% of the portfolio’s total value.

To understand the scale of potential financial shocks, we quantified the country’s contingent liability, which is the financial obligation the government might face following a severe agricultural disaster. The findings show that there is a 1 percent chance in any given year (a 1-in-100-year event) that losses could exceed EUR 7.3 billion. This highlights the substantial fiscal risk posed by agricultural production volatility.

The various agricultural products in the portfolio do not all react to shocks in the same way; a bad year for wheat might not be a bad year for grapes. This imperfect correlation creates a natural buffer, significantly reducing the overall risk. If this diversification effect were ignored, the estimated loss for a 1-in-100-year event would more than double to reach EUR 15.6 billion. Recognizing this effect, which provides a diversification benefit of EUR 8.3 billion for such an event, is crucial for designing efficient and cost-effective financial protection strategies.

To manage the financial impact of these potential losses, we developed an illustrative financial strategy to demonstrate how France could proactively manage these contingent liabilities. The illustrative risk financing strategy combines government-held resources (risk retention) and market-based instruments (risk transfer) to create a more efficient and sustainable system.

Layer 1: Risk Retention. The first layer of this strategy involves risk retention, where the government self-insures for frequent, less severe events. This layer is designed to provide immediate liquidity for predictable losses without relying on external markets. It consists of two parts: (a) an annual budget allocation of EUR 3.45 billion, designed to cover more common losses; and (b) a supplementary reserve fund of EUR 1.9 billion. The purpose of this fund is to accumulate resources over time, which can be invested and carried over from one year to the next, to be mobilized for more significant events that exhaust the annual budget. Together, these pre-arranged funds, totaling EUR 5.35 billion, would be sufficient to cover losses for events up to a 1-in-20-year severity. This can be compared to existing mechanisms, such as the average expenditure on state aid programs for ARM between 2014-2019, which was around EUR 350 million annually, and exceptional subsidies that peaked at nearly EUR 1.2 billion in 2021. As an important caveat, the numbers presented under the Risk Retention layer assume coverage of the totality of losses and do not exclude deductibles. Another aspect that may be overestimating the losses is the price reference used in the base calculation as well as the fact that the losses are calculated on a -representative-sample of production. Separately, the calculations are made on national basis, resulting in and potential underestimation of losses. By design, they therefore may reflect higher estimates than what would normally be due under the current policy framework.

Layer 2: Risk Transfer for Extreme Events. For more extreme and infrequent catastrophic events that would overwhelm the retention layer, the strategy incorporates a risk transfer mechanism. This layer's purpose is to transfer the highest, most severe layers of risk to entities better equipped to handle them, such as global reinsurers, protecting public finances from the strain of a major disaster. This layer involves purchasing a macro-level insurance policy from the private market. This illustrative policy would be triggered by severe, nation-wide yield losses and would provide payouts directly to the government. The estimated annual technical premium for such a policy would be around EUR 256 million.

It is important to distinguish this national-level insurance from the existing subsidized insurance programs available to individual farmers. The two are complementary: farm-level insurance helps farmers manage their individual losses, while the national instrument protects the government's budget from systemic, large-scale shocks.

Even with this comprehensive strategy, a residual risk remains. For a 1-in-100-year loss event, the combined financial instruments would not cover all the EUR 7.3 billion in losses. The analysis shows there would still be a financing gap of approximately EUR 901 million. This residual risk would require emergency budget reallocations or other ex-post financing measures, highlighting the immense financial pressure that catastrophic events can place on public finances even with a robust strategy in place.

The analysis underscores the importance of a proactive and structured financial strategy to enhance the resilience of France's agricultural sector. By combining risk retention and risk transfer mechanisms in a layered approach, the government can more effectively manage its fiscal exposure to agricultural shocks, ensure timely support for the sector, and protect its budget from the volatility of extreme events. This illustrative strategy provides a clear framework for moving from reactive crisis management to a more sustainable and predictable system of disaster risk financing.

To conclude, France has a well-structured agricultural risk management system. The public-private partnership is clearly organized according to loss levels related to adverse climatic events. Contagious disease risks are managed through prevention, including vaccination for livestock, and containment measures as soon as losses are detected. Interfaces between insurers, mutual funds, and public authorities are well established and are functioning effectively.

However, France's risk management system needs to continuously adapt in face of societal demands for human, plant, animal, and soil health, as well as climate change. Mounting losses, linked to annual climatic events but also to recurrent events, need to be financed. Three consecutive years of drought have an exponential impact on losses compared to a single year. In addition, new risks linked to the development of agroecology, including the increasing ban on plant protection products, need to be considered. Despite current technical prevention and adaptation efforts, the average cost of losses is expected to

increase, creating a challenge for the agricultural insurance sector. At the same time, the cost of extreme losses is also expected to increase, creating a challenge for the National Solidarity Fund and other ex-post compensation programs.

Innovation is essential for meeting these challenges. Innovation by insurance companies is needed to design more efficient products and to reduce management costs. The co-reinsurance pool currently being created is already a relevant element of innovation. Innovation in mutual funds or insurance companies is also needed, to factor in revenue and income losses per production unit. Finally, innovation in financing compensation for exceptional situations is also required. The *Caisse Centrale de Réassurance* could be a leading organization in this area.

Italy

Italy's agri-food production system is the third largest in Europe and relies on relatively small family farms. The sector is contributing roughly 13 percent of the EU's agricultural output, second only to France and Germany. It is characterized by a high number of small family farms that have been consolidating. Nearly 45 percent of the Italian agricultural holdings fell in the 2,000-to-15,000-euro standard output range in 2020, while only 9 percent exceeded 100,000 euros. There were 1.13 million active farms in 2020 (down 30 percent since 2010) working 12.5 million hectares of utilized agricultural area. The average farm size has grown to 11.1 ha (from 7.9 ha in 2010) as many tiny holdings have merged or exited.

It also features significant diversity and increasing diversification. While small holdings still dominate, there is a notable increase in larger commercial operations (farms over 100 ha now account for almost 1.6 percent of holdings). This means that highly intensive, mechanized farms in the fertile Po Valley of the north coexist with small traditional holdings in the south and islands. A growing share of farms (about 18 percent) also engages in diversified activities like agritourism or on-farm renewable energy, reflecting innovation in the sector.

FIGURE 10 Composition of Italian agricultural output, using the Economic Accounts for Agriculture

Million euros, producer prices, 2023



Source: Eurostat

Overall, the primary production base remains diverse, while high-value commodities dominate the output structure. In 2023, nearly two thirds of the output value at producer prices came from five subsectors: vegetables, wine, dairy, fruits and cereals. About two-thirds of the Italian farms cultivate arable crops (grains, industrial crops), and over 70 percent have perennial crops (notably olive groves and vineyards). Major crops include durum wheat (for pasta), corn, and other cereals in the north, tomatoes and vegetables (Italy is a top EU producer of fresh and processed tomatoes), fruit and citrus (especially in the south), and prized Mediterranean specialty crops like wine grapes and olives. Italy is also the world's largest wine producer (with about 50 million hectoliters/year) and a leading olive oil and tree fruit producer. The livestock sector, while smaller in scale than crop production, is substantial: over 214,000 farms raise livestock, with cattle (beef and dairy) present on 44 percent of those, followed by poultry (27 percent), sheep (26 percent), and pigs (18 percent). Italy's dairy industry is significant (notably in Lombardy and Emilia-Romagna, fueling Italy's cheese production), and it has specialized pork production for processed meats (e.g., Parma ham). Still, animal output represents around 35 percent of Italy's agricultural value – lower than in some northern EU countries – reflecting Italy's emphasis on high-value crops.

Italy has a well-developed food processing and agribusiness sector that adds value to farm outputs, making food and beverage the country's largest manufacturing industry after metallurgy. Thousands of SME food companies (pasta producers, wineries, cheesemakers, etc.) and cooperative enterprises connect Italy's farms to global markets. Italy now exports a wide array of high-value foods: wine (about EUR 7.8 billion in 2023), cheeses and cured meats, premium pasta and baked goods, olive oil, and fresh and processed fruits and vegetables. The agri-food supply chain's GDP contribution has been growing in recent years, buoyed by strong export demand for Italian products. In 2023, agri-food exports hit a record EUR 63.1 billion (up 6.6 percent year-on-year), nearly matching imports of EUR 64.7 billion. This marks a dramatic improvement in the trade balance – and, with exports growing faster than imports, Italy's agri-food trade is projected to tip into surplus in the coming years.

While food and beverages have been on a strong upward trend since 2010, except for a dip during the pandemic, primary production has seen modest downward adjustment in real terms. This is due to a confluence of factors. The rapid consolidation of the farming sector improved efficiency on some larger farms but also reduced aggregate output, as land and marginal producers left the sector. Moreover, Italy's output mix has shifted toward higher-value but lower-volume products: for example, vineyards and orchards have higher unit value but do not bulk up volume indices like field crops do. Regional disparities accentuate the trend. The fertile, irrigated Po Valley in the north continues high production (grains, dairy, industrial tomatoes), but agriculture in the south has struggled, due to poor profitability under drier conditions. Farm incomes also mirror this geographic polarization: competitive export-oriented farms (e.g., in wine and cheese sectors) thrive, while smaller rain-fed farms in the south face tighter margins and weather-related risks.

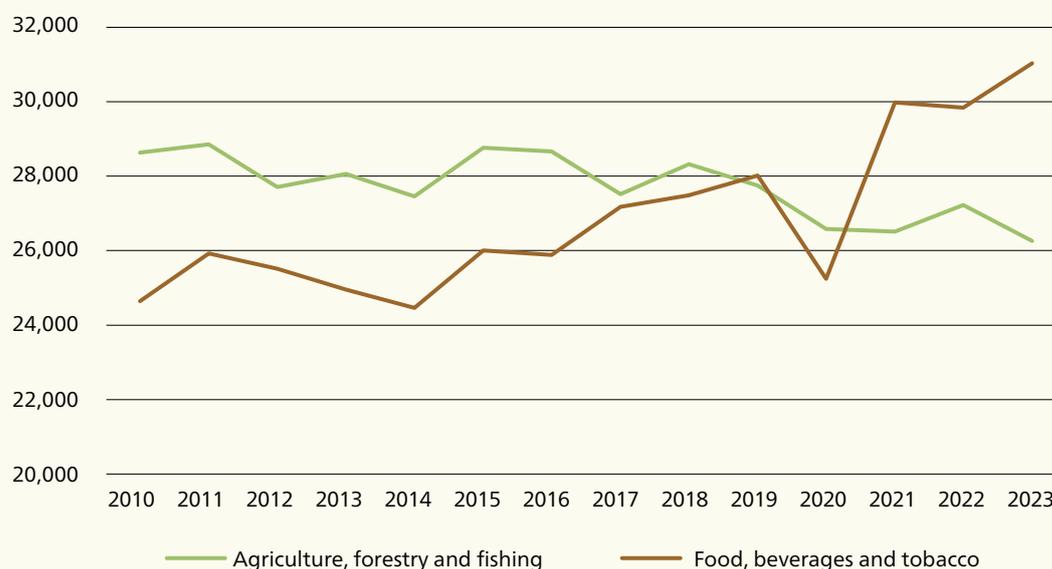
In the recent decades, Italian agriculture has been repeatedly struck by extreme climate events. Prolonged droughts stand out: a once-in-50-year drought in 2017 led to Italy's agricultural output volume plunging by 4.4 percent (wine production collapsed –14 percent, fruit – 6 percent), and a historic 2022 drought in the Po Valley triggered emergency measures as crop losses mounted (farmers suffered an estimated EUR 3 billion in drought-related losses by mid-2022). Several of Italy's top farming regions (e.g. Emilia-Romagna, Piedmont, Sicily) experienced their driest conditions in decades, with water shortages hurting staples from corn and rice to olives and tomatoes. Conversely, episodes of excess rainfall have caused devastating floods. In May 2023, extreme rains in Emilia-Romagna swamped rural areas, and thousands of hectares of orchards, vineyards, and grain fields were left underwater. These floods destroyed farm infrastructure and will take years for local agriculture to fully recover. Italian farms also endure frequent violent hailstorms and windstorms, especially in the north; such events can shred standing crops in minutes (e.g., summer 2023 storms ravaged fruit crops and greenhouses across Piedmont and Lombardy). Meanwhile, unseasonal frosts have repeatedly struck in spring. A notably severe frost in April 2021 hit just after early bud-break, freezing virtually 80–100 percent of fruit blossoms in parts of Veneto, as well as damaging Emilia-Romagna's vineyards and even olive groves in the south. This wiped-out entire harvests of apricots, cherries, and kiwis, causing hundreds of millions of euros in losses. Overall, the frequency and intensity of climate hazards are rising: 2023 saw a costly rollercoaster of drought, heatwaves, then floods and storms. These hazards have made production more volatile and forced a greater reliance on crop insurance and emergency relief to buffer farm incomes.

FIGURE 11 Evolution of real and nominal value added in Italian primary agricultural production and food processing, using

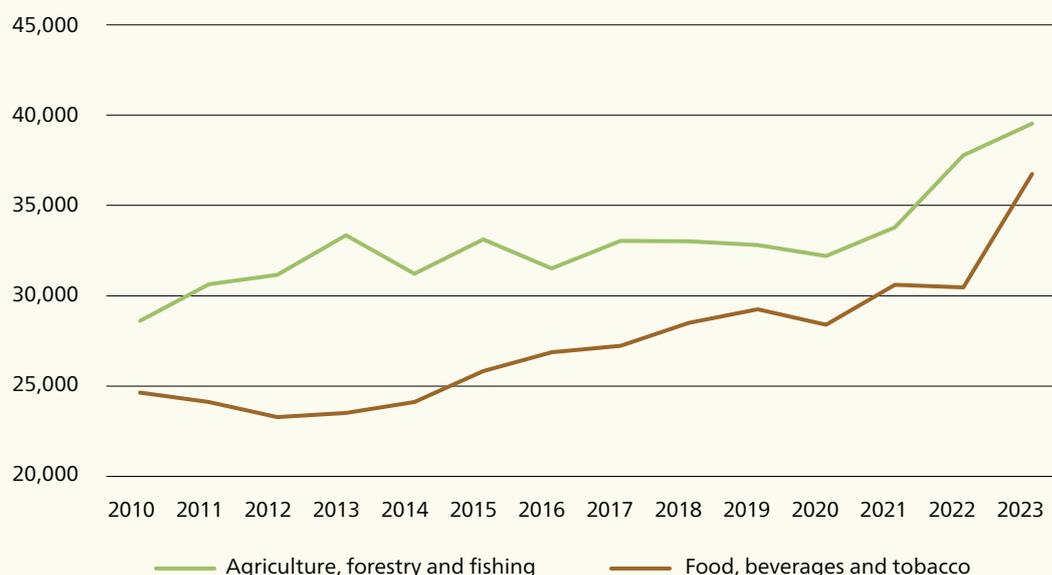
NACE classification, Rev.2

Million euros, chain-linked volumes 2010, and current prices, 2010-2023

a. Real



b. Nominal



Source: Eurostat

Biological hazards have also significantly impacted Italian agriculture. Foremost is the spread of plant pests and diseases. The bacterium *Xylella fastidiosa*, first detected in Apulia in 2013, has caused an unprecedented olive tree epidemic. Over the past decade, *Xylella* has withered more than 21 million olive trees in Puglia—decimating ancient groves and slashing Italy’s olive oil output (Puglia formerly produced 50 percent of Italy’s oil). Entire landscapes in Salento have been transformed by the loss of olive cover, with associated economic damages estimated in billions of euros. In the realm of animal health, Italian farmers have weathered successive livestock disease outbreaks. Highly pathogenic avian influenza (bird flu) has hit the poultry sector multiple times – notably in 2015–2017 and again in 2021–2022 – forcing authorities to cull millions of chickens and turkeys to contain the virus. The 2021–22 H5N1 outbreak was Italy’s worst

on record, with over 13 million birds killed or destroyed (mostly in the densely farmed Veneto-Lombardy area), causing egg and poultry meat output to temporarily plummet. More recently, ASF emerged in mainland Italy in 2022, after being confined to Sardinia for years. First found in wild boars in Piedmont, ASF has since spread into Lombardy and Emilia-Romagna, leading to rigorous quarantines and culls. As of late 2024, Italy has slaughtered nearly 120,000 pigs to curb ASF, including entire herds in the heart of its pork industry. The outbreak threatens the famed Parma ham and other pork products: sector losses are already around EUR 500 million due to herd liquidations and export bans by several countries. Thanks to strict biosecurity and a culling strategy, authorities are working to contain ASF's spread, though it remains a serious long-term risk for Italian hog farmers. In addition, sporadic invasions of crop pests (like the brown marmorated stink bug that ravaged fruit in northern Italy around 2018–2019) and livestock ailments (e.g. periodic Bluetongue virus in sheep) have added to the hazard landscape. Each of these events – droughts, floods, frosts, and disease outbreaks – has undercut production in certain years, illustrating the wide range of hazards Italian agriculture faces.

ARM has been a long-standing priority for the Italian agricultural community. A key milestone in the development of the public-private-partnership (PPP) approach for ARM has been the establishment of the National Solidarity Fund (Fondo di Solidarietà Nazionale) in 1970. The objective of the National Solidarity Fund was to deal with the impact of natural calamities in agriculture through an institutionally structured approach. The Fund activities were divided into ex-post compensatory interventions and ex-ante interventions, the latter consisting of subsidies to insurance premiums - mainly for hail covers - and the so-called “active defence” (hail nets, anti-freeze fans, etc.) (Grossi, 2004).

Negotiations for establishing costs and conditions of subsidised insurance policies were initially carried out bilaterally by farmers’ aggregation entities, known as Consorzi di difesa, and aggregations of insurance companies. This negotiation approach terminated in the mid-1990s with both the liberalization of farmers’ demand and the dismantling of the two insurance aggregations – CIRAS (Consorzio Italiano Rischi Agricoli Speciali) and CIAG (Consorzio Italiano Assicuratori Grandine) – which coordinated insurance intervention in agriculture. The Italian Competition Authority (Autorità Garante della Concorrenza e del Mercato – AGCM) considered these entities to conflict with market competition rules and, therefore, the coinsurance model adopted by the two consortia – which had inspired the Spanish insurance industry to develop the coinsurance pool led by Agroseguro – was no longer applicable in Italy.

A key step in the evolution of the Italian ARM system has been the Legislative Decree 102 of 2004, which introduced a significant reform aimed at improving the effectiveness of intervention. In particular, the reform radically shifted support from ex-post compensations – which were considered insufficient, subjective, and untimely – to ex-ante measures, particularly insurance. A key feature of the 2004 reform was to establish that insurable agricultural production activities would no longer be eligible for compensatory interventions. The 2004 Decree also mandated the development of annual plans for the definition of insurance support conditions. Over time, the annual insurance plan evolved into a more comprehensive “Agricultural Risk Management Plan” (*Piano di Gestione dei Rischi Agricoli*), which is issued annually by the Ministry of Agriculture, Food Sovereignty, and Forests and defines the implementation conditions for ARM in Italy.

Given the country’s remarkable geographical diversity, Italian agriculture is exposed to a wide range of production and market risks. Key climatic risks are formally classified according to frequency and severity:

- Catastrophic Risks: flood, drought, frost
- High Frequency Risks: excess snow, excess rain, hail, strong wind
- Ancillary Risks: sunstroke, hot wind and heat wave, temperature variations

Other relevant sources of environmental risks include pests and diseases, wild animals, and wildfires. Fluctuations in costs of production and product prices (market risks) are also key risks for Italian farms.

The Italian ARM system is structured over three levels of interventions (Figure 12). Level 1 covers cat-risks through the AGRICAT national mutual fund; Level 2 focuses on risk-transfer and risk-sharing tools; Level 3 is composed of investments for prevention and mitigation, risk assessments, and risk preparedness; and of ex-post interventions.

State aid resources are mainly used to support insurance policies that are not part of CAP interventions and for residual ex-post compensation measures. Excluding the exceptional interventions related to the COVID-19 and the Ukraine crises, between 2020 and 2024, the average spending for state aid supported measures in ARM has been around EUR 350 million per year (Table 14).

TABLE 13 Planned public expenditure for CAP-supported risk tools

2023 – 2027 programming period, Euro

Description of interventions	Public expenditure	EAFRD share	National share	Expenditure distribution per intervention
SRF.01 - Subsidized insurance	1,486,391,837	665,907,474	820,484,363	51.7%
SRF.02 - Mutual funds for production risks	60,095,910	26,923,127	33,172,783	2.1%
SRF.03 - Mutual funds for income stabilization	60,095,910	26,923,127	33,172,783	2.1%
SRF.04 - National mutual fund for catastrophic events	1,268,083,130	568,104,596	699,978,534	44.1%
Total Allocation for Risk Tools	2,874,666,788	1,287,858,324	1,586,808,463	100.0%

Source: ISMEA, 2024

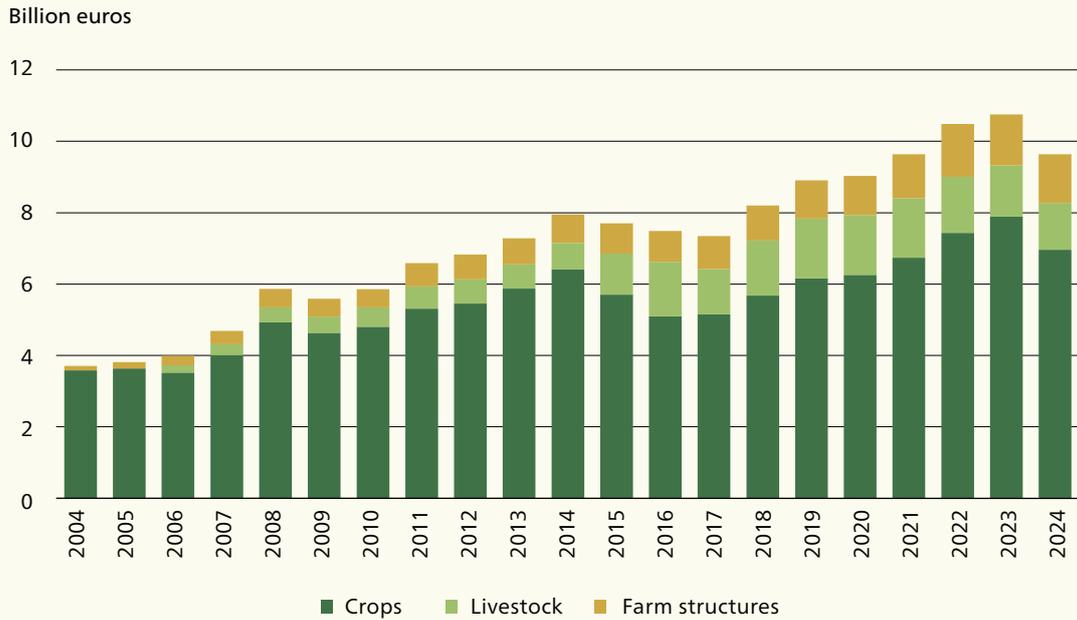
TABLE 14 State aid programs relevant for agricultural risk management in Italy

2014 - 2024, Million Euro

Type of program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Compensations	9.8	35.5	21.5	78.7	236.5	190.6	188.5	160.7	317.3	337.8	319.4
Insurance subsidies for non-CAP measures				0.3	9.1	3.6	4.9	4.1	5.5	6.5	10.3
COVID-19							1769.6	3342.6	2003.3	323.9	340.3
Ukraine									218.7	1205.6	553.0
Other ARM-measures		0.3	0.4	0.1	4.1	1.7	111.2	82.4	36.9	29.2	103.0
Total	9.8	35.8	21.9	79.1	249.6	195.9	2074.1	3589.8	2581.7	1902.9	1326.2

Source: Ministry of Agriculture, Food Sovereignty and Forests of Italy

The main ARM intervention in Italy is insurance. Over the past 20 years, values of insured production in current monetary terms have been on a growing trend, reaching approximately EUR 10 billion. However, a slight reduction has been recorded in 2024 and is also expected in 2025 (data not available yet), indicating potential issues in farmers' uptake. The largest share of insured production is for crops (72 percent), with lower shares for livestock and farm structures (14 percent each). The series of insured values clearly shows the impact of the migration of EU support for ARM from the first to the second pillar in 2014, which was difficult to process and created challenges in adapting ARM processes to the rules of rural development programs.

FIGURE 13 Value insured per subsector

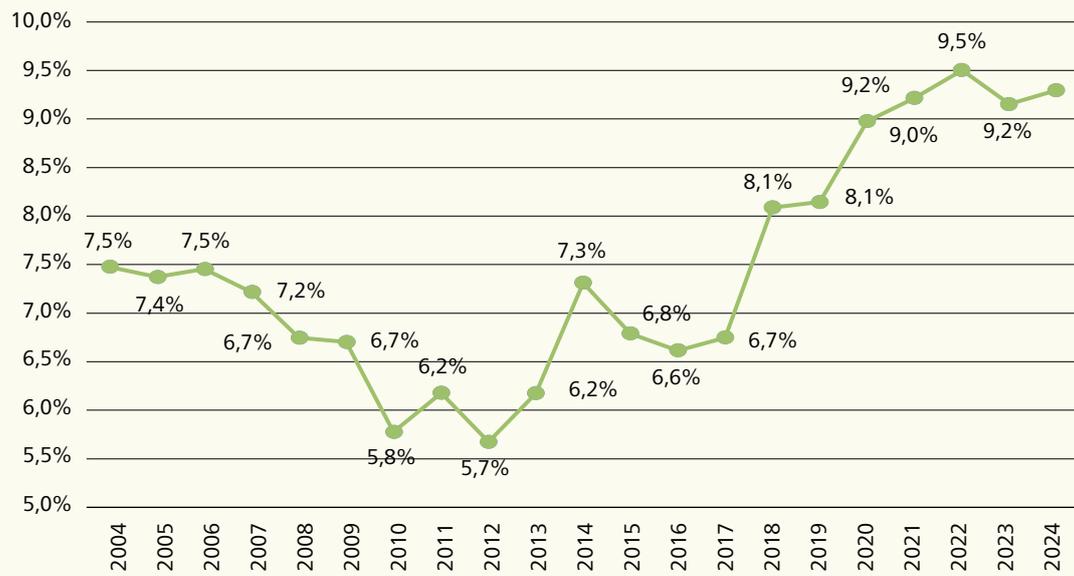
Source: ISMEA

In the insurance domain, premium volumes and premium rates are growing (Figure 14, Figure 15), **while the number of insured farms is decreasing** (Figure 16). In the Italian context, the uptake of insurance covers has a marked regional and sectoral dynamic. Insurance uptake is concentrated in the northern regions, with approximately 80 percent of the national value insured for crops, while central and southern regions lag with 8.5 percent and 12 percent respectively (ISMEA, 2024). Likewise, northern regions have a remarkably higher share of production covered by insurance, with Trentino-Alto Adige leading (67.4 percent of crop production value), followed by Friuli-Venezia Giulia (47.2 percent), and by Lombardia, Veneto, Piemonte, and Emilia-Romagna (over 30 percent) (ISMEA, 2024). These dynamics are explained by the presence of a higher share of fruit and vegetables and of wine grapes that are all more rewarding per unit area but are also more vulnerable.

FIGURE 14 Insurance premium volume for crop policies

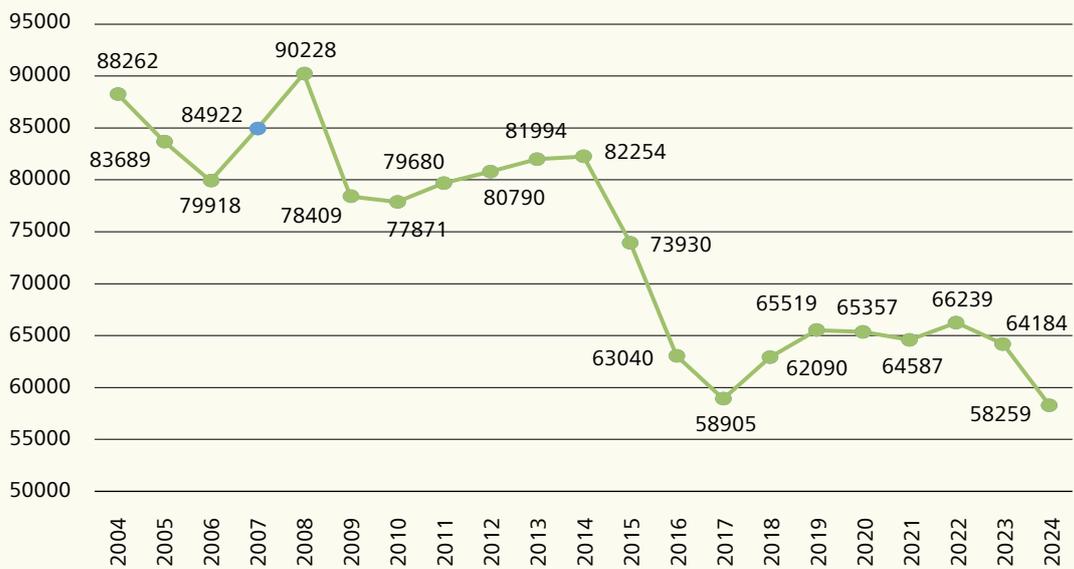
Source: ISMEA

FIGURE 15 Insurance premium rates for crop policies



Source: ISMEA

FIGURE 16 Number of farms with crop policies



Source: ISMEA, 2024

The Italian ARM system has shown significant interest in the mutualistic approach introduced in the CAP in 2014. To date, 14 Mutual Funds have been officially recognized, of which 5 are for production losses and 9 are for income stabilization (Table 16). In 2023, the total number of farmers enrolled in mutual funds reached 3,823 for Income stabilization funds and 15,423 in funds for production risks (CAP SP Report, 2023).

TABLE 15 Mutual Funds for production risks and for income stabilization recognized in Italy

Managing Entity	Fund Name	Typology	Product covered	Year of Recognition
ASNACODI ITALIA	IST settoriale Barbabietole da zucchero Italia	M17.3/SRF03	Sugar Beet	2023
AGRIFONDO MUTUALISTICO LOMBARDO	Agrifondo Mutualistico Lombardo IST Riso	M17.3/SRF03	Rice	2023
	Agrifondo Mutualistico lombardo IST Latte	M17.3/SRF03	Cow milk	2022
CONDIFESA BOLZANO	Fondo mutualistico IST settoriale Latte Bolzano	M17.3/SRF03	Cow milk	2023
	Fondo mutualistico settoriale IST mela della provincia di Bolzano	M17.3/SRF03	Apples	2021
PRO.DIFESA	Fondo Prodifesa	M17.2/SRF02	Crops	2021
Associazione Gestifondo Impresa	Fondo fitopatie	M17.2/SRF02	Crops	2021
	IST latte bovino	M17.3/SRF03	Cow milk	2021
Co.Di.Pr.A. Trento	Fondo fitopatie	M17.2/SRF02	Crops	2021
	IST mele	M17.3/SRF03	Apples	2021
	IST latte	M17.3/SRF03	Cow milk	2021
AGRIFONDO MUTUALISTICO VENETO E FRIULI VENEZIA GIULIA	Fondo fitopatie e infestazioni parassitarie dell'Uva da vino	M17.2/SRF02	Wine grapes	2020
	Fondo fitopatie e infestazioni parassitarie dei seminativi	M17.2/SRF02	Arable crops	2020
	IST Scaligero – Settore ortofrutta	M17.3/SRF03	Fruit and vegetables	2020

Source: Ministry of Agriculture, Food Sovereignty, and Forestry

The mutualistic approach has been welcomed by farmers and farmers' aggregation entities, but its implementation has been challenging. The Italian experience indicates a strong need for simplifying and relaxing EU and national rules that regulate the structure of mutual funds and the use of the funds collected by members and public entities (see the Recommendations section for more details on the issues to be addressed).

Despite the strong tradition in operating agricultural insurance and the relevant amount of public support channelled through the dedicated PPP framework, in Italy penetration of agricultural insurance is far from being universal. In 2023, the share of the value of crop production insured was 19.2 percent and the hectares covered by policies against weather and climate risks reached just over 10 percent of the national UAA (ISMEA, 2024).

The significant gap in protection against agricultural production risks led Italian policy makers to conceive and establish the AGRICAT national mutual fund. The objective of AGRICAT is to extend risk management for catastrophic risks to most Italian farms by targeting the recipients of CAP direct payments. AGRICAT started to operate in 2023, covering risks classified as “catastrophic”: drought, frost, and flood, and its compensations vary according to the productive sector, to farms' location, and to whether crops are insured or not (Box 5).

AGRICAT's financial endowment amounts to approximately EUR 350 million per year (AGRICAT, 2025). Thirty percent of the endowment originates from a 3 percent mandatory levy on all CAP direct payments, based on the provisions of Article 19 of Regulation (EU) 2115 of 2021. The remaining seventy

percent is complemented by EAFRD rural development resources. In 2023, the fund compensated losses for approximately EUR 106 million, of which EUR 50 million originated from an extraordinary additional endowment provided by the Italian Government (Law 100/2023) because of the flooding events that hit the Emilia Romagna and Marche regions. Compensations for 2024 are being processed and are projected to be in the range of EUR 230 million.⁶

BOX 5 AGRICAT compensation modalities

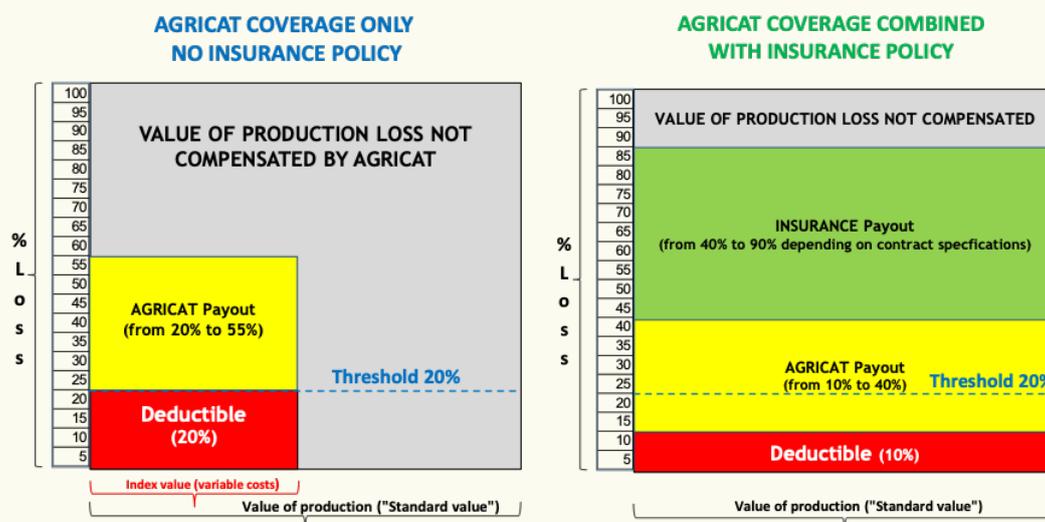
Given the need to act in a diverse agricultural production risk environment and to be integrated in an advanced ARM PPP framework, AGRICAT compensation modalities are necessarily complex.⁷

First, AGRICAT covers risks that in the Italian ARM system are classified as “catastrophic”: drought, frost, and flood. In addition, AGRICAT’s range of compensation varies according to whether the crops are also covered by an insurance policy for catastrophic risks. In particular:

- 1) If the crop is not covered by a complementary insurance policy, the AGRICAT fund compensates losses between 20 percent and 55 percent of the reference production level;
- 2) If the crop is also covered by an insurance policy for catastrophic risks, the fund covers losses between 10 percent and 40 percent of the reference production level, and the complementary insurance policy covers more severe losses above 40 percent and up to 90 percent, depending on the specifications of the insurance contract.

In addition, for case no. 1, compensations are quantified based on a unitary insured value per crop, defined as the “index value”, which is parametrized to match reference variable production costs for the different crops; while for case no. 2, compensations are based on a “standard value”, which is an indicator of the actual value of the crop. In order to comply with EU rules on support to agricultural insurance, compensation can be triggered only if the loss is greater than a threshold set at 20 percent of the reference production level.

The following figures graphically illustrate AGRICAT’s compensation modalities.⁸



Important public interventions in the Italian ARM system have focused on expanding the reinsurance capacity for agricultural risks through the establishment of a public Reinsurance Fund and the development of a Co-reinsurance Consortium. The Fund for reinsurance of agricultural risks was established in 2000 to promote the experimentation and dissemination of new insurance instruments. The fund is financed by the national budget with variable annual amounts (EUR 150 million in 2023). The

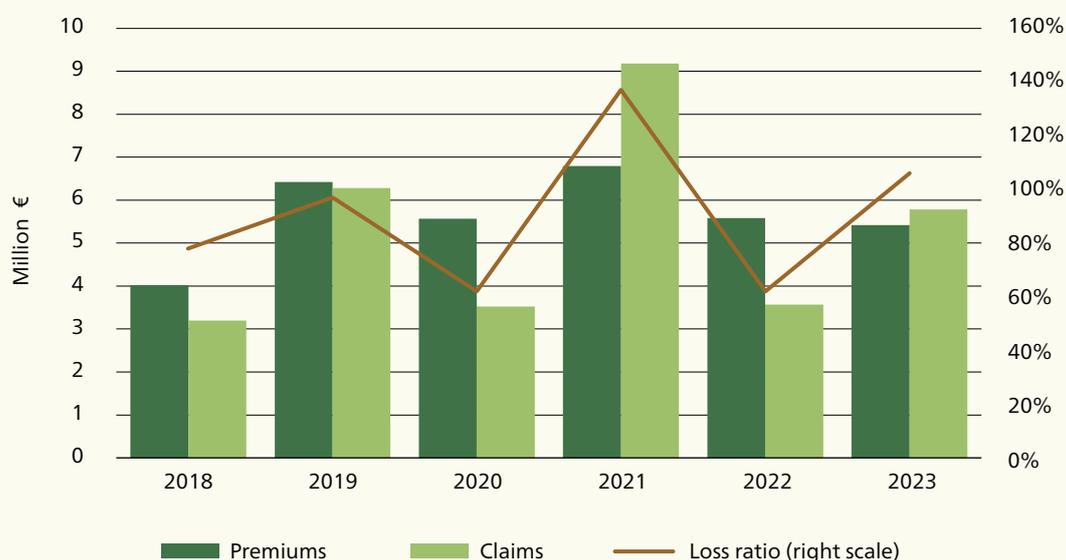
⁶ AGRICAT, September 2025.

⁷ The official definitions of the AGRICAT compensation modalities are provided in Section 5 of the Agricultural Risk Management Plan 2026 (MASAF, 2026).

⁸ Such compensation modalities are in force from 2026 and may change in future versions of the “Agricultural Risk Management Plan” (Piano di Gestione dei Rischi Agricoli) issued by the Ministry of Agriculture, Food Sovereignty, and Forests. In previous crop seasons (2023 to 2025), the ranges and the compensation modalities were different, and varied depending on the type of crop, on whether the farm was registered in the northern or in the southern regions of the country, and on whether the crops were covered by a complementary “smart policy” or not.

Co-reinsurance Consortium is participated by private insurance companies and by the Reinsurance Fund. In 2023, the capacity of the consortium amounted to € 86 million for traditional policies and to EUR 43 million for experimental policies; 50 percent of the capacity for both lines was provided by the public Reinsurance Fund.

FIGURE 17 Reinsurance Fund. Premiums collected, claims paid, and loss ratios



Source: www.ISMEA.it

The complexity and diversity of the risk environment in Italian agriculture in a progressively changing ecosystem call for a constant review and adaptation of ARM approaches. Box 6 summarizes the strengths and weaknesses of the Italian ARM system. The policy makers and the research community in Italy are acutely aware of the need to constantly review and update the system and have been promoting new solutions that have also been extended to other EU Member States (see, for example, the establishment of the AGRICAT national mutual fund financed by a levy on direct payments). An interesting development in the analysis and quantification of agricultural risks is the work that ISMEA is carrying out on the assessment of vulnerability in the agricultural sector through the Catastrophic Events Vulnerability Index (CEVI) (Figure 18), which allows to take an in-depth look at the impact of risk events in agriculture as a basis for ARM policies. The CEVI is a municipality-level index developed based on the integration of the meteo-climatic exposure to catastrophic events (flood, drought, and frost) and of the vulnerability of the crop production environment.

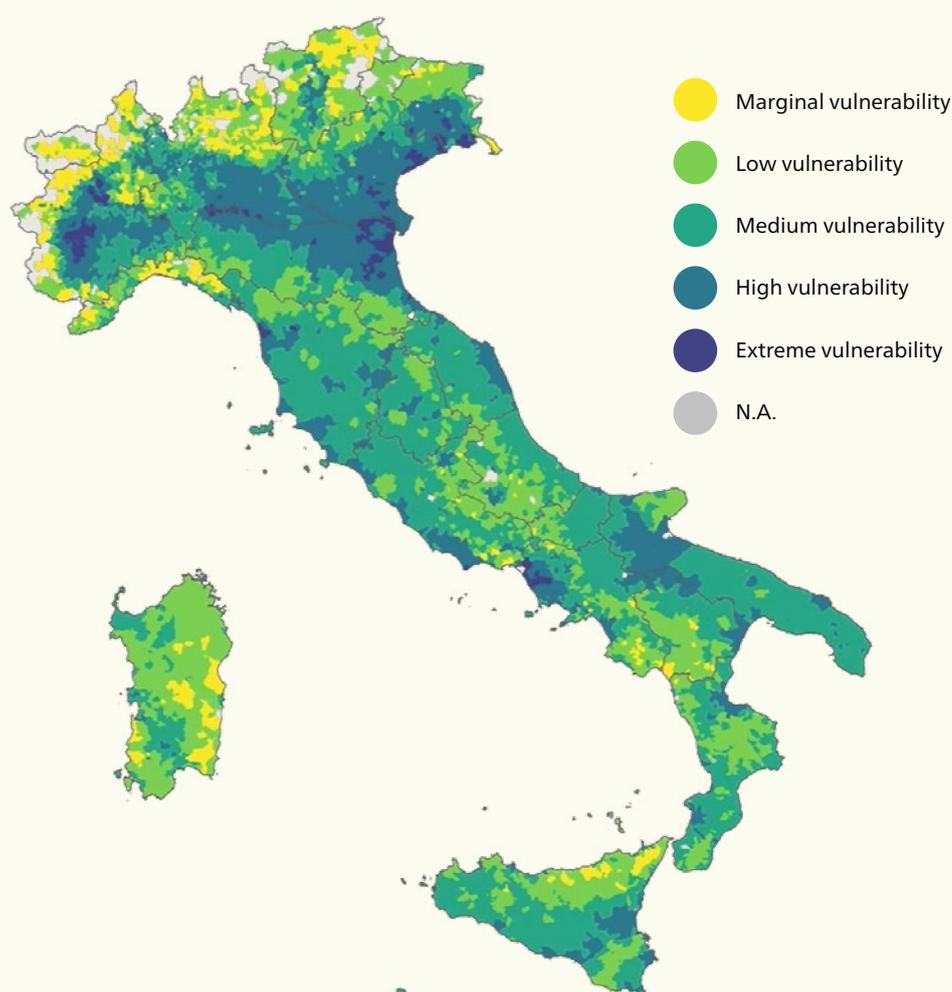
BOX 6 Strengths and weaknesses of the Italian public-private agricultural risk management system

Strengths

1. Long-standing history of agricultural insurance and public support system
2. Wide supply of ARM solutions consistent with farmers' needs in a significant part of the country and/or type of production
3. Structured intermediaries (Consortia) facilitating farmers' access to ARM products
4. Innovative initiatives to manage emerging risks (income, biotic adversity) with mutual funds
5. Policy makers' interest in promoting risk management tools
6. Interaction between stakeholders for the development and evolution of solutions and tools
7. System characterized by advanced skills and knowledge

Weaknesses

1. Low overall share of production value covered by ARM tools (although the establishment of the AGRICAT fund is aimed at addressing this specific issue)
2. Regulatory uncertainty caused by frequent changes introduced in the Annual Risk Management Plans, and by the untimely issuing of such Plans
3. Complexities and barriers in accessing benefits for insurance based on CAP funds (application of the second-pillar model)
4. Insurance products and procedures that are not suitable for low value-added production and/or small businesses (high incidence of management costs compared to risk)
5. Uncertain rules for supporting mutual funds that penalize funds compared to insurance companies
6. Excessive monitoring and/or assessment of the adequacy of support applications
7. Uncertainty in the level of collective and individual contributions, with significant delays in the disbursement of support
8. Demand for support exceeding available resources with uncertain and uneven support levels at the regional level
9. Withdrawal of some insurance covers and/or reduction of product performance due to the growth of extreme/systemic events
10. Greater risk for specialized farms with higher value-added that contribute the most to national production
11. Poor accessibility to risk management tools to produce smaller companies located in marginal areas with social impact of adverse events.

FIGURE 18 Catastrophic Events Vulnerability Index (CEVI)

Source: ISMEA.

To analyze the risk exposure of agricultural production in Italy an actuarial analysis was carried out focusing on a portfolio of twenty-five crops and cow milk for a total value of about 1.5 percent of Italy's national GDP.⁹ The total production value of the portfolio analyzed is approximately EUR 31.4 billion, and it accounts for about half of Italy's total agricultural production value for crops and animals. On average, the sector is expected to lose approximately EUR 960 million annually (3 percent of the portfolio's total value) due to production volatility. However, in case of extreme events, portfolio losses might exceed EUR 2,873 million with a 1 percent probability (1-in-100).

A key element of the analysis is to show the critical role of risk diversification, which significantly reduces potential aggregate losses. Historical data from 2000 to 2023 shows that some years, like 2003 and 2023, were particularly adverse for the entire sector, with most crops experiencing lower-than-average yields. However, since risks are not perfectly correlated, a bad year for one crop may not be a bad year for another, and diversification is a key strength of the Italian agricultural production portfolio. Hence, when different crops are combined, the overall risk is significantly lower than the sum of individual risks. For example, in a 1-in-100-year event, the total potential loss for the portfolio is reduced from EUR 6.7 billion to EUR 2.9 billion, simply by accounting for this diversification effect. This is a quantitative illustration of how a diversified agricultural sector naturally builds resilience.

A layered DRF strategy combining government-held resources (risk retention) and market-based instruments (risk transfer) has been developed. The analysis is summarized below and presented in full detail in Appendix 4, and provides an illustrative example to show how potential DRF approaches can help manage the economic impact of widespread agricultural losses. It is worth noting that the analysis focuses on "production losses" only. A more comprehensive analysis covering additional sources of risk that generate overall "income losses" would be also suggested.

Layer 1. Risk Retention: This would involve the government setting aside its own funds to cover frequent, less severe events for an amount of EUR 2.15 billion. This "risk retention" layer would consist of two parts: (a) an Annual Budget Allocation of EUR 1,450 million each year to handle predictable, smaller-scale losses. This amount is comparable to the resources currently absorbed by Italy's existing agricultural risk management tools, such as subsidized farm-level insurance, mutual funds (including the AGRICAT national fund), and ex-post compensations. This budget could be used to finance these ongoing programs; (b) a supplementary Reserve Fund of EUR 700 million that can be built up over time and used for more severe events that may exhaust the annual budget. This fund would provide a buffer for years with unusually high losses, such as the severe flooding seen in 2023, which required a dedicated, extraordinary government allocation. Together, the two instruments total EUR 2.15 billion and would be sufficient to cover losses with a 95 percent level of confidence.

Layer 2. Risk Transfer for Extreme Events. For catastrophic events that exhaust the government's retained funds, the strategy includes a nationwide risk transfer mechanism based on parametric insurance. This instrument would be designed to trigger payouts to the government when nationwide production losses for specific crops exceed a high threshold (e.g., a 1-in-20-year event). The estimated cost for this coverage is at least EUR 109 million (technical premium)¹⁰, with a maximum potential payout of EUR 2.4 billion. This national-level risk transfer mechanism is distinct from the subsidized farm-level insurance programs already in place. While complementary, they serve different purposes: farm-level insurance is structured to provide more frequent payouts for individual farmer losses, while the national cover is a "macro-level" tool designed to protect the national budget from extreme and systemic shocks through large-scale capital injections to the public budget when aggregate losses are severe.

By combining an annual budget, a reserve fund, and a national-level risk transfer instrument, the government can efficiently manage events of different magnitudes. However, a residual financial risk or "funding gap" remains. The actuarial analysis indicates that in the most extreme catastrophic scenarios, the combined funds from all layers could be depleted; specifically, the analysis shows that there is a 2.46 percent annual probability that losses could exceed the total resources of this illustrative plan in any given year. For example, in a 1-in-100 year loss event estimated at EUR 2.87 billion, the financial instruments would cover most of it, but there would still be an unfunded gap of approximately EUR 347 million.

⁹ A more comprehensive description of the actuarial analysis, which includes the illustration of methodological approach and the analytical process adopted, is presented in Appendix 3.

¹⁰ Risk takers might add additional loadings to this estimate to cover operational costs, capital profit, etc.

This residual risk would require emergency budget reallocation, highlighting the financial pressure that catastrophic events can place on public finances.

The illustrative analysis summarized above provides an example of a proactive and layered disaster risk financing strategy that allows for a structured and sustainable approach to managing agricultural risks. A strategy of this kind reduces the need for contingent and complex budget reallocations and ensures that support can be delivered more effectively when it is needed the most.

The actuarial analysis presented above should be considered as a general illustrative example and further and more in depth explorations would be required to develop a comprehensive and implementable DRF strategy. In particular, items to be included in future analyses could be: a) the expansion of the set of products analyzed; b) the inclusion of other sources of risk in order to allow to analyze “income losses”, rather than “production losses” only; c) the identification of the specific tools that should be adopted to deliver compensation to farmers, together with the appropriate level of farmer contributions to the system; d) the interaction of the country level strategies with potential EU level intervention (e.g. supranational risk pools).

In conclusion, this section about agricultural production risks in Italy highlights the long-standing priority that has been assigned to ARM in the country, and how a quantitative DRF approach can provide an operational framework in which public and private intervention can be optimized. As mentioned above, the complexity and diversity of the risk environment in Italian agriculture in a progressively changing ecosystem call for a constant review and adaptation of ARM approaches. The structural strength of the farm-level risk transfer framework, that has evolved over more than 50 years of application, is reduced by the partial uptake of ARM covers, which is concentrated in specific production sectors (higher value products) and specific areas of the country. Solutions aimed at expanding the coverage level, in particular for catastrophic risks, have been adopted (i.e., the AGRICAT national mutual fund), but the streamlining process is still ongoing.

Latvia

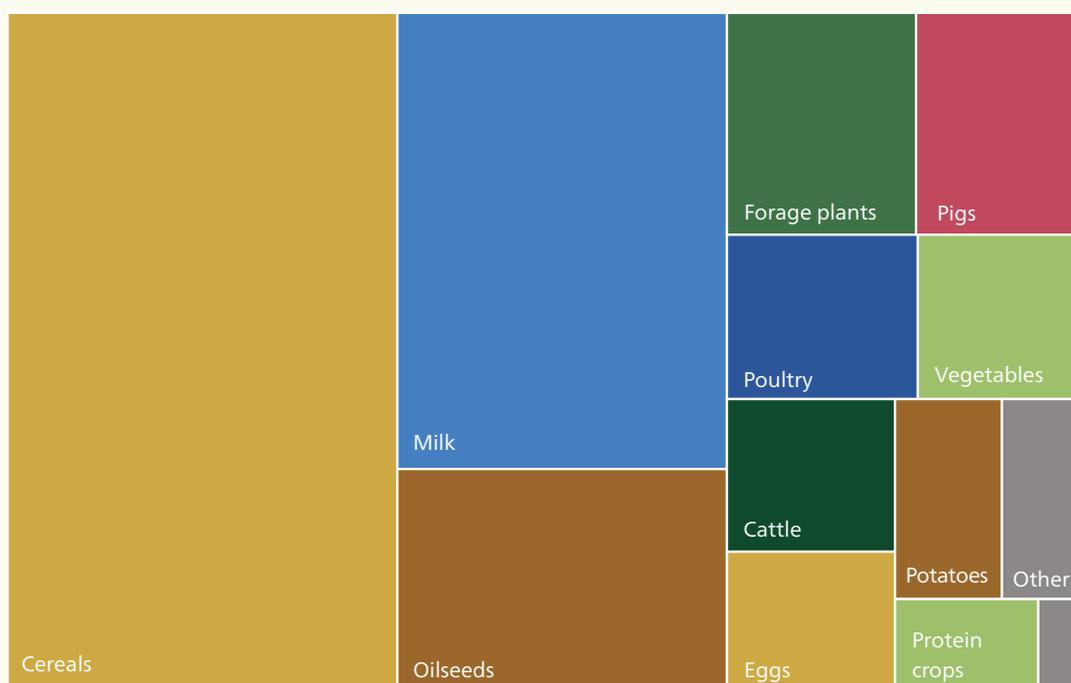
Latvia’s agri-food production system is relatively small but has undergone rapid consolidation. Agriculture (including forestry and fishing) contributes only about 4.4 percent of Latvia’s GDP, on average, over 2010-2023, yet remains vital for rural livelihoods. As of 2023 Latvia counted about 57,400 farms (as published on Latvia’s official statistics portal) – 31 percent fewer than in 2010 due to accelerated exits of smallholders. Over the same period, the average farm size grew from 21.5 hectares in 2010 to nearly 34.8 hectares in 2023.

The sector’s structure is highly polarized. The majority (78 percent of farm holdings, in 2020) generated less than 8,000 euros in standard output, and only 3.4 percent of all farms generated more than 100,000 euros. Yet almost two thirds of Latvia’s agricultural output and slightly more than half of its utilized agricultural area is in the hands of the larger-scale operations that generate more than 100,000 euros in standard output.

Cereals and oilseeds are the backbone of Latvian agriculture, followed by livestock. Utilized agricultural area has held steady at around 1.97 million hectares, since 2020, of which the vast majority is arable land and permanent pasture. Grain crops (led by wheat, plus barley, oats, rye) and rapeseed together account for nearly half of agricultural output value (46 percent). Latvia harvested a record 3.2 million tons of grain in 2024, owing to favorable weather conditions. Meanwhile, the livestock sector contributes more than one-third of output (37 percent in 2023 at producer prices). It centers on dairy cattle (milk is the single largest commodity at 21 percent in 2023 at producer prices) and pig/poultry operations, 9 percent, though herd sizes have trended down. Production is spread across all regions – large, mechanized crop farms dominate the flat central Zemgale plains, whereas smaller mixed farms (often dairy-based) persist in hilly or less fertile areas (Vidzeme, Latgale), reflecting regional variations in farm structure and soils.

FIGURE 19 Composition of Latvian agricultural output, using the Economic Accounts for Agriculture

Million euros, producer prices, 2023



Source: Eurostat

Latvia's agricultural output has grown modestly in volume over the past decades, anchored by rising crop yields and EU market integration, but remains variable year-to-year. Real agricultural value oscillates with global price swings and weather conditions. In nominal terms, in 2022, surging grain prices and a strong harvest boosted farm revenues to their highest level on record (agricultural GVA peaked at about EUR 900 million, or about 2.6 percent of GDP). By 2024, however, output value had receded by about one-third, as grain prices normalized, underscoring the sector's vulnerability to commodity markets. Overall, productivity has been improving. Average cereal yields rose above 3.9 t/ha in 2024, and the share of modern larger farms is increasing, which boosts efficiency. Latvia has also diversified its crop mix under EU sustainability initiatives – for example, expanding pulses and adopting wider crop rotations – and now leads the EU in organic farming (over 14 percent of farmland) as a share of total area. Still, crop production remains relatively concentrated in cereals and rapeseed, while some traditional staples like potatoes and rye have declined sharply (potato area fell from 30 thousand ha in 2010 to about 13 thousand in 2024). On the livestock side, output has slowly shifted towards fewer, larger holdings: the average dairy farm has grown from 12 to 15 cows since 2020, and pork production is consolidating even as African swine fever outbreaks periodically suppress pig inventories.

Export orientation is a notable strength. Latvia exports a large surplus of grains (especially wheat) to international markets and is broadly self-sufficient in milk products. Agri-food exports reached close to EUR billion in 2023, led by cereals, dairy, fish, and forestry products (wood pellets, timber), while key imports include fruits, vegetables, and animal feed. This trade integration, along with EU Common Agricultural Policy support, has bolstered sector performance.

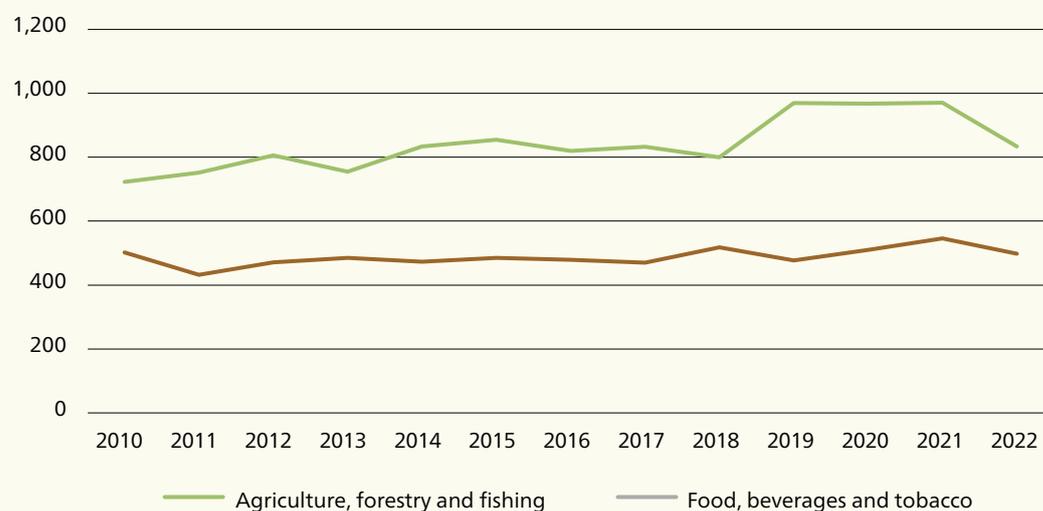
In terms of climate resilience, Latvia benefits from a cooler, humid climate (limiting drought risk relative to Southern Europe), but it is not immune to hazards. The country suffered severe droughts in 2018 and 2021 that dented fodder and grain yields, and wetter-than-normal seasons have caused flooding in low-lying fields. The government's push for precision agriculture, sustainable practices, and expanded irrigation in drought-prone areas is gradually strengthening resilience.

FIGURE 20 Evolution of real and nominal value added in Latvian primary agricultural production and food processing

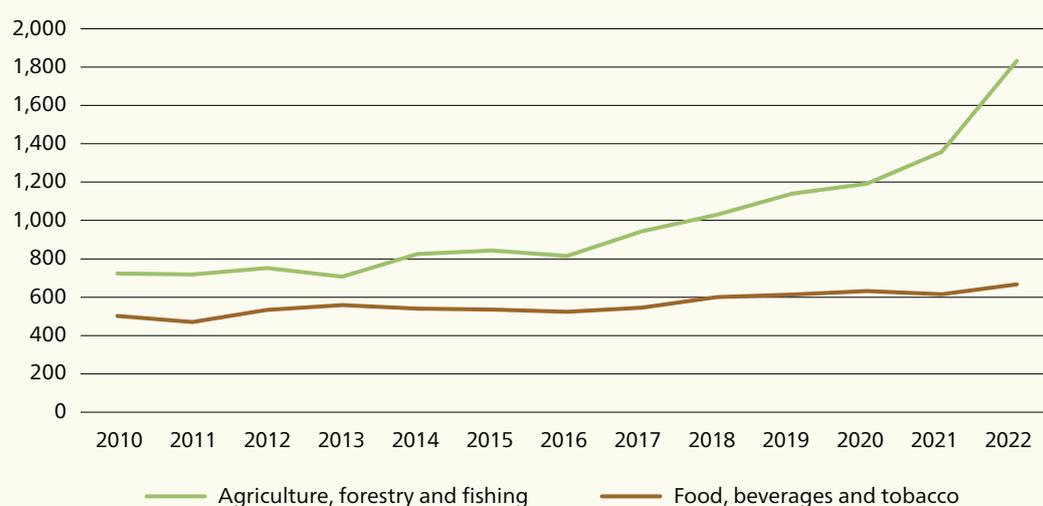
NACE classification, Rev.2

Million euros, chain-linked volumes 2010, and current prices, 2010-2023

a. Real



b. Nominal



Source: Eurostat

Since 2010, Latvian agriculture has been repeatedly challenged by extreme weather hazards. Severe droughts have struck with increasing frequency, most notably in 2018 when a long dry spell cut grain harvests by 23.6 percent year-on-year (to 2.1 million tons, the lowest in 7 years). That drought and accompanying heatwave inflicted an estimated EUR 359 million in farm losses, from stunted cereals and oilseeds to scorched pastures. Other dry years followed – farmers endured feed shortages again in 2021 amid summer heat, and by 2023 Latvia faced an even worse drought. Spring 2023 was exceptionally dry (May rainfall was 76 percent below normal, the driest on record since 1924)³, which along with a rare late frost devastated crop nationwide. Orchards were hit hardest: fruit blossoms froze across all regions, with most of the 2023 fruit harvest lost. Preliminary estimates pegged the combined revenue drop for crop and livestock farms at roughly EUR 300 million from this twin drought-and-frost disaster. Conversely, excessive rainfall has also caused havoc. In autumn 2017, incessant rain left fields waterlogged, flooding some crops and hampering winter grain sowings. That year, Latvian fruit growers had already suffered significant losses from a spring frost, and the saturating rains brought further damage to orchards. On the other end of the weather swing, violent storms with heavy downpours and hail have struck in mid-growing season. For example,

a powerful storm system in July 2022 swept across large parts of the country, shredding greenhouses and lodging (flattening) wide swaths of cereals. By mid-July 2022 over EUR 1 million in crop insurance claims had already been filed for storm damage – and insurers noted losses were worse than the previous year’s heat damage, as entire winter wheat fields in central Latvia (Zemgale) were ruined beyond harvest.

Biological hazards have compounded these challenges, as Latvia’s farms have contended with major pest and disease threats. Foremost is ASF, which entered Latvia in mid-2014 (likely via wild boar) and quickly became entrenched. Since then, the virus has spread through wild boar populations and sporadically into domestic pig farms, causing devastating losses in the pig sector. Dozens of farm outbreaks have occurred – every case forcing a full cull of all pigs on site – and wild carriers remain widespread. The largest flare-ups have required drastic measures: for instance, in 2025 an ASF outbreak at a single large farm necessitated the slaughter of 20,000 pigs to contain it. Latvia’s pork production has consequently fallen, and ongoing biosecurity alerts have curtailed pig trade (during peak ASF waves, pork exports were restricted, and smallholders often exited the business). The poultry sector faces a parallel menace from highly pathogenic avian influenza (bird flu). Migratory wild birds have occasionally brought avian influenza viruses to the Baltics – Latvia confirmed its first wild bird H5N8/H5N1 cases in 2021–2022 – and though the country largely avoided farm infections for years, it was always a looming risk. In spring 2025, Latvia reported its first H5N1 outbreak in a poultry farm, which hit a backyard flock and prompted immediate response measures. While relatively small in scale, this incident underscored the constant threat of avian flu to Latvian poultry growers (and the virus’s potential to spread if biosecurity falters). Apart from animal diseases, farmers also face various crop pests and diseases. Increases in wet, humid weather have led to more frequent fungal and bacterial outbreaks in crops: for example, the rainy summer of 2017–2019 saw widespread fruit tree blight and mildew problems, and experts warn that bacterial blight is now a significant looming threat to Latvia’s apple and pear orchards. Insect pest pressures are also rising – mild winters have enabled higher survival of crop pests. Cereal farmers must manage periodic spikes in pest populations (e.g. summer aphid outbreaks in grains) and diseases like rust or rot in wet years. Fortunately, none of these plant pest/disease episodes have reached the catastrophic scale seen in some other countries, but they still cause localized yield losses and add costs for control.

These experiences have driven home the need for robust risk management. Latvia now highlights drought, excess rain, frost, ASF, and avian flu as its top agricultural risks in its national strategy, and has increasingly turned to instruments like subsidized insurance, disaster aid, and on-farm mitigation measures to build resilience against these hazards.

The broader CAP framework is essential for stabilizing farm incomes and promoting de-risking at farm level. Direct income payments (CAP Pillar I) make up the backbone of CAP inflows to Latvia – starting around EUR 200 million in 2014 and rising to roughly EUR 300 million by 2020 as EU payment rates for Latvia increased. These payments (basic income support, greening, etc.) averaged EUR 250–300 million per year, stabilizing farm incomes. Under CAP Pillar II, besides Measure 17, Latvia is also investing significantly in activities that help reduce farmers’ exposure and vulnerability to risks.

When it comes to risk transfer, the agricultural insurance market in Latvia is small and saturated but demand is growing. Competition among insurers has led to market consolidation, with smaller providers exiting the sector. Between 2015 and 2022, 32 different insurance providers, including insurance companies and brokers, participated in agricultural risk insurance under CAP Measure 17. On the demand side, agricultural insurance uptake remains limited but is increasing. In 2021, data from the Latvian Insurers’ Association shows that 939 crop farms had multi-peril crop insurance policies and about 1,941 farms carried livestock insurance (mainly covering animal disease losses). These numbers suggest roughly 2,000 farms were insured in some form by 2021. By 2023, insurance coverage expanded significantly among crop growers: approximately 30 percent of Latvia’s sown area was insured, up from only about 10 percent in the mid-2010s. This growth indicates that many medium and large commercial farms (especially in cereals and oilseeds) have increasingly adopted multi-peril crop insurance, while most uninsured farms are smallholders, who cite high premium costs and limited tailored products. To counter this, the government is examining ways to encourage group policies or co-ops to improve bargaining power.

Reinsurance is handled by the parent companies of Latvian insurers. While legislation allows for state involvement in reinsurance, particularly to partially compensate insurers for drought-related crop losses, this provision is rarely applied.

The system primarily covers multi-peril crop insurance and, to a lesser extent, livestock disease insurance. Latvian crop policies typically insure against damage from hail, storms, frost, and winterkill, and some insurers offer drought coverage (often with high deductibles). Hail is the most insured peril, a legacy of stand-alone hail insurance, but multi-peril packages have grown in popularity. Insurers use a combination of global and local meteorological data, satellite imagery, and statistical modeling to assess risk and set premiums. Loss assessments are conducted through field sampling, on-site inspections, and increasingly, drone technology. Although each insurer maintains its own risk database, there is currently no unified national database for agricultural insurance. Livestock insurance is generally limited to direct losses from accidental deaths but also from diseases like ASF or avian influenza. Insurance for indirect losses in livestock farming is not available in Latvia. Premium rates vary widely, ranging from 0.5 percent to 12 percent of the insured value, depending on the number and severity of risks covered, the crop type, and the farm's claims history. This range is broader than in most EU countries, where premiums typically fall between 2 percent and 8 percent. Deductibles in crop insurance range from 0 percent to 30 percent, while livestock insurance generally features lower deductibles.

Gaps in market coverage remain. Farmers generally feel they have flexibility in choosing insurance providers, citing differences in premiums, coverage, conditions, and trust factors like reliability and administration. However, significant limitations persist, especially in livestock insurance, where age restrictions and herd-wide coverage requirements make policies costly and impractical. Crop insurance also faces gaps, such as lack of flood coverage in flood-prone areas and insufficient protection against wild animal damage for crops and small ruminants. Farmers express interest in compensation for indirect losses, like herd renewal and grassland reseeding. Also, certain sectors, especially high-value horticulture crops (e.g. vegetables, berries) remain underinsured, because few insurers offer affordable cover for those commodities. Despite general satisfaction with on-site loss assessments, disputes often arise over grain maturity stages, winter damage evaluations, and inconsistent or unclear risk definitions.

The dynamic of insurance premiums and payouts highlights the growth in insurance demand as well as the volatility of the sector. Table 17 shows the volumes of agricultural insurance premiums and payouts made during the last decade in Latvia. Overall, the volume of premiums increased for both crops and livestock, but the increase was faster for crops. The Compound Annual Growth Rate for crops, over 2014-2023 was 41 percent, versus 17 percent for livestock. The loss ratio of Latvian crop insurance can swing widely: mild years see low claims, but bad-weather years (like 2017's floods or 2021's frost or 2023's compound perils) result in high payouts. The relatively small pool of insured farms means individual events can significantly impact insurers, which in turn keeps premiums high – a chicken-and-egg challenge where low uptake leads to higher cost per policy.

TABLE 16 Volumes of insurance premiums and payouts in Latvian agriculture,

Million euros and percent, 2014-2023

Indicator/Year	Premiums		Payouts		Loss ratio	
	Crops	Livestock	Crops	Livestock	Crops	Livestock
2014	0.5	1.5	0.2	0.8	40%	53%
2015	0.6	1.6	-	1.0	0%	63%
2016	0.6	2.0	0.2	1.3	33%	65%
2017	1.0	3.2	0.1	1.9	10%	59%
2018	3.4	4.5	0.8	2.9	24%	64%
2019	5.6	8.5	3.3	5.6	59%	66%
2020	8.6	7.4	6.3	6.7	73%	91%
2021	11.9	7.5	3.8	5.5	32%	73%
2022	12.4	6.8	9.0	5.1	73%	75%
2023	10.7	6.3	15.8	4.7	148%	75%
Average	5.5	4.9	4.0	3.6	71%	72%

Source: Latvian Insurers' Association; Note: the figures above exclude Vereinigte Hagel Latvia, which is a major player on the Latvian agricultural insurance market.

A substantial public subsidy, delivered primarily through the CAP framework, makes premiums more affordable. This premium support is the main agricultural risk management tool in Latvia and continues a tradition that preceded the EU risk management toolkit. Under the Rural Development Plan (Measure 17.1), the government reimburses 50–65 percent of farmers’ insurance premiums. During 2014–2022, the subsidy rate was 65 percent; in the new 2023–2027 CAP period Latvia reduced it to 50 percent. This was implemented to spread limited budget funds further as more farmers sign up. Even at 50 percent, Latvia’s premium support rate is on par with its Baltic neighbors and remains generous by EU standards. Besides continuing the insurance premium subsidies, Latvia has also earmarked funds under CAP 2023–2027 to explore new tools, such as a national disaster fund or mutual fund for catastrophic losses, allowed under Article 76 of the CAP. However, progress is slow because stakeholders have concerns about feasibility and there’s low enthusiasm for mutual insurance mechanisms.

In addition to premium subsidies, the government supports insurance via education and regulatory measures. For instance, training programs in risk management are offered (CAP Measure M01) to raise awareness. The state also provides a legal framework for insurers to receive subsidy reimbursements efficiently. It also liaises with the Latvian Insurers’ Association to refine products and definitions (e.g., what qualifies as “drought damage”), and to develop a comprehensive crop loss database. This responds to a farmers’ concern that risk definitions are ambiguous in policy terms, and to a call for a more transparent loss assessment.

On top of this baseline, the government has provided extraordinary compensation in response to crises, using state aid mechanisms, complemented by EU-funded extraordinary assistance. Notable instances include the 2017 floods, when torrential rain destroyed crops and the state paid EUR 18.4 million in 2017 from its emergency fund. Similarly, after the 2018 drought (one of the worst in decades), a relief package of about EUR 2.1 million was disbursed by late 2018 to crop and livestock farms. Earlier, in 2014–2015, the EU had financed roughly EUR 7–8 million in special aid to Baltic farmers hit by Russia’s food import embargo: Latvian dairy farmers benefited from emergency milk bonuses, and fruit growers were compensated for unsold produce. Another EU-funded market support came in 2016, when Latvian dairy farmers received EUR 9.3 million from an EU milk sector aid package. These one-off aids are smaller relative to CAP flows, but vital for crisis recovery.

TABLE 17 State aid programs relevant for agricultural risk management in Latvia

Million euros, 2014–2024

Type of program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Compensations	2.28	0.39	0.04	18.18	2.11	0.75	1.63	0.32	0.32	0.04	
Subsidies on insurance premiums	1.37	1.50									
COVID-19*	-	-	-	-	-	-	26.31	11.54	3.70	-	-
Ukraine	-	-	-	-	-	-	-	-	-	-	-
Other ARM-relevant programs	-	-	-	-	-	-	-	-	-	-	-
Total	3.65	1.89	0.04	18.18	2.11	0.75	27.94	11.87	4.02	0.04	-

Source: Ministry of Agriculture of the Republic of Latvia

By 2019, Latvia deliberately shifted away from routine ad-hoc bailouts. The agricultural contingency budget (“unforeseen events” fund) was largely folded into planned programs. Instead, farmers were encouraged to use risk management tools like insurance (subsidized by the RDP Measure 17.1). This policy shift meant fewer disaster payments – for example, no direct state compensation was paid for the moderate droughts of 2019 and 2021 (the government declined a 2021 drought payout), focusing on insurance claims instead.

In 2020, however, the COVID-19 pandemic prompted a temporary return of broad emergency aid. The Latvian government earmarked EUR 45.5 million from its crisis reserve for agriculture and food producers. According to the State Audit Office, about EUR 35.5 million was planned across three support programs, and about 84 percent of that (close to EUR 30 million) was ultimately paid out. This included grants to compensate lost income in dairy, beef, and pig farming – an “income stabilization support” that paid up to EUR 100,000 per farm and ended up exceeding the actual revenue drop in some cases. The remaining funds went to smaller aid schemes (e.g. for horticulture and small rural businesses) which saw a lower uptake. By late 2021, these COVID aids wound down.

This also continued in the following years, as the impacts of the situation in Ukraine unfolded. Input prices (fuel, feed, fertilizer) skyrocketed in 2022. The EU activated its agricultural crisis reserve for the first time: Latvia received about EUR 7 million from this EU fund (out of EUR 500 million EU-wide). The Latvian government matched this with national money for a combined EUR 14 million package in mid-2022, delivered as lump-sum payments to farmers facing extreme cost increases. No major disaster aid was needed in 2023, despite a spring drought/frost, thanks to insurance and more resilient farm finances.

Against this background, we conducted an actuarial analysis to quantify the risks the Latvian agriculture is facing and design an illustrative financial strategy to enhance the country’s resilience against them. We considered a representative portfolio of key agricultural products. The portfolio was comprised of five crops and cow milk, which together account for approximately 83 percent of the total production value at producers’ prices (PVPP) for crops and 49 percent for animal outputs, respectively. This portfolio, valued at approximately EUR 1.2 billion, represents a significant portion of the country’s agricultural output and about 2 percent of its national GDP.

The analysis revealed that the average expected annual loss for this portfolio is nearly EUR 41 million, representing 3.55 percent of the portfolio’s total value. The risk is highly concentrated in a few crops. For instance, common wheat and spelt account for 45 percent of the portfolio’s value but are responsible for 52 percent of the expected losses. Similarly, rape and turnip rape seeds contribute 26 percent of the expected losses. This concentration highlights the sector’s vulnerability to events that disproportionately affect these specific crops. Historical data from 2000 to 2023 confirms this, showing that severe droughts in years like 2018, 2021, and 2023 caused significant yield declines in grain crops.

The analysis showed that the risks affecting different products are not perfectly correlated. This is important because it means that a single adverse event, like a drought, will not impact all products in the same way. For example, milk production often has a negative correlation with crop yields, meaning that a bad year for crops might not be a bad year for milk. This lack of perfect correlation provides a natural buffer, as losses in one area can be partially offset by stability in another. This diversification reduces the overall financial risk to the sector. In the case of an extreme event, such as a 1-in-100-year event, the potential loss without the diversification effect would be EUR 294 million. However, when accounting for diversification, this potential loss is reduced to EUR 237 million, resulting in a diversification benefit of EUR 57.6 million and significantly lowering the potential financial shock.

To manage these financial risks, we developed an illustrative financial strategy. This strategy combines government-held resources (risk retention) and market-based instruments (risk transfer) to create a more efficient and sustainable system. The goal is to enhance Latvia’s fiscal resilience and ensure that support can be provided to farmers without jeopardizing public finances.

Layer 1 – Risk Retention. The risk retention layer involves using pre-arranged, dedicated government capital sources to cover more frequent, less severe losses. This layer totals EUR 155 million and is designed to cover contingent liabilities for events up to a 1-in-20-year severity (a 95 percent annual probability). The risk retention layer would consist of two parts: (a) an annual budget allocation of EUR 75 million to provide immediate support to farmers for more frequent events. and (b) a supplementary reserve fund of EUR 80 million. The purpose of this fund is to accumulate resources that carry over from one year to the next. The money in the fund could be invested in high-quality financial instruments to earn interest and would be used to cover more severe events that exhaust the annual budget allocation.

Layer 2 – Risk Transfer for Extreme Events. For more severe and less frequent events that would exhaust the combined risk retention layer, the illustrative strategy includes a risk transfer layer. This involves transferring risk to the private market by purchasing area-yield index insurance at a national level. This type

of insurance would pay out for losses that fall between a 1-in-20-year and a 1-in-100-year event. The estimated technical premium, or pure cost of risk, for this insurance layer is about EUR 4.93 million annually (technical premium)¹¹, with maximum potential payout of EUR 62 million. This figure is derived from the difference between the loss at the 1-in-100-year event (EUR 237 million) and the coverage provided by the risk retention layer (EUR 155 million). Therefore, the insurance would be expected to pay up to EUR 62 million in the case of a catastrophic event at the 1-in-100-year severity.

By structuring the insurance at a national level, the government can achieve efficiencies, reduce costs, and strengthen its negotiating power with insurers. This instrument is distinct from the farm-level insurance that individual farmers might purchase; it is a tool for the government to manage its own large-scale financial exposure.

Even with this comprehensive strategy, a residual risk for catastrophic, very rare events remains. The analysis shows there is still a small (2.84 percent) annual probability that the combined financial instruments could be depleted in a given year. Losses exceeding this point would create an unfunded financing gap, which for a 1-in-100 year event, is estimated at EUR 20 million. This residual risk would require emergency budget reallocation, highlighting the financial pressure that catastrophic events can place on public finances.

The analysis above provides a clear picture of the financial risks facing Latvia's agricultural sector and offers a concrete, illustrative strategy for managing them. By combining risk retention tools like dedicated budgets and reserve funds with risk transfer instruments like national-level insurance, the country can significantly enhance its capacity to absorb financial shocks, protect its farmers, and safeguard its economy from the impacts of adverse agricultural events. This proactive approach to risk management improves the efficiency and sustainability of the entire agricultural sector.

To conclude, Latvia's agricultural risk management system is growing but has much untapped potential. Faced with growing climate and market risks, Latvia needs to rethink its risk management framework and boost uptake. Regulatory clarifications, product innovation and better delineation and complementarity between tools, such as insurance and IST, could help increase the effectiveness of the system. Additionally, capacity building efforts, both involving national stakeholders and exchanges with regional/EU counterpart would foster transparency, reduce disputes, and support informed decision-making across the sector.

Slovakia

Agri-food in Slovakia plays a modest but vital role in the national economy. The country's agricultural land totals approximately 1.83 million hectares of farmland (about 1.31 million hectares arable, 0.50 million hectares pasture). Over half of this land (52 percent) lies in Areas with Natural Constraints (ANC) – hilly or mountainous regions with lower productivity. Over the period 2010–2023, the average contribution of agriculture, forestry, and fishing to national GDP has been 2.1 percent. If combined with food, beverages and tobacco, the sector's contribution rose to 3.5 percent.

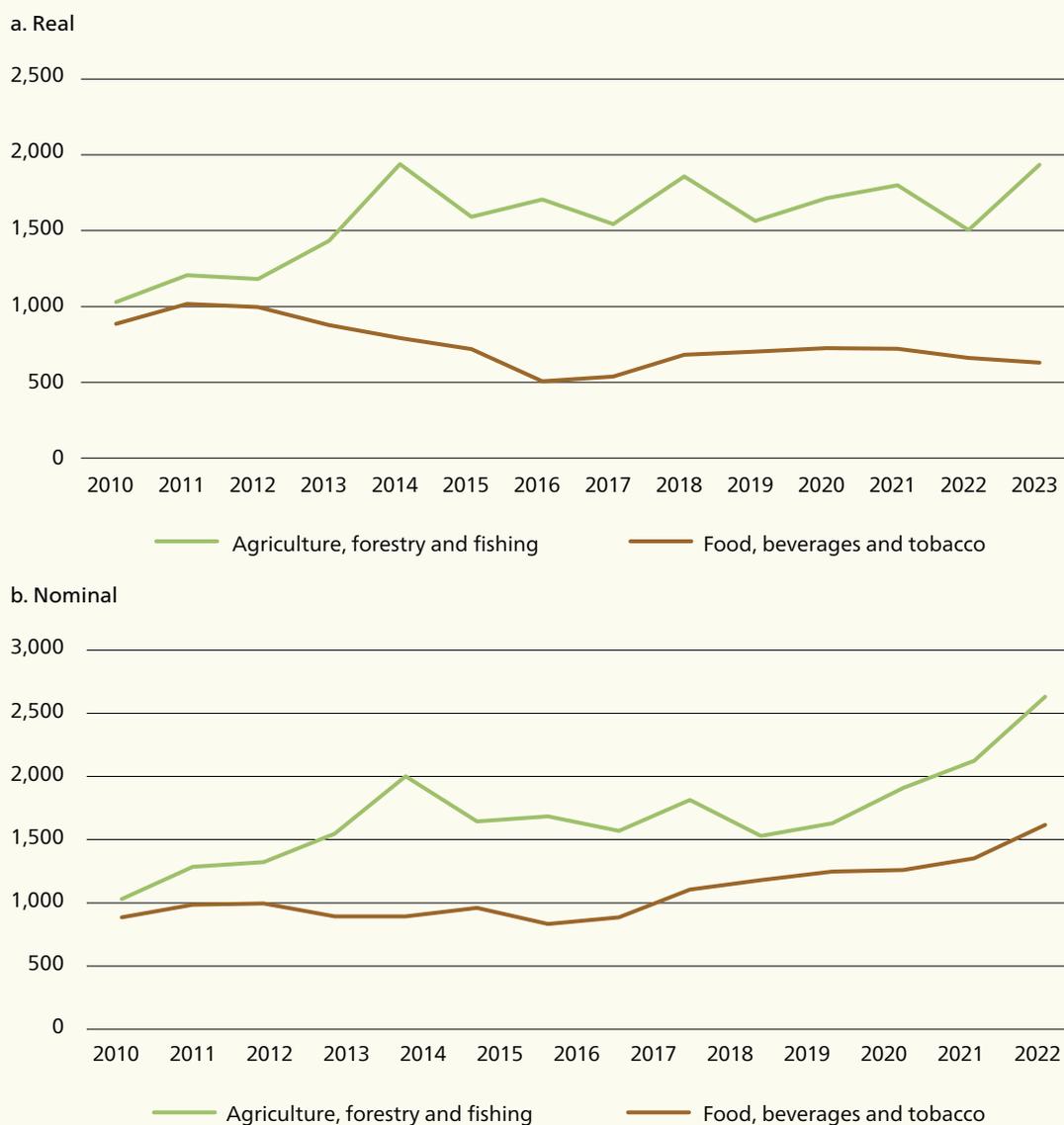
The sector's structure is highly polarized. A small number of large corporate farms (often successors of former collective farms) dominate land use. Holdings generating over 500,000 euros of standard output make up only about 6 percent of Slovakia's 17,000 farms but control about 70 percent of all agricultural land and generate nearly 75 percent of all the agricultural output (2023). Conversely, 63 percent of farms are smaller family holdings (<15,000 euros of standard output), together managing under 4 percent of the farmland. This bimodal farm size distribution – many subsistence plots alongside a few giant agribusinesses – gives Slovakia one of Europe's most consolidated farm structures. Productivity gains in crops, along with EU Common Agricultural Policy support, have helped keep many large Slovak farms profitable. Direct EU payments (including special subsidies for farms in hilly ANC regions) form a significant share of farm incomes, effectively underpinning the sector's viability.

¹¹ Risk takers might add additional loadings to this estimate to cover operational costs, capital profit, etc.

FIGURE 21 Evolution of real and nominal value added in Slovak primary agricultural production and food processing,

NACE classification, Rev.2

Million euros, chain-linked volumes 2010, and current prices, 2010-2023



Source: Eurostat.

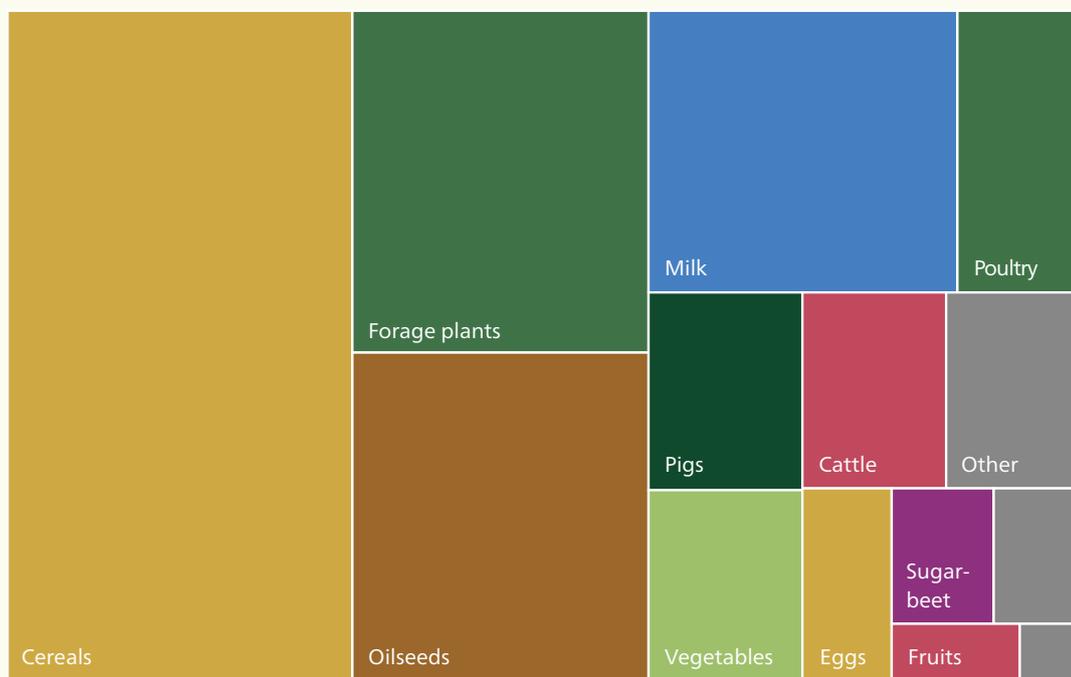
Slovakia's agricultural output has fluctuated with weather and markets but trended slightly upward in value. In 2022 and 2023, the total gross value added of the agriculture, forestry and fishing sector hit a record EUR 2.65 billion (up from just over EUR 1 billion in 2010, in current prices), thanks to high global crop prices. Crop revenues especially jumped in recent years – since 2018, crops have formed about two thirds of sector output at producer prices versus livestock, a third. However, volumes remain volatile. For example, severe droughts in 2017 and 2022 cut cereal yields by some 15 percent below the last decade's average, causing those years' farm output to dip (2022 saw crop output fall back in volume even as prices soared). Overall, grain yields have slowly improved with modern techniques (wheat yields now at about 5.6 tons/hectare in a normal year, considering the last decade's average, up from about 4.8 tons/hectare in the early 2010s), and leading farms are internationally competitive in field crops. By contrast, livestock production has generally contracted over the last decade – e.g. Slovakia's raw milk output is roughly flat since 2010, and pig meat output fell sharply in the mid-2010s, making the country more import-dependent for pork. This structural shift toward cropping is also reflected in farm incomes and employment: primary agriculture now employs under 3 percent of the workforce, and many small livestock keepers have exited.

On the positive side, Slovakia's food processing industry (notably dairy, grain milling, and brewing) adds value to domestic crops and milk. Agri-food manufacturing contributes 1.4 percent of GDP (average 2010-2014). The country's external agri-food trade position is a moderate deficit. In 2023, agri-food exports were about EUR 4.8 billion (approximately 4.8 percent of Slovakia's total export value), while imports reached around EUR 7 billion (7.1 percent of total imports), continuing a pattern of net imports. Slovakia exports sizeable grain surpluses (wheat, maize) to EU partners and niche products like alcoholic beverages and confectionery but relies on imports for many high-value or labor-intensive foods – e.g. fruits, vegetables, and meat products from neighboring countries.

Crop cultivation is the mainstay, while dairy is the most important livestock item. Cereals and oilseeds generate nearly half of the country's agricultural output value at producer prices (2023) and cover about 50 percent of the country's utilized agricultural area. Major crops include wheat, barley, maize, and rapeseed, along with notable sugar beet and fodder crops (and smaller areas of potatoes, vegetables, and vineyards). The livestock sector is comparatively limited (about a third of the sector's output) and has seen decline. Dairy cattle farming is dominant – raw milk is consistently a top agricultural commodity (about 0.81 million tons of cow' milk in 2023). Pork production has struggled (the pig herd shrank due to low profitability and African swine fever outbreaks), and beef cattle numbers and sheep/goats remain modest. High-volume poultry operations have grown in importance for meat and eggs, but overall animal output has not kept pace with crops. Regionally, the fertile lowlands of western and southern Slovakia (Danubian Plain) host large, mechanized grain and oilseed farms, whereas northern and central regions – often highland and ANC areas – feature smaller mixed farms or pastures, reflecting natural conditions. Despite these structural contrasts, about 90 percent of Slovak agricultural output comes from commercial farms (often cooperatives or companies) that are well-capitalized and integrated into supply chains.

FIGURE 22 Composition of Slovak agricultural output, using the Economic Accounts for Agriculture

Million euros, producer prices, 2023



Source: Eurostat

Over the past decade, Slovak agriculture has been repeatedly challenged by extreme weather events. Drought is the most persistent threat: a severe 2017 drought shrank national grain yields by roughly 14 percent below the decade's average, and an even worse 2022 drought saw cereal yields drop 16 percent below the same reference. These rain shortfalls have withered crops (notably cereals, oilseeds, and fodder) and left livestock farmers struggling with feed shortages. Apart from drought, other climate extremes occur on a

smaller scale. Spring frosts have repeatedly struck early bud-break in orchards and vineyards – for example, an April 2017 cold snap and another in 2024 devastated fruit blossoms, contributing to a 50 percent plunge in apricot yields in 2023. Likewise, hailstorms and flash floods occasionally hit during the growing season. Intense downpours in lowland areas (e.g., parts of western Slovakia in spring 2020) have flooded or waterlogged fields, and summer hail or windstorms periodically shred crops (flattening wheat, damaging corn and wine grapes) in their swath. Fortunately, such events tend to be localized; in aggregate, hail, floods, and windstorms account for only a small fraction of nationwide farm losses. Nonetheless, the overall trend of more erratic rainfall and temperature extremes – from multi-month droughts to unseasonal frosts – has made Slovakia’s crop production increasingly volatile and underscored the sector’s vulnerability to climate change.

Biological hazards have compounded these challenges, affecting both crops and livestock. One notable issue is damage from pests and wildlife. Slovakia’s extensive forests and thriving game populations mean that wild boars and deer frequently raid crops, causing substantial field losses (especially in maize, root crops, and orchards near woodlands). In fact, official damage reports now list “wild game” as a leading cause of crop loss value, second only to drought. Periodic surges in rodent populations have also wreaked havoc: after mild winters, vole infestations can explode, as seen around 2019, when thousands of hectares of cereals were destroyed by voles in the southwest. Farmers must intensify pest control in such years to limit the damage. On the livestock side, Slovakia has faced the spread of ASF. This was first detected in the country’s wild boar in 2019, and since then dozens of farm outbreaks have occurred, primarily in eastern Slovakia. Each outbreak forces a full cull of all pigs on the farm to contain the virus, and wild boar in many districts remain infected reservoirs. The largest incidents have devastated commercial piggeries; as a result, Slovakia’s swine herd has shrunk (by over 20 percent since 2018) and the country has become more reliant on pork imports. Authorities have paid millions of euros in compensation to affected producers and imposed strict movement bans and biosecurity measures, but ASF continues to pose a serious long-term threat. Meanwhile, the poultry sector warily eyes avian influenza. While Slovakia has not suffered a major avian flu outbreak in domestic flocks to date, the virus has been found in wild birds in the region, and neighboring countries have culled millions of poultry during the 2021–2022 European outbreaks. The risk of an H5N1 incursion remains high, prompting Slovak farms to tighten biosecurity as a preventative step. Apart from these headline diseases, farmers also contend with endemic livestock illnesses and occasional crop blights (for instance, wet years can bring fungal diseases in wheat or potatoes), though these are typically managed with routine measures.

TABLE 18 Losses in Slovak agriculture by key hazards

Million euros, 2017-2024

Type of damage	2017	2018	2019	2020	2021	2022	2023	2024	Total	Share
Wild game	38.7	19.8	17.3	9.2	26.0	9.0	10.2	18.5	148.7	30%
Drought	40.7	21.8	23.5	22.5	n.a.	126.2	3.6	8.6	246.9	50%
Frost	9.8	n.a.	n.a.	13.0	n.a.	n.a.	0.5	0.1	23.4	5%
Voiles	n.a.	n.a.	13.6	2.8	0.2	0.9	19.7	8.7	45.8	9%
Hail	n.a.	n.a.	2.3	0.9	n.a.	n.a.	0.2	2.0	5.4	1%
Heavy rain	n.a.	n.a.	n.a.	0.7	n.a.	n.a.	2.0	23.8	26.5	5%
Total	89.2	41.6	56.7	49.0	26.2	136.0	36.3	61.7	496.7	100%

Source: Slovak Agricultural and Food Chamber

In response, both the farms and the government are ramping up measures and actions that can reduce on-farm risks. Slovakia’s large farmers can diversify normal risks by themselves. Most of these holdings are not highly specialized in one or a few commodities¹². On top of that, they maintain multiple income streams:

¹² Large agricultural holdings in Slovakia (over 500 ha) tend to be diversified rather than narrowly specialized and are much less specialized than their counterparts in Western Europe. Crucially, these large holdings spread production across multiple crops – for example, a single enterprise might cultivate grains, oilseeds, and feed crops on different fields, rather than monocropping. Some of the largest players additionally integrate livestock operations (especially dairy or beef cattle herds) alongside cropping, taking advantage of extensive pastureland in less-favored regions. This structure provides internal diversification: big farms can offset a poor harvest in one crop with another crop or a steady milk output, reducing their exposure to any single commodity’s risk.

many receive substantial EU direct payments (including area-based subsidies and ANC top-ups), which can constitute a large portion of their revenue, alongside crop sales and any livestock or processing income. At the same time, the government is expanding programs (like irrigation investments, on-farm modernization, or pest fencing) to bolster resilience. Although Slovakia has relatively ample water resources and low overall water stress in agriculture, recent years have seen more frequent weather extremes (droughts, localized floods) impacting yields. Investments in irrigation infrastructure are being stepped up through rural development funds, but the pace of their implementation remains relatively slow. Fragmented land ownership causes high transaction costs on the land market, while public resources are limited relative to the investment needs for irrigation infrastructure.

Agricultural risk transfer relies primarily on commercial insurance, bolstered by public subsidies for insurance premiums. In Slovakia, due to the small size of the market, there are only four insurance companies offering commercial crop and animal insurance: Allianz, Generali, AGRA poisťovňa and Hasičská poisťovňa. 90 percent of all agricultural legal persons (translating into just over 3,000 holdings) and 32 percent of natural persons (translating into close to 4,500 farmers) have commercial agricultural insurance. Overall, about 45 percent of the agricultural production is estimated to be insured. Typically, insurance products for the livestock sector cover: (i) diseases of animals (including dangerous and infectious); (ii) mass and individual damage to livestock; (iii) damage to eggs and day-old poultry; (iv) damage to herds and breeding animals (including imported ones); and (v) sow and rabbit insurance. In livestock insurance, coverage for disease risk is a basic product. The insurance company negotiates specific terms with each client individually regarding the insured value of the animals, deductibles, and premium amounts. For crops, insurance products cover: (i) hail; (ii) spring frost, (iii) overwintering, (iv) floods, (v) storms, (vi) fire, (v) drought, (vi) natural events, (vii) pre-grown seedlings and seedlings, and (viii) grapevine against spring frosts. Statistical data (Table 19) shows variation in premiums paid, claims received, and loss ratios. The loss ratios for crops and animals fluctuated, sometimes reaching high levels when major incidents occurred.

TABLE 19 Volumes of premiums and indemnities in Slovak agriculture

Million euros and percent, 2014-2023

Indicator/Year	Premiums		Claims paid		Loss ratio	
	Crops	Livestock	Crops	Livestock	Crops	Livestock
2014	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2015	6,108	1,747	1,663	495	27%	28%
2016	5,079	1,553	2,446	165	48%	11%
2017	5,896	1,569	4,613	127	78%	8%
2018	5,916	1,632	1,469	99	25%	6%
2019	8,327	1,781	3,629	1,379	44%	77%
2020	8,481	1,791	2,695	1,104	32%	62%
2021	9,584	1,931	2,445	5,579	26%	289%
2022	12,001	2,598	3 110	2 140	26%	82%
2023	13,991	3,209	6,816	221	49%	7%
Average	8,376	1,979	3,210	1,257	39%	63%

Source: MARD SR, Green Report Note: Data based on the sample of farms based on IL MARD SR

TABLE 20 Overview of insurance coverage options in the Slovak livestock sector

Insurance Company	Coverage Options	Deductible	Insurance Rate
AGRA Insurance Company	Basic option covers infections; higher options include acute poisoning, electric shock, or natural disasters; most comprehensive option includes mass diseases and individual damage to breeding animals	4% for breeding cattle	Not specified
Allianz Insurance Company	Cattle, poultry, pigs, sheep, goats, horses, and dairy cows; set of risks (infection, infectious diseases, losses due to electricity, poisoning, natural disasters, overheating); individual damages	10%-20%	0.9%-1.5% for set of risks; 6%-8% for individual damages
Generali Insurance Company	Cattle, poultry, pigs, sheep, goats, and rabbits; set of risks, not individual damages	10%-20%	0.9%-1.5% for set of risks; 6.4%-9% for individual damages

Source: <https://www.agrapoistovna.sk/poistenie/>, <https://www.generali.sk/pre-podnikatelov/polnohospodarske-poistenie/>, <https://www.allianz.sk/sk/podnikatelia/mali-a-stredni-podnikatelia/polnohospodari.html>

TABLE 21 Overview of insurance coverage options in the Slovak crop sector

Insurance Company	Coverage Options	Deductible	Insurance Rate
AGRA Insurance Company	Basis, Agrar Universal, Agrar Flat Rate, Drought Index Insurance, Sugar Beet Universal, Fruit and Fruit under the hail nets. Hail, fire, windstorm, flooding, inundation, spring and winter frost, drought.	0%-20%	1%-3% for field crops, higher for fruits, vegetables, and specialty crops
Allianz Insurance Company	Hail, windstorm, fire, flood, drought, spring frost, overwintering.	20%	1%-3% for field crops, 4%-11% for fruit, 5%-10% for vines
Generali Insurance Company	Hail, fire, windstorm, drought, spring frost, flood.	10%-20%	1%-4% for arable crops, 5%-10% for fruits and vegetables

Source: <https://www.agrapoistovna.sk/poistenie/>, <https://www.generali.sk/pre-podnikatelov/polnohospodarske-poistenie/>, <https://www.allianz.sk/sk/podnikatelia/mali-a-stredni-podnikatelia/polnohospodari.html>

The insurance products available on the market are not suitable for small and medium-sized farms, which show little interest in the existing options. Insurance is expensive for small farms, procedures are complex, and awareness of available insurance options is low. For insurers, small farms are less profitable compared to large enterprises. Surveys (Pokrivčák, J. and M. Tóth, 2020) indicate low awareness of crop and livestock insurance among Slovak farmers, who lack independent information on the pros and cons of commercial insurance and report a lack of independent risk management advisory services. Parameters like deductibles are not motivating for many to insure their crops or livestock.

Agricultural insurance premiums were originally financed from the national budget, and, more recently, transitioned under the CAP rural development pillar. In recent decades, the availability of public support for insurance premiums has been inconsistent. Slovakia re-introduced public subsidies for risk premiums in 2019, after a gap during the six years prior. Premium support was previously implemented between 2004 and 2010, and then also in 2012. After 2019, it has been financed annually as state aid from the national budget until 2024. In 2023, it benefited only 1,016 applicants. During the 2014–2020 EU programming period, Slovakia did not implement any interventions specifically under Measure 17 for risk management tools, such as mutual funds or income stabilization instruments. However, Slovakia decided to roll out the risk management instruments under the latest CAP (2023–27) and introduced EU-subsidized crop insurance premiums in 2025 for the first time (up to 65 percent subsidy). Between 2023 and 2027, Slovakia

earmarked EUR 40 million for these insurance interventions, with an initial annual allocation of EUR 8 million, later increased to EUR 12 million for 2025. However, no CAP insurance support was provided in 2023 or 2024, as state aid support continued, making the forthcoming increase in funding especially notable. With the transition of the insurance premium subsidies under the CAP framework, the national budget subsidies under the country's state aid programs were terminated.

There are tradeoffs between the two sources of funding. A key challenge with the state aid programs has been the uncertainty about the actual support rates farmers would receive. While the state aid framework allowed public support to go up to 65 percent of the paid premiums, the actual support intensities ended up being defined by the intersection between farmers' demand for aid and the available budget. Over time, this dynamic undermined system stability and farmer interest. One of the lessons learned was that, to maintain long-term sustainability, narrowing support intervals, e.g., setting a fixed range of 40–65 percent, would have helped farmers estimate their real insurance costs more accurately. Ensuring program continuity would have been equally critical. In turn, while CAP funding provides more predictability and stability through budget security and clearer participation criteria, it comes with other restrictions, especially concerning loss thresholds and support amounts, as defined in Article 76 of the CAP Regulation. Many current commercial insurance products, having damage thresholds lower than the 20 percent required under the CAP, do not meet Article 76 requirements. Only some fruit, vegetables and drought products are compliant, which is limiting CAP support uptake.

CAP market measures provide additional risk management support. Slovakia's viticulture and wine-making sector benefits from targeted support for vineyard insurance, with an average of 60 entities receiving up to EUR 350,000 annually through the EU market measures.

The government is also using disaster aid programs to deal with the increasingly severe events affecting its farmers. Such measures are implemented either within Agricultural Block Exemption Regulation or within the notified state aid and are financed from the national budget. Slovakia used large ex-post compensations for the catastrophic droughts that hit the sector in 2017 and in 2022 (Table 22). Ex-post compensation is now also planned for offsetting farmers' losses caused by the foot and mouth disease in 2025. However, payment delays have been an occasional challenge. For instance, the compensation for the 2017 drought, EUR 15.7 million, was not paid until 2019. Only 139 farmers received this support. Eligible applicants were those who lost more than 30 percent of their production due to drought, and subsidy rates ranged from 35 percent to 90 percent, depending on where the farmer operated and whether the crop was insured or not.

TABLE 22 State aid programs relevant for agricultural risk management in Slovakia

Million euros, 2014-2024

Type of program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Compensations	-	-	-	-	0.2	15.7	1.9	2.8	44.4	2.7	-
Subsidies on insurance premiums	-	-	-	-	-	4.0	5.0	6.0	8.0	8.0	-
COVID-19*	-	-	-	-	-	-	2.8	2.5	2.0	-	-
Ukraine	-	-	-	-	-	-	-	-	9.9	16.8	-
Other ARM-relevant programs	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	0.2	19.7	9.7	11.3	64.2	27.5	-

Source: Ministry of Agriculture and Rural Development of Slovakia.

Note: * these COVID-19 related measures were not implemented by the Ministry of Agriculture and Rural Development; rather, they were implemented by the Ministry of Economy, Ministry of Labor, and Ministry of Investment, Regional Development and Innovation, but farmers were eligible to participate.

There is no fund for catastrophic risks in Slovakia, even though discussions on establishing a so-called Risk Fund covering catastrophic risks have been in place for decades. Unfortunately, an analysis conducted by the Slovak Ministry of Agriculture and Rural Development revealed that establishing a Risk Fund would be demanding in terms of capacity, finances, and institutions involved, and its effective operation would face issues with asymmetric information. Slovakia currently lacks the necessary skilled professionals in agricultural insurance, legislative groundwork, and technical and information capacities, and lacks proof of long-term sustainability for such a fund.

A representative survey (Pokrivčák and Tóth, 2020) shows that farmers are interested in compensation for catastrophic or uninsurable risks, especially drought, frost, and wildlife damage. Commercial insurance is not viable for these risks in the long term. One insurer offers drought index insurance, which only partially meets farmers' needs. EU legislation allows state aid to cover hard-to-insure and uninsurable risks.

Exceptional EU-support packages also provided significant compensations to Slovak farmers, especially in the recent years, adding to the national resources. In 2016, the European Commission activated a EUR 500 million package to stabilize the dairy and livestock sector struggling with market challenges. Slovakia received EUR 2.46 million in conditional adjustment aid, which was matched by national resources, effectively doubling the support. In 2021, Slovakia used EUR 3.654 million under Measure 21 (of which EUR 2.7 million came from EAFRD), providing exceptional temporary support to about 160 farmers particularly affected by the COVID-19 pandemic. In 2023, Slovakia received EUR 5.24 million from the EU Agricultural Reserve to address disruptions in agricultural markets caused by the developments in Ukraine. It topped-up this EU funding with another EUR 10.48 million, resulting in total support of EUR 15.72 million. These funds were allocated exclusively to wheat farmers, at a base rate of EUR 38.42 per hectare.

Against this background, we conducted an actuarial analysis to quantify the risks the Slovak agriculture is facing and design an illustrative financial strategy to enhance the country's resilience against them. We considered a representative portfolio of seven key crops and cow milk, valued at nearly EUR 1.6 billion, representing approximately 60 percent of the country's total agricultural production value. The analysis estimates that the sector faces an expected annual loss of almost EUR 70 million, which is about 4.4 percent of the portfolio's total value. This underscores the sector's vulnerability to adverse events, such as the widespread drought in 2022. In the case of an extreme event with a 1 percent probability (a 1-in-100-year event), losses could escalate to EUR 367 million.

While certain crops such as grain maize and common wheat are major contributors to potential losses, the portfolio, as a whole, benefits from the fact that not all products are affected by shocks in the same way. This imperfect correlation between products creates a natural buffer, reducing the overall financial liability. For instance, at a 1-in-100-year loss level, this diversification benefit is estimated to be EUR 138 million, demonstrating that a portfolio-based view is crucial for accurately assessing and managing systemic agricultural risks.

To manage the financial impact of these potential losses, an illustrative financial strategy was developed to show how the government can proactively manage these contingent liabilities. This layered approach combines retaining a manageable portion of the risk with transferring the most severe, less frequent risks to third parties.

Layer 1: Risk Retention. The risk retention layer involves establishing pre-arranged financing to cover more frequent losses. This layer's purpose is to provide immediate liquidity for events that are more likely to occur. It totals EUR 245 million and consists of two parts: (a) an annual budget allocation of EUR 125 million for farmer support; and (b) a supplementary reserve fund of EUR 120 million. The purpose of the reserve fund is to accumulate resources over time, invest them in high-quality financial instruments to earn interest, and deploy them for less frequent but more severe events. Together, these risk retention instruments are designed to cover losses up to a 1-in-20-year severity, providing a robust foundation for the country's response capacity.

Layer 2: Risk Transfer for Extreme Events. For more extreme and catastrophic events that would overwhelm these reserves, the illustrative strategy incorporates a risk transfer layer. This layer's purpose is to shield the national budget from the most severe shocks by transferring the risk to the market. It involves a national-level area yield index insurance product designed to trigger payouts to the government when production

losses reach a severe threshold (events occurring with a 5 percent to 1 percent probability). With a total coverage limit of EUR 184 million, this instrument would protect against major disasters at an estimated technical premium of EUR 8.35 million annually. In comparison to existing mechanisms, this national-level instrument would complement, not replace, current farm-level insurance subsidies. While farm-level insurance addresses individual losses, the proposed national instrument is designed to manage systemic, widespread disasters that affect a large portion of the sector simultaneously, providing a macro-level financial backstop for the government.

The analysis demonstrates that by adopting a strategic, layered approach to disaster risk financing, Slovakia can significantly enhance its capacity to manage agricultural shocks. This illustrative strategy provides a clear pathway to building fiscal resilience, ensuring that public funds are protected and that support can be delivered to the agricultural sector when it is needed most. However, even with these instruments in place, a residual risk for the most catastrophic events remains. For a 1-in-100-year loss event, the total loss is estimated at EUR 367 million. The pre-arranged instruments would not cover all of it; after exhausting the risk retention funds and receiving an estimated EUR 68.7 million from the risk transfer mechanism, there would still be a financing gap of around EUR 53 million. This remaining liability would require emergency budget reallocations, highlighting the immense financial pressure that catastrophic events can place on public finances and critical national priorities.

To conclude, effective risk management in Slovak agriculture faces structural and institutional barriers. Farmers are most concerned about price and production risks, but current insurance products are often too complex, costly, and insufficiently tailored to the needs of the small and medium-sized farms. Limited awareness, lack of advisory services, and unstable public support further undermine participation. Past inconsistencies in the levels of premium subsidies payment deadlines have affected trust in risk management tools. While CAP direct payments and ANC schemes provide some financial stability, they cannot substitute for robust insurance, particularly as climate and catastrophic risks grow. Addressing these challenges requires a more flexible approach—combining state aid for hard-to-insure risks and prioritizing higher support rates for resource-intensive sectors. Investment in knowledge transfer, advisory services, and long-term capacity building is essential; without these, innovative solutions like mutual funds and risk pools will struggle to succeed.

To strengthen agricultural risk management in Slovakia, it is essential to make the CAP toolkit more flexible and enable member states to better integrate funding between national and EU budgets as needed. Priority should be given to strengthening preventive measures, such as investments in water retention, erosion control, and infrastructure, and overcompensation for losses. Facilitating cross-border insurance services and sharing best practices across the EU will help address challenges faced by smaller member states.

5 AGRI-RISK SOLUTIONS FOR THE FUTURE

The recommendations below aim to both increase the effectiveness, coverage and use of the CAP risk management toolkit, and to make it more agile in face of evolving risks. Recommendations 1-5 seek to provide concrete solutions for expanding the scope of the current ARM tools, through greater coverage, promotion of innovative products, improved access for small farmers, and adaptation/extension of the existing CAP tools. Recommendations 6-9 focus on building a strong foundation for making risk management at EU and Member State level more effective, through increasing transparency, facilitating knowledge-sharing and pooling/building data systems that are conducive to increasing the evidence base for the benefit of all relevant sector risk stakeholders.

RECOMMENDATION 1:

Expand the scope of insurance and other ARM tools and promote innovation in their design

Flexibility in the implementation of CAP-supported ARM products and greater innovation in the design of such tools are critical for best responding to the rapidly changing production and regulatory environments. The European Commission can play a major role in promoting this through three broad interventions.

Firstly, the European Commission needs to clarify that ARM products targeting the revenue of agricultural production activities are eligible for EU premium support. In referring to agricultural risk management, the 2013 and 2021 CAP Regulations only mention “production” and “income” losses, while “revenue” losses are also an important reference for farmers and need to be distinguished from income losses. Since revenue is defined as the product between production and price, tools that protect revenue - just like income protection products - should not be considered among the class of products that compensate for price reductions, which are not eligible for public support in the CAP framework. Since revenue has not been explicitly mentioned in the CAP regulations, and interactions between Member States and the Commission have led to the view that revenue products are not eligible for EU premium support, unlike in other non-EU markets, such products have rarely been offered in the EU. Revenue insurance has been retailed in Italy for a brief period, but with very low take-up since the policies were not eligible for CAP subsidies and some support was provided through de minimis state aid. France also designed and tested revenue insurance in 2010, but this did not succeed because of similar issues with CAP support. In contrast, under the Federal Crop Insurance Program of the United States, approximately two-thirds of the value insured is currently covered by revenue policies.

Specifically, it would be helpful to expand the scope of the post-2027 CAP regulatory articles replacing article 76 of Regulation EU 2015/2021, to include “revenue” losses, together with “production” and “income” losses. This will allow Member States to use CAP resources more broadly, and support ARM tools that also cover revenue fluctuations.

The lack of established and functioning markets for futures contracts on agricultural commodities in EU countries may need to be considered. These markets are often used to establish a reference for the price component of the contract, as is currently done in the United States, for instance. Actuarial technical assistance for developing appropriate guidelines or methodologies for including price risk in a revenue contract would be useful for overcoming this gap.

Secondly, the European Commission needs to provide guidelines on the implementation of indexes in ARM tools. When used in the appropriate context, indexes represent a useful component of ARM strategies. The Commission can facilitate the implementation of index approaches by developing guidelines with clear, accurate, and conducive definitions of the features required for such products to be eligible for CAP support. Earlier indications provided in the Fiche for Measure 17 of the 2014- 2021 programming period did not fully capture the dynamics of index insurance in the agricultural domain. An option could also be to recommend the setting up of national committees to validate indices, as done in France and Italy, for instance. It should be noted that, unlike the previous CAP Regulations, Article 12 of the Regulation proposal COM(2025) 560 does not mention the possibility of adopting the index approach among CAP-supported ARM tools.

The guidelines on the use of indexes in CAP supported ARM tools would need to be clear and should be developed with the assistance of technical experts. For instance, a downside of the former Fiche for Measure 17 was that it was imposing unrealistic conditions (e.g., in terms of the basis risk). It is important that the new guidelines also discipline issues related to the potential misuse of index insurance products, which are structurally exposed to basis risk (i.e., the potential mismatch between losses and payouts).

Lastly, the European Commission could support research and development efforts for developing, testing, and launching innovative instruments to cope with new challenges. Such challenges are resulting, for instance, from the green transition of agricultural practices or from the emerging risks due to bans on traditional phytosanitary products and are insufficiently addressed by traditional ARM products. The ARM offering can be varied. Instruments can be based on the traditional insurance approach, but linked to a specific production practice (e.g., loss of value in quantity or quality because of new green agricultural or livestock practices). Alternatively, they can be purely financial in nature (e.g., flexibility of loan terms depending on the occurrence of events that impact on the volume or quality of production; specific guarantees). Finally, they can be extended to combine quantity, quality and market losses (i.e., revenue or margin insurance per production unit, linked to the adoption of specific technologies or to specific climatic event constraints).

Specifically, one proposal is that the European Commission introduces in its post-2027 regulations the possibility to support research and development done by insurance companies and banks. As these tools need to be developed only for a transitional period, the return period may not be long enough to render them sustainable for private sector developers, and, as such, they may justify public backing for their design and implementation. Development risks are high, even if sector demand is likely to be strong given the mandatory provisions under the One Health concept. The public support element would enable insurance companies, banks and financial institutions to develop, test and launch such specific ARM instruments. Some credit institutions are already developing innovative financial instruments linked to new agricultural risks, while French insurers are also considering the issue. The first stage of contract design is not costly if well-organized between financial institutions, national research agencies and farmers' groups (cooperatives and/or farmers unions). The second stage cost – for pilot testing – depends on the regional diversity of the current agricultural practices within the EU. The third stage cost – for implementation – will depend on the shape of the adoption curve.

Another proposal is to expand the provisions replacing Article 76 of Regulation (EU) 2015/2021 to include financial contributions for agricultural credit tools addressing emerging risk events. Experience shows that financial instruments are more flexible and easier to develop than insurance instruments. They may therefore be better suited for managing transition risks, which are, by definition, limited in time. However, just like the innovative insurance products, they face risks concerning development and adoption and could justify public support during the transition period.

A final and related proposal is to introduce flexibility in the definition of the loss threshold in the provisions replacing Article 76 of Regulation (EU) 2015/2021. To begin with, the threshold is already unsuitable for handling general sanitary risks, as France's attempt with the FMSE and decision to opt out of

EAFRD funding in 2025 already demonstrate. The reason is that these risks require rapid and effective containment, which may not meet the 20 percent bar –thereby creating a disincentive for sector stakeholders to report a crisis timely, while losses are minimal. A similar challenge may be encountered when managing the new risks associated with the green transition, which, in some cases, may reduce the effectiveness of the sanitary prevention methods. Considering all this, a lower and more flexible loss threshold could expand the Member State opportunities to tap into CAP funding and better handle these specific risks.

RECOMMENDATION 2:

Lower insurance barriers and transaction costs to expand small-farm uptake

Small farms face the steepest barriers to agricultural insurance because fixed and semi-fixed loadings dominate small premiums: distribution and contracting, claims handling, data uncertainty and catastrophe margins, plus the farmer’s own administrative effort. At low insured values, these costs outweigh the pure risk, and multi-step subsidy procedures add transaction costs and strain cash flow. In addition, traditional insurance distribution finds small stand-alone contracts commercially unattractive. Acquisition and servicing costs per policy are mostly fixed, including claims intake and loss assessment, while commissions and sales targets grow with premium size. Agents and brokers therefore prioritize larger contracts or pooled portfolios, leaving small farms underserved, with fewer product options, slower service and higher effective loadings. As a result, small or lower-risk farms face the highest markup per euro of risk, making contracts unattractive and costly, with limited accessibility and options from the supply side.

Several measures proposed below can help broaden small-farm participation in the insurance system. They can achieve this by lowering entry barriers, reducing loadings in the net premium, and cutting transaction costs by addressing bureaucratic bottlenecks and cash-flow exposure. For them to be effective, the system should also ensure traceability and transparency of cost items, to prevent positions of power that run counter to the interests of affiliated farmers.

The post-2027 CAP regulations could authorize targeted premium support above the current 70 percent ceiling, up to 85 percent, specifically for small contracts. The additional aid would be tied to a maximum contract size to reduce the weight of loadings and align the net premium more closely with the underlying risk. This could be implemented under a “small contract regime”, to which farmers may adhere. Within the CAP, the Small Farmers’ Scheme has already been implemented and can serve as a reference for a “small contract regime”. The small incremental implementation costs will likely be offset by greater farmer participation in the insurance scheme. It is important to mention that, currently, Article 12 of the new CAP proposal does not preclude applying such a higher support rate. Further to the EU regulatory provisions, and, possibly, implementation guidelines that could be issued by the European Commission, Member States may then consider modulating insurance aid by contract size during implementation.

The post-2027 CAP provisions could also allow farmer aggregations to be accredited as eligible intermediaries under CAP-supported schemes and empower them to submit a single aid application on behalf of their members for the pools they manage. To this end, the new regulations could explicitly recognize accredited farmer aggregations as eligible intermediaries. The CMO approach (see Article 49 of Regulation 1308/2013, referring to the wine sector) is already going in this direction, by allowing subsidies to be channeled through insurers, though not yet through farmer aggregations. If such regulatory changes are introduced, Member States will then be responsible for ensuring the accreditation of farmer aggregations as intermediaries and adopting smooth implementation procedures.

Finally, the post-2027 CAP could permit the public contribution to be applied upfront, so farmers pay the premium net of the subsidy from the outset. Outside the CAP, insurance pools with subsidies netted at source show how fixed and transaction costs can be reduced (e.g., Spain).

RECOMMENDATION 3:**Re-confirm and strengthen provisions and assistance in implementing mutual funds**

Mutual funds for managing production and income risks are intended to complement agricultural insurance, yet their use within the CAP remains very limited. These instruments can be valuable where insurance becomes inefficient or unavailable: when premiums are prohibitively high because transaction costs absorb much of the premium; when certain risks are uninsurable, such as income volatility or localized pests and diseases; or when risks become unpredictable during the ecological transition, for example following pesticide bans. Despite their potential, implementation across Member States has been sporadic. Complexity of design, legal uncertainty on eligibility and cost recognition, fragmented guidance and lengthy procedures have led many administrations to abandon or delay these tools. As a result, most funds remain pilots with little scale or continuity.

To improve their uptake, support for mutual funds, compensating production or income losses, needs to be confirmed in the post-2027 CAP, while their design, accreditation and operation need to be radically simplified. A clear reference to these tools in the new CAP proposal is important to prevent their abandonment in favor of already well-established instruments, such as insurance. However, this recommendation does not require amendments to regulations but rather technical solutions for designing effective and efficient mutual funds. The priority is therefore practical and involves establishing a permanent EU-level helpdesk to provide technical assistance to Member States and to fund managers in designing and running mutual schemes. Once the general principles are defined, the European Commission could publish detailed technical guidelines, complemented by hands-on assistance and common templates, and ensure hands-on assistance to Member States and key stakeholders. Clear rules, technical guidance and accessible support structures would enable these instruments to move from sporadic pilots to scalable schemes, strengthening the resilience of farmers against risks not adequately covered by insurance.

It would be equally important to extend the support for mutual funds to cover revenue losses, not only production or income losses, ensuring coherence with other ARM tools (Recommendation 1). This approach, consistent with Commission Recommendation (EU) 2019/1665 of 30 September 2019 on Article 33(3) of Regulation 1308/2013, which in point 6(b) allows Member States to use the value of marketed production (VMP) as a proxy for income, would also simplify implementation, especially in cases where the cost components included in income-based stabilization tools are limited and show little variation over time.

In addition, the capacity of the EU CAP Network could be reinforced to bring stakeholders together and deliver practical solutions. Emphasis should be placed on pooling the experiences of Member States, such as Italy and France, together with lessons from those that failed to operationalize these tools. This would help build shared know-how and solutions across the EU Member States. Italy provides concrete experience in the implementation of mutual funds and IST from the perspective of fund managers. France placed significant effort in developing sectoral IST, but the process is still ongoing.

In this context, solutions and services should be identified immediately, so they are available before the definition of the new National and Regional Strategic Plans. This will ensure application from the very start of the next CAP period. Failing to do this may result in further implementation delays at the start of the next CAP cycle, and subsequent low uptake.

RECOMMENDATION 4:**Harmonize support for agricultural risk management tools under a dedicated CAP framework**

Uneven treatment of risk management tools under the CAP undermines both efficiency and uptake. Insurance, mutual funds and income stabilization tools are supported under different legal bases, each with divergent conditions. For example, insurance in the CAP Strategic Plans is subsidized up to 70 percent, while under the wine CMO the support ranges from 50 percent to 80 percent. Only the wine CMO allows

intermediaries to receive public contributions directly, while, in other schemes, farmers must apply individually. Mutual funds under Article 76 can be co-financed up to 70 percent, yet under sectoral interventions only up to 50 percent and without eligibility for initial capitalization and annual payments into the fund. Furthermore, insurance is subsidized on the entire premium, which includes all loadings (management, claims, loss assessment, reinsurance), whereas for mutual funds support covers only the pure risk contribution. Essential operating costs are excluded, forcing managers to finance them from their own budgets and thereby limiting scale and effectiveness. Fragmented rules subject similar instruments to different treatment, create legal and operational uncertainty for fund managers and authorities, and discourage Member States from programming risk management tools in their Strategic Plans. The result is uneven delivery performance, with wide disparities in the timeliness and efficiency of support.

In response, the post-2027 CAP would be well served by recognizing the specificity of agricultural risk management by establishing a dedicated and harmonized framework across all instruments. This would involve aligning support conditions, eligible costs, and administrative pathways across the successor provisions of Articles 76 and 47 of Regulation (EU) 2115/2021, and the wine CMO. Such alignment could cover: (i) uniform eligibility for the initial capitalization of mutual funds; (ii) harmonized aid intensities for comparable instruments, while retaining the higher targeted rate for small contracts (see Recommendation 2); (iii) an explicit allowance for both local and national mutual funds to use their resources for management costs, loss assessment, and prudent risk transfer within capped, auditable limits; (iv) clear demarcation criteria to prevent overlaps between insurance and mutual schemes; and (v) a common, flexible access procedure with fixed annual payment deadlines to ensure timely reimbursements. A level playing field with clear eligible costs and streamlined access would lower procedural barriers, improve predictability, and drive uptake of tools that protect both production and farm incomes. To this end, the European Commission could leverage the broad formulation of the new CAP's Article 12 and its linkage to sectoral interventions in the proposed revision of CMO to propose establishing a dedicated ARM access procedure with fixed annual payment deadlines. Furthermore, it could provide standard templates and clear guidance specifying the measures envisaged and the requirements to meet the objectives and recommendations under the new CAP regulations for the new National and Regional Plans. While harmonization primarily concerns EU-level regulatory frameworks, consistent implementation by Member States will be essential to ensure coherence, prevent market fragmentation, and guarantee equal access to risk management support across the EU.

RECOMMENDATION 5:

Clarify the regulatory framework for the adoption of co-insurance and co-reinsurance pools in agriculture in the EU Member States.

Co-insurance pools for agricultural risks have been successfully implemented in various countries, and some EU Member States see it as an approach worth exploring. Co-insurance pools are agreements between a group of insurers and/or reinsurers who join their capacities to cover certain types of risks. The members of the pool share premiums and claims based on an agreed participation quota in the pool. An example in the EU is the Spanish agricultural insurance framework, which relies on a co-insurance pool operated through the managing agency Agroseguro. Türkiye is also relying on a similarly designed co-insurance pool. Co-reinsurance pools are also adopted in agricultural markets (see, for example, the co-reinsurance pool for agricultural risks in Italy). Given that insurers' aggregations can be seen as a limitation in market competition, there is uncertainty about the possibility of establishing such agreements in EU jurisdictions.

The European Commission, with support from the European Insurance and Occupational Pensions Authority (the EU insurance supervisor), could clarify the issue and develop guidelines on the EU and national regulatory frameworks for the establishment of co-insurance/co-reinsurance pools for agricultural insurance programs. This would allow the EU countries to consider a wider set of options in developing advanced agricultural risk management programs. In particular, it would be useful to provide clear guidelines for Member States on what is regulated at the EU level and what is subject to national legislation, as soon as technically possible.

RECOMMENDATION 6:**Improve transparency and data collection of the national and EU-funded disaster relief mechanisms for farmers**

Faced with new challenges, Member States have consistently and continuously increased their payments to farmers, from CAP support to state aid and de minimis measures. In recent years, global challenges have posed increased threats to the resilience and competitiveness of Europe's agri-food systems, at unprecedented levels. In reaction to a worsening geopolitical situation, as well as more frequent and widespread extreme weather events, the European Commission and EU Member States have put forward an array of policy measures and financial resources, at both national and EU-level. This has translated into a proliferation of short-term and often one-off crisis-relief responses.

However, the collection of information on such measures and related expenditure is not streamlined, nor reported on in a consistent way. A regular tracking of individual Member States' tools and funding to crises in the agricultural sector is needed to, firstly, ensure a level-playing field in the single market and avoid unfair competition and, secondly, to provide a solid dataset to be used as a basis for relevant and efficient risk management strategies. Improving transparency and streamlining data collection would in fact allow policy makers to design support packages which are grounded in evidence and provide researchers with fundamental insights to further develop comprehensive risk management approaches.

Transparency could be improved through better classification and reporting in the state aid database. The recent amendment in relation to the reporting of de minimis aid is, in that context, a step in the right direction. More fundamentally, the European Commission, with dedicated resources, could support greater transparency on ARM-relevant state aids and ARM-relevant de minimis support. Specific provisions could be included in the relevant future Regulation, empowering the Commission to request and collect the relevant data from all the Member States in a streamlined manner. The provisions should specify and regulate the form and content of these reports, based on the existing national practices, as well as the timing for delivery. The European Commission could then publish comprehensive reports bi-annually (or on another agreed regular schedule), with a first report aimed at being published when the new Multiannual Financial Framework becomes effective. Moreover, using its Agri-Food Data Portal, the European Commission could take responsibility for gathering a robust set of data into a single repository and produce an exhaustive report, including all risk management-related instruments and financing at both national and EU-level; these could be published at least every two years.

RECOMMENDATION 7:**Provide Technical Assistance for medium- to long-term projections of climate change and other hazards' impact on risks, including country risk profiling**

Agriculture risk management starts from adaptation to evolving scenarios, one of the core principles of rural development policies. Enhanced understanding and analysis of risk is key for facilitating adaptation processes and would allow rural development policy makers to design policies that support climate adaptation practices and manage climate risks better. This requires broad access to risk scenario analyses across Member States and regions.

The European Commission, with adequate financing, could facilitate Technical Assistance to assist Member States in estimating production losses due to adverse climate events (including their sanitary repercussions) under current and future climate scenarios. Actuarial analysis is critical for fair-pricing the pure risk premium of ARM tools, crop insurance contracts or mutual funds. Forward-looking agri-climatic models can estimate average production losses and losses for decennial, quinquennial and centennial extreme adverse events. The agro-climatic model¹³ of the Central Re-Insurance Fund (CCR) in France and possibly other Member States can serve as an example. The distribution of production losses, by quantity and quality, at current and future climate sce-

13 Kapsambelis, D.; Moncoulon, D.; Veysseire, M.; Soubeyroux, J.-M.; Cordier, J., (2022), "Modeling the Impact of Extreme Droughts on Agriculture under Current and Future Climate Conditions Using a Spatialized Climatic Index. Appl. Sci. 12, 2481. <https://doi.org/10.3390/app12052481>

narios estimated by agri-climatic models, makes it possible to estimate the pure risk premium of ARM instruments, while at the same time estimating the economic gain from measures to adapt agriculture to climate change.

A helpful first step would be to identify the models available in the Member States, as well as the ad hoc work of the European Commission. It will then be useful to supplement the information, as necessary, with all the Member States. This may require mandating provision of adequate agronomic, meteorological and remote sensing data from the Member States. The information thus collected or created will allow: (1) the best pricing of pure risk premiums of ARM instruments, and (2) the optimization of rural development policies for adaptation to climate change.

Second to that, Member States should be expected to conduct their own broad risk assessments that would inform their programming and policy decisions. The European Commission could provide a framework for conducting agricultural risk assessments in the Member States. One such example is the World Bank's Agricultural Sector Risk Assessment framework (see Box 7). Such evaluations could be used as a basis for programming and justifying the utilization of post-2027 CAP funds.

BOX 7 The Blueprint of the World Bank Agricultural Sector Risk Assessment Framework

The World Bank's Agricultural Sector Risk Assessment framework is built around three core components: risk identification, risk prioritization, and risk management strategy development. The first step—risk identification—focuses on mapping the full spectrum of risks affecting the agricultural sector, including production risks (e.g. droughts, floods, pests), market and price risks, institutional and policy risks, and environmental risks. This process relies heavily on historical data analysis, stakeholder consultations, and spatial mapping to understand the frequency, severity, and geographic distribution of risks. It also considers systemic vulnerabilities such as climate change, infrastructure gaps, and weak institutional capacity that may amplify risk exposure.

The second component—risk prioritization—aims to rank the identified risks based on their potential impact on agricultural outcomes. This involves quantitative modeling (e.g. loss estimation, scenario analysis) and qualitative assessments to determine which risks are most critical and require immediate attention. The framework emphasizes the importance of distinguishing between idiosyncratic risks (affecting individual farms) and systemic risks (affecting entire regions or value chains), as well as understanding the coping capacity of different stakeholders. Prioritization helps governments and development partners allocate resources efficiently and design targeted interventions.

The final component—risk management strategy development—focuses on designing a comprehensive and integrated approach to reduce, transfer, and cope with prioritized risks. This includes promoting climate-smart agriculture, investing in infrastructure (e.g. irrigation, storage), strengthening early warning systems, and expanding access to financial instruments such as insurance and credit. The framework encourages a layered strategy that combines public and private sector roles and aligns short-term responses with long-term resilience goals. It also highlights the need for institutional coordination and policy coherence to ensure that risk management is embedded across agricultural planning, budgeting, and investment processes.

RECOMMENDATION 8:

Set up formal means and opportunities for information sharing and knowledge transfer to support stakeholders in the Member States to design and implement ARM tools

As already suggested in the previous recommendations, Technical Assistance on ARM is critical, and many issues regarding the implementation and uptake of ARM tools may be traced back to a lack of understanding and expertise at Member State level. For example, the low adoption of mutual funds as an ARM tool can be also explained by the technical complexity of designing and implementing such interventions. Member States may not have the required understanding and expertise, as was evidenced by some of the countries covered in the deep dive analyses under this report.

Information sharing and knowledge transfer initiatives may help improve understanding of ARM and enhance the adoption of more advanced ARM programs. These can range from EU forums on risk management in agriculture to a structured EU technical assistance body. The European Commission could take the leadership, as soon as possible, on providing such means and technical assistance to its Member States.

These activities could expand to disaster risk financing as well as other tools that may not necessarily be covered under the CAP. Many Member States are developing disaster funds to support the private or public-private insurance system or to support farmers for non-insurable risks. These disaster funds are supposed to act within the catastrophic risk layer. Building efficient national and European risk management for this layer requires some degree of clarification and harmonization of the rules of management (such as loss triggers, definition of reference prices, calculation of losses, etc.). This is important for ensuring fair competition among Member States but also for allowing risk transfer of catastrophic events (e.g. quinquennial losses for current or future climate scenarios) to traditional or alternative reinsurance, if needed by Member States.

RECOMMENDATION 9:

Streamline ARM-relevant data collection, reporting and use across the EU and at Member State level

The efficient functioning of the ARM tools relies on good data management. Agricultural risk management requires diverse data, including on-farm data (soil, crop health, input costs, yields, financial records), weather and climate data (rainfall, temperature, wind, both in historical patterns and forecasts), market data (input and commodity prices), and environmental data (water rights, watershed boundaries) to enable accurate risk identification, analysis, and informed decision-making for mitigating potential losses and improving farm sustainability.

Farmers, insurance companies and policy makers have different, though partially overlapping, data needs for risk management. Farmers depend on timely, localized information—such as weather forecasts, market price updates, pest outbreak warnings, and soil conditions—to manage on-farm agricultural risks and make informed decisions. Today, a wide range of data platforms and services deliver these risk-relevant data to farmers. Insurance companies rely on granular, high-frequency data such as historical crop yields, weather records (rainfall, temperature, drought indices), and satellite-derived vegetation indices (e.g., Normalized Difference Vegetation Index, NDVI) to model hazard probabilities, price premiums, and verify claims with minimal basis risk. They also use market price data and pest/disease occurrence to refine underwriting and product design. Policymakers, on the other hand, require longitudinal and aggregated data to monitor sector-wide resilience, design interventions, and evaluate policy impacts. This includes climate trends, production losses, price volatility, and socio-economic indicators like farm income and asset profiles. While farmers and insurers prioritize precision and timeliness for operational decisions, policy-makers emphasize coverage, comparability, and historical depth to inform strategic planning.

At the EU level, the European Commission could lead on two aspects. First, it could enable broad data collection and consolidation to inform ARM policymaking. A specific component of this could be data on losses and compensations (see Recommendation 6). This could be done through technical assistance that can be carried out in stages, as follows: the first stage would provide an inventory of ARM relevant data at EU level and identify any gaps; a second stage would provide technical guidelines to Member States and, as appropriate, involve cooperation with various agencies (such as the European Environmental Agency or European Food Safety Authority) to enable consolidation of existing data and cover critical gaps through adequate collection and reporting. The public data thus gathered could then be published in one of the key EU statistical repositories, such as Eurostat (possibly in a dedicated module, like the reporting used for tracking greenhouse gas emissions), and/or the Commission's Agri-Food Data Portal. Second, the European Commission could lead on the refinement of the ARM monitoring and evaluation framework in the post-2027 CAP. This can be achieved through including context indicators on risks, ensuring that sanitary risks are adequately covered in the new monitoring framework, and providing methodological support to Member States on risk management indicators and on the impact evaluation of risk management measures. These activities could be done in partnership with the European Evaluation Helpdesk for the CAP, which is a part of the EU CAP Network.

Member States could also make efforts to provide better data and services to their farmers and other stakeholders. Regarding the former, a key objective could be to increase the availability of data and reduce access costs for farmers and insurance industry alike. This can be achieved by making public data platforms available to farmers and other stakeholders, and, where possible, maximizing the inter-operability across various national data sources and platforms to benefit ARM decisions (see Box 8). In this context, early

warning systems (covering weather, sanitary and other risks) need to play an important role. Governments can also improve ARM-related services to their constituents in various ways. For instance, they can invest in supporting innovative instruments like climate index insurance and revenue or income protection tools, leveraging complex datasets that include market prices, individual or area yields, subsidy levels, production costs (e.g. FADN-based indices), and other relevant indicators. At the same time, governments can support farmers, through extension, dedicated applications, guidelines and other tools, to conduct better on-farm risk assessments and prepare better risk management plans (see Box 8). While the development and operating costs of such tools can be moderate to significant, these can deliver important benefits to the farmers. Public-private partnerships can be an important way to share both costs and benefits between the relevant stakeholders.

BOX 8 Global examples of public or public-private risk management services to farmers

Uruguay: Uruguay's National Agricultural Information System (SNIA) exemplifies a coordinated data platform that unifies diverse information streams — from climate and production to market and biosecurity data — to strengthen agricultural risk management. Led by the Ministry of Agriculture with support from the National Agricultural Research Institute (INIA) and international partners, SNIA uses tools like the IRI Data Library to ingest raw data on weather and climate, crops and livestock, economics and markets from multiple providers, standardizing these inputs in a common framework for cross-analysis. For example, SNIA links Uruguay's nationwide livestock traceability system with real-time climate and land-use data, allowing users to monitor herd distribution, stocking rates, and beef production by region in near real time. It also overlays climatic indicators with crop yield records and price statistics to generate integrated risk maps and decision-support tools — from drought severity indices and seasonal yield outlooks to forest fire alerts and index-based insurance models for previously underserved crops and cattle. This “one-stop” integrated system supports all stakeholders: farmers receive timely meteorological warnings and pest/disease alerts through interoperable digital services (e.g. a pesticide application traceability app and an early-warning network for extreme weather), insurers gain access to comprehensive historical risk data to design and price better coverage, and policymakers can holistically assess sector vulnerabilities and quickly coordinate responses using the consolidated, multi-layered information. By connecting previously siloed databases and knowledge “islands,” Uruguay's SNIA enables more proactive risk assessment and informed decision-making, bolstering the country's climate resilience and agricultural sustainability.

France: A headline initiative is ClimaTerra, launched in 2024 as part of France's national adaptation strategy. This is a comprehensive program that offers farmers a free climate vulnerability audit of their holding, followed by personalized adaptation planning and technical support. Through the Chambers of Agriculture (France's public agricultural advisory bodies), farmers can sign up to have a trained advisor visit their operation and perform a vulnerability assessment — essentially an on-farm risk assessment focused on climate-related risks like drought frequency, heat waves, late frosts, and new pest pressures. The assessment looks holistically at the farm's production systems (crops, livestock, soils, water resources) and past climate impacts. It then uses regional climate projections (the program uses scenarios of +2°C, +4°C, etc., aligned with national climate models) to identify future vulnerabilities. After this, the advisor works with the farmer to craft a strategic action plan with tailored adaptation measures. Importantly, ClimaTerra does not stop at planning, and continues to provide up to 4 days of free expert support per farm to help implement the chosen measures and monitor progress. The goal is to reach 10,000–15,000 farms per year by 2026, dramatically scaling up the practice of on-farm climate risk assessment and adaptation.

Canada: Canadian farmers benefit from strong government support for risk assessment, with a notable mix of innovative digital tools and integrated farm planning programs. A flagship initiative is the AgriShield platform — an online risk assessment and mitigation tool developed by Farm Management Canada with federal support, which delivers real-time farm risk assessments across multiple risk categories. AgriShield aggregates data on weather events, market fluctuations, pests, and more, and provides farmers with a 360° analysis of how these risks could negatively impact their specific operation. By centralizing many data sources, the tool helps farmers visualize vulnerabilities in advance and benchmark their risk exposure. The federal government's aim with such tools is to increase the share of farms with a formal risk management plan. Early outcomes indicate improved awareness: farmers using AgriShield or similar tools report better understanding of their risk profile and more proactive planning (e.g. setting aside cash reserves after assessing financial risk scenarios).

Australia: Biosecurity risk management at farm level is treated as a shared responsibility in Australia's system. The federal and state governments, together with industry organizations, run the Farm Biosecurity Program, which provides extensive educational materials and self-assessment tools for farmers. The program's flagship resource is the Farm Biosecurity Action Planner, a user-friendly checklist to help farmers systematically evaluate biosecurity risks on their property. It prompts farmers to assess areas such as entry biosecurity (gates, signage, visitor protocols), pest monitoring, animal health practices, and cleaning/disinfection routines. By working through the checklist, farmers identify strengths and weaknesses in their current practices and can then prioritize actions to reduce risk. The Farm Biosecurity Program, which is a joint initiative of Animal Health Australia and Plant Health Australia (with government funding and industry levy support), ensures these materials are widely disseminated, including templates for developing a formal on-farm biosecurity plan.

At the same time, Member States could intensify cooperation with their insurance industry. Fragmented data and limited transparency are undermining ARM. Currently, critical information on insurance products, pricing, and losses is often siloed among insurers and authorities – guarded as proprietary due to competitive concerns. This opacity leads to inefficient pricing (premiums include high loading costs for uncertainty and administrative overhead) and narrow insurance coverage, especially for small or specialty crops that lack shared data for assessing risk. At the same time, public reporting of adverse events (like droughts or pests) is inconsistent and opaque, making it hard to gauge how many farmers are affected or to compare outcomes across regions. Increased collaboration between Member State governments, private insurers, and mutual insurance organizations would help create a transparent information-sharing system. National authorities could lead by establishing frameworks (or mandates) for data sharing on insurance products, prices, claims, and payouts across the sector. This is a paradigm shift from today’s isolated, local data silos to a shared database or pool accessible by all partners. By pooling information, the industry can calculate pure risk premiums more accurately and eliminate redundant risk margins, which in turn lowers farmers’ premium costs and reduces transaction costs for all. It also enables insurers to design policies for currently underserved, niche agricultural products (e.g. minor/specialty crops) because with aggregated data, the uncertainty is reduced. To start this cooperation, Member State authorities should consider convening public-private working groups or platforms that could lead to better frameworks and tools for the sector. At the same time, Member States need to improve the transparency of reporting on adverse events and their impacts (see Recommendation 6).

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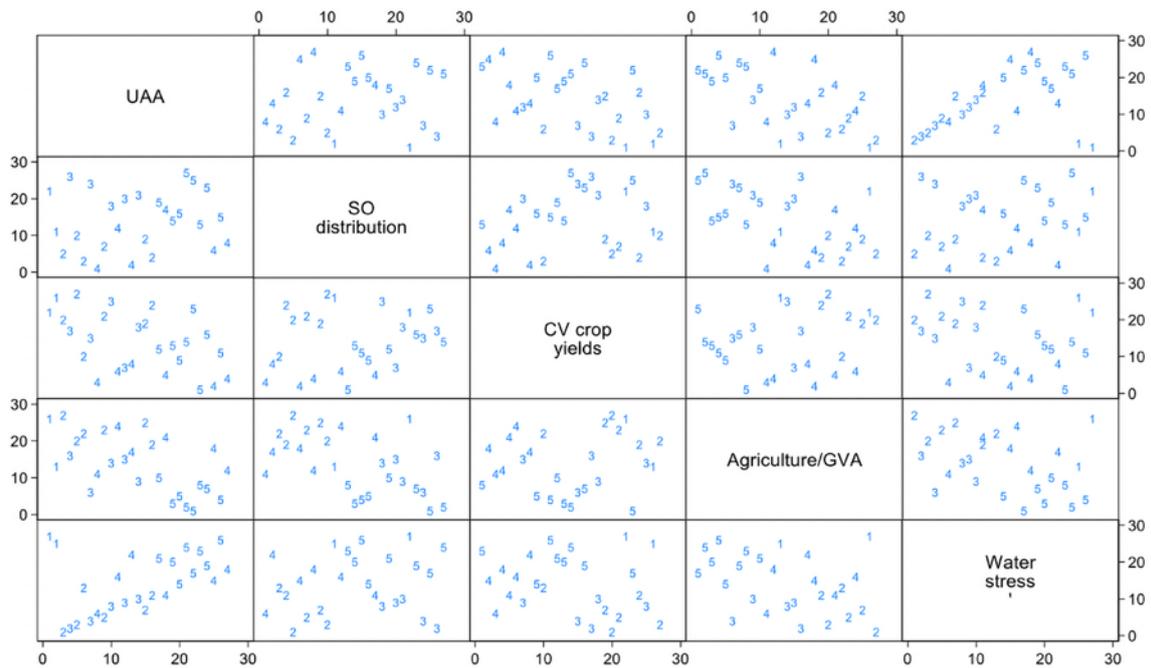
APPENDIX 1

Additional data and tables used in the econometric analysis

TABLE A.1 Summary statistics of clustering variables by the clusters

Segments	UAA	SO distribution	CV crop yields	Agriculture/GVA	Water stress
Segment 1	1.5	16.5	24	19.5	26
Segment 2	9	6.33	20.16	22.66	6.66
Segment 3	9.4	21.8	16.4	12	6.6
Segment 4	17	7.66	4.66	17.16	14.66
Segment 5	21.5	19	12.37	5	20.5
Total	14	14	14	14	13.96

FIGURE A.1 Matrix graph depicting the size of the clusters



APPENDIX 2

Econometric analysis methodology and detailed findings

To examine the drivers of ARM instruments and given the nature of our data, we rely on panel data methods represented by regression equations of the form:

$$ARM_{ct} = X_{ct}\delta + v_t + u_c + \varepsilon_{ct}$$

Where ARM_{ct} refers to the ARM expenditures for countries c under different time periods, t . We use public subsidies for risk management tools as our dependent variables. We distinguish between CAP-funded tools, with EU and national counterpart financing combined, on the one hand, and CAP and state-aid funded programs co-mingled over the period, on the other hand. While the former is our main dependent variables of interest and does not include state aid for insurance (or broader risk management tools), the latter is also used as it includes the countries that have not adopted the CAP risk management toolkit in 2014-2022 (Bulgaria, Slovakia) but have still provided insurance subsidies to their farmers. X_{ct} represents a vector of explanatory variables, reflecting different dimensions: (1) policy signals (state aid, share of direct payments in farm income), (2) sector structural features and risk exposure (water stress, utilized agricultural area, share of agriculture in the economy, agriculture as a share of the food value chain); (3) farm characteristics and choices (share of large farms, land under climate mitigation contracts, farm output to input ratio, off-farm income diversification), and (4) observed effects (coefficient of variation for some crops such as apples, grapes, maize, potato, and rapeseed). Their parameter estimate is reflected as δ . While a positive coefficient represents a positive driver of ARM expenditures, a negative coefficient represents an inverse association with ARM expenditures. v_t represents fixed effects and u_c stands for time invariant unobserved heterogeneity. ε_{ct} refers to the stochastic error term.

In our analysis, the state aid variable encompasses only the financial assistance provided to farmers after the occurrence of various adverse events, often as a means of alleviating subsequent economic hardship. These supports are typically triggered by weather and climate disasters, such as severe droughts, floods, or storms, as well as outbreaks of animal diseases. They are intended to help agricultural producers recover and continue their operations in the wake of significant disruptions. Although state aid can be understood in a broad sense as encompassing a variety of payments and supports, we deliberately excluded certain categories in this analysis. Among others, payments related to the COVID-19 pandemic and the impacts of the situation in Ukraine have not been included in our computation of state aid. This approach allows for a more accurate reflection of state support provided specifically in response to agricultural calamities rather than broader, extraordinary circumstances. Our analysis will test whether ex-post compensations provided to farmers have a negative effect on the uptake of ARM tools.

Direct payments as a share of gross farm income reflect the potential correlation between Pillar I support and the adoption of ARM instruments. Data for this variable comes from FADN. Total direct payments include coupled and decoupled EU and national subsidies, except on rural development, costs and purchase of animals. Gross farm income reflects total output, minus the intermediate consumption, plus the balance between current subsidies and taxes. On the one hand, direct payments can reduce farmers' exposure to price volatility and income fluctuations, thereby diminishing the need for other risk management tools such as insurance or futures contracts. On the other hand, they may also enable farmers to invest in risk-reducing practices, such as diversification or soil conservation, by improving liquidity and reducing financial constraints. Our analysis will show which correlation is observed.

Water stress in agriculture is measured using an index which captures the pressure on a country's renewable freshwater resources. It comes from the SDG Indicators Data Portal managed by FAOSTAT and is defined as the ratio between total freshwater withdrawn by agriculture and the total renewable freshwater resources available, after accounting for environmental water requirements needed to sustain ecosystems. This ratio is expressed as a percentage and indicates the degree to which water resources are exploited to meet a country's water demand. As a measure of drought, it is intuitive to expect a positive association between water stress and ARM adoption.

As a key descriptor of sector structural features, UAA represents the main land area used for farming activities across the EU. Higher UAA will create a broader asset base in the agricultural sector, and possibly a greater exposure to risk, commanding a greater utilization of ARM tools. However, bigger production could also imply better and more diverse production structures, which could reduce the demand for ARM.

The share of agriculture in the economy (GDP) could be a driver of ARM adoption since it reflects the sector's relative importance to the overall economy and its exposure to risks. A higher share indicates that agriculture plays a significant role in national income, highlighting that adverse events such as droughts, pests, or market shocks can have widespread economic and social impacts. This could lead to a greater prioritization of ARM strategies within the respective country.

The share of agriculture in the food value chain reflects the degree to which primary production is integrated in the broader food system. A high share indicates that the agricultural sector plays a dominating role in the chain of creating value added across the food sector and is equivalent to a low share of food processing and distribution. Depending on the size of the share, we expect a positive association with investments in ARM, as this would mean a larger agricultural sector which is exposed to various kinds of risks in the sector which would necessitate robust risk management strategies.

The share of large farms reflects the percentage of holdings greater than 100,000 EUR of standard output in each country's farm population. This variable is an indication of the farm structure in each Member State and displays strong contrasts within the group. France hosts a much larger share of big holdings than any of the other countries analyzed (51 percent in 2023, versus 15 percent in Slovakia, a distant second). Overall, there is a tendency of farm consolidation and holding size increase in all five countries over the period covered. We expect standard output to exhibit a positive relationship with spending on ARM, as literature shows that, in general, large farms tend to insure more. While this is largely telling of targeting which can influence take up, larger farms may require income support as they are largely vulnerable to income shocks (production, market and weather risks) (Severini et al., 2021). That said, this variable could also exhibit a negative correlation as larger farms may have better options to hedge risks over various production portfolios, making them less willing to invest in ARM.

The area under climate mitigation contracts refers to the share of agricultural land under supported commitments to improve climate mitigation and emission reduction. This includes initiatives to maintain and enhance carbon storage (including permanent grassland, permanent crops with permanent green cover, agricultural land in wetland and peatland). This variable, extracted from the Agri-Food Sata Portal, tracks the extent of climate commitments by farms, which are somewhat complementary to risk management. Some of these commitments are voluntary schemes within the CAP that pay farmers for environmentally friendly practices that go beyond mandatory standards and contribute to biodiversity, climate mitigation, water protection, and sustainable land management. In this regard, we expect an ambiguous relationship that could go in both directions as complements but also as substitutes.

The total output to input value reflects the cost structure and degree of economic pressure - or ease - faced by farms. The data has been extracted from FADN. A lower output to input ratio indicates that a larger portion of farm revenue is spent on inputs such as seeds, fertilizers, machinery, energy, and labor, which increases production costs and reduces profit margins. On the contrary, a higher output to input ratio may impose less financial pressure. The relationship between financial stress and the propensity to insure is nuanced, as literature shows. On the one hand, farmers with more wealth or financial resources may be less likely to insure, as they rely on self-insurance or feel confident in their capacity to cope with damage. On the other hand, smaller farmers with cash constraints are less likely to insure unless their liquidity levels increase and insurance becomes affordable to them.

Off-farm income diversification refers to the share of farm holders having other gainful livelihood activities. The data, obtained from Eurostat, highlights the extent to which farm operators diversify their income sources beyond agriculture, reflecting socio-economic realities such as: (i) supplementing farming income with off-farm work, (ii) partial or seasonal farming practices due to other employment, (iii) trends in rural labor markets and farming sustainability. This variable captures the economic resilience and diversification of farm households, labor allocation, and rural livelihood strategies (Cafiero et al., 2017; Barbieri and Mahoney, 2008). Given this complementarity with ARM, especially as it is itself a risk management strategy, we expect an inverse relationship with investments in ARM.

In all regression models, we also control for the coefficient of variation of some major crops including apples, grapes, maize, potato, rapeseed, and wheat. As a measure of yield variability, we expect this to have a context specific association with the use of ARM tools.

Recognizing that our dependent variable is subject to censoring—with values clustering at zero and extending continuously above this threshold—we opted for censored regression models to ensure robust estimation. Specifically, we utilized the Tobit model and model our outcomes as a corner solution model (Tobin, 1958). This model is particularly well-suited for situations where the outcome variable is not observed below or above certain limits. It assumes that that ε_{ct} is normally distributed, $\varepsilon_{ct} | X_{ct} \sim \text{Normal}(0, \sigma^2)$. This approach allows us to capture both the occurrence and the intensity of agricultural risk management expenditures across the five EU member states, yielding efficient and reliable estimates of the underlying determinants. Despite estimating the non-linear Tobit model, we also estimate a linear OLS model with country and time fixed effects for comparison purposes.

To facilitate the interpretation of our estimated coefficients and to accurately derive elasticity values, we apply two distinct transformation methods to our outcome variable. First, we utilize the natural logarithm transformation, which is commonly used in econometric analyses to address skewed data distributions. Recognizing the presence of numerous zero values in the data, we employ the standard approach of adding 1 to each observation prior to transformation, ensuring all values remain defined. In addition to the logarithmic approach, we implement the inverse hyperbolic sine (IHS) transformation (Aihounton and Henningsen, 2021). The IHS method is particularly advantageous when dealing with datasets containing zeros or negative values, as it preserves the integrity of the data and allows for consistent interpretation of coefficients. This dual transformation strategy helps to address potential limitations inherent in working with skewed or zero-heavy datasets.

To minimize bias and ensure our estimates are accurate and reliable, it is important to account for time invariant unobserved heterogeneity. Time invariant unobserved heterogeneity refers to various country unobservables that have not been measured or are difficult to measure. This could by and large take the form of omitted variable bias. Given that we have panel data, we could control this using various panel data methods. Two common panel data estimators are the fixed effect estimator and the random effect estimator. The fixed effect estimator has generally been used as the workhorse for many linear data models as it allows for possible correlation between μ_c and X_{ct} . By so doing, it treats time invariant unobserved heterogeneity as a as an unobserved random variable that is correlated with X_{ct} (Tabe-Ojong et al., 2022). While important, it could lead to the incidental parameters problem which is prevalent with non-linear models (where they cannot get absorbed) and could lead to biased and inconsistent estimates (Lancaster, 2000). This could be the case with this analysis as our outcomes take the form of a non-linear model. The random effect estimator on the other hand is somewhat different as it assumes that time invariant unobserved heterogeneity is not correlated with X_{ct} (Wooldridge, 2016). This is a strong and very naïve assumption to make as it is hard to intuitively explain this in real life except for randomized experiments.

Using either the FE or the RE model is always based on the nature of the outcomes and intuition but there are statistical tests that could support estimator choices. We run the Hausman test to see which estimator to use for our analysis. Based on the large p-values that we obtain, we fail to reject the null hypothesis that the RE model is the appropriate model. However, given the strong assumption of exogeneity of this model, we rely on the correlated random model (CRE) which is a flexible approach that relaxes this strict exogeneity assumption of the RE model (Mundlak, 1978; Chamberlain, 1984). The CRE model assumes that the correlation between μ_c and X_{ct} is linear function of the average across time of all time varying controls. As a flexible extension of the RE model, it avoids the incidental parameters problem common with fixed effects model but goes ahead to provide FE estimates for time invariant unobserved heterogeneity.

To confirm the validity of our estimates, we perform some robustness and validity checks. The first check is on how we control for time invariant unobserved heterogeneity. Although we used the correlated random effect model to control for this, we also rely on a variant of the FE estimator, the least squares dummy variable regression which is a variant of the FE estimator. The choice of this as opposed to the standard FE estimator is based on the premise that we are estimating a Tobit model - a classic nonlinear model that does not accommodate FE model. The least squares dummy variable simply introduces dummy variables that control different aspects of unobserved heterogeneity, in this case, we include country FEs. Table A.2, column 1, in the appendix shows the results of this estimation which is similar in sign, magnitude and direction to our original estimates.

The second robustness check is about the censoring thresholds in the Tobit model. When estimating the Tobit model, we intentionally avoided making strict assumptions regarding the precise level at which expenditure outcomes were censored. To demonstrate that this choice does not fundamentally influence our results, we explored models using both minimum and maximum censoring thresholds. In this context, minimum (left) censoring implies that all observed values of the dependent variable below a specific lower bound are truncated, so any value less than this threshold is effectively set at the limit. Conversely, maximum (right) censoring means that values above a certain upper bound are similarly truncated, with any values exceeding this point recorded at the maximum threshold. This approach allows us to assess the robustness of our estimates across different censoring specifications and ensures that our findings regarding expenditure are not an artifact of any censoring rule. Table A.2, columns 2 and 3, below shows these results which are very similar to our main estimates.

TABLE A.2 Drivers of Public Expenditure on Risk Management (robustness checks)

	(1) LSDV	(2) LC	(3) RC
State aid (disaster relief)	-0.185***	-0.245***	-0.167***
	(0.034)	(0.033)	(0.032)
Direct payments in farm income	-2.047***	-2.118	-2.993***
	(0.725)	(1.594)	(0.756)
Share of large farms	2.189***	3.098***	2.031***
	(0.509)	(0.479)	(0.476)
Land under climate mitigation contracts	27.472***	21.418***	26.625***
	(4.087)	(4.289)	(3.940)
Water stress	20.050***	6.500	24.986***
	(5.441)	(10.602)	(5.292)
Utilized agricultural area	-0.169***	-0.070**	-0.167***
	(0.019)	(0.030)	(0.018)
Agriculture in the economy	-27.628***	-156.475***	-24.112**
	(10.591)	(37.396)	(10.147)
Farm output to input ratio	-145.031***	200.138**	-151.099***
	(49.853)	(90.102)	(47.365)
Agriculture in the food value chain	5.588***	16.407***	3.708***
	(1.222)	(5.318)	(1.315)
Off-farm income diversification	-3.950***	-6.983***	-3.641***
	(1.283)	(1.367)	(1.206)
Constant	993.453***	-237.755	325.483***
	(135.264)	(862.879)	(61.443)
Observations	45	45	45
Number of countries	5	5	5
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

Notes: LSDV stands for least squares dummy variable. LC stands for left censoring and RC for right censoring. In all models, we control for the coefficient of variation of crops such as apples, grapes, maize, potato, rapeseed, tomato and wheat. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX 3

Supranational risk transfer mechanisms

Introduction

This section presents the results of an innovative supranational risk transfer mechanism that aggregates the production of Italy, France, Slovakia, Bulgaria and Latvia. The mechanism recognizes that the aggregate portfolio risk is lower than the simple sum of individual risks, due to the imperfect correlation among production value and losses.

Several technical designs for the risk transfer mechanism can be developed depending on the stage at which aggregation is performed —whether on production value, losses, or payouts. Each aggregation stage may include or exclude diversification effects, which significantly influence the model's outcomes. For instance, the production value per product at national level can be added up and then the losses can be calculated from the aggregate value, or losses per product can be first calculated and then an aggregate loss is derived from the sum of the per-product losses. In turn, diversification effects can be considered or not in each step of aggregation.

When diversification is considered, substantial reductions in technical premiums for identical coverages are observed: over 25 percent in product-level designs and approximately 12.5 percent in aggregate coverages.

The following sections present the results of some of the designs for the portfolio of products considered in the five countries selected for this analysis, namely: Bulgaria (BG), France (FR), Italy (IT), Latvia (LV) and Slovakia (SK).

Technical design based on per-product losses

In the results per-country of the risk transfer mechanism presented in the main report, the analysis was performed based on loss per product and payout per product, which were then aggregated to obtain a national result, without considering diversification effects among products: losses were calculated from value per product (Equation 4, below), and then payouts were calculated for each product (Equation 10, 11 and 12 below). Finally, the payouts were aggregated at the national level (Equation 13, below) without considering the diversification effects. From the design perspective, the Attachment and Exhaustion probabilities were set at 5 percent and 1 percent per product. However, when the products are pooled and the portfolio is considered, the probability of a payout (attachment) is much higher than 5 percent while the probability of a full payout (exhaustion) is lower than 1 percent.

The total technical premium of the supranational¹⁴ risk transfer mechanism is reduced by 25 percent (or around EUR 100 million) when diversification among products within each country is considered, even without accounting for diversification among countries (Table A.3). The sum of the technical premiums presented in the main report amounted to EUR 397 million. However, when diversification among products within each country is considered, the sum of technical premiums of the countries rated at the portfolio level is only EUR 297 million. Note that only the rating method was changed, considering that when pooling the products, the potential losses are reduced from the risk taker perspective (not all products will suffer losses to the same extent). The design of the payouts, including the total Limit (maximum payout), remain the same in both options.

¹⁴ In Total, 74 products are considered in the portfolio: seven in Bulgaria, twenty-seven in France, twenty-six in Italy, six in Latvia and eight in Slovakia.

TABLE A.3 Rating based on Losses Per product and Payout per product.

	Loss per product & Payout Per product ("pp")					
	Technical Premium (EURM)			Technical Premium (% of Limit)		
	Without diversification	With diversification	Diversification benefits	Limit	Without diversification	With diversification
BG	17.73	14.87	2.86	388.09	4.57%	3.83%
FR	256.49	191.67	64.82	5,665.68	4.53%	3.38%
IT	109.47	79.01	30.46	2,424.60	4.51%	3.26%
LV	4.93	4.31	0.62	110.05	4.48%	3.92%
SK	8.35	6.89	1.46	183.57	4.55%	3.75%
Total	396.97	296.75	100.22	8,771.99	4.53%	3.38%

A second design alternative, still based on per-product losses, involves calculating a national loss as the sum of losses per product, to trigger a national payout of the risk transfer mechanism. In this case, the losses (shortfall below average) are calculated product-by-product and then are added up to obtain a national loss that considers diversification among products (Equation 5, below). Subsequently, payouts are calculated at the national level based on this national loss (Equation 15, 16 and 17, below) and are then summed to obtain a supranational payout (Equation 18, Annex). The attachment and exhaustion points are established so that the payout probability per country is 5 percent and the probability of a full payout per country (i.e., payout equal to the Limit) is 1 percent. At supranational level, the attachment probability is higher than 5 percent because the coverage can be activated in different countries under different events. Moreover, the probability of full payout is lower than 1 percent because an event that triggers a full payout in one country does not necessarily trigger a full payout in the others.

Under this design, the total premium is EUR 140 million without considering diversification and EUR 123 million when diversification across countries is taken into account, for a Limit of EUR 3,098 million (Table A.4). Compared to the previous case presented in Table A.3, the Limits are much lower as well as the technical premiums, but the individual premium rates per country are around 4.5 percent, similar to the previous design. Note that in this design, the losses among products within each country are compensated before calculating the payouts, and therefore the Limits are much lower.

TABLE A.4 Rating based on Losses Per product and payout per country

	National triggers (EUR million)		Loss per product & Payout Per country ("pc")		
	Attachment loss	Exhaustion loss	Limit (EUR million)	Tech. Premium (EUR million)	Tech. Premium (% of million)
BG	533.63	777.19	243.56	11.18	4.59%
FR	5,369.43	7,295.99	1,926.56	87.13	4.52%
IT	2,150.06	2,873.15	723.09	32.82	4.54%
LV	153.94	236.68	82.74	3.73	4.51%
SK	245.12	367.00	121.88	5.55	4.55%
Total w/o diversification	N/A	N/A	3,097.83	140.41	4.53%
Total with diversification	N/A	N/A	3,097.83	122.77	3.96%

A third possible design, still based on losses per product, consists of aggregating all the losses from all products and countries to define a supranational loss, and then calculate the payouts based on this supranational loss. In this case, the losses (i.e., the shortfall below average) are calculated on a product-by-product basis, then are aggregated across all products to obtain a national loss per country, which is subsequently summed up to obtain a supranational loss that considers diversification among countries¹⁵. In this case, there is only one attachment loss (EUR 7,294 million) and one exhaustion loss (EUR 9,629 million) for the supranational coverage, from which the Limit is calculated (EUR 2,335 million). Based on these parameters, the payout rule is applied. The technical premium rate is around 4.5 percent or EUR 105.5 million, and in this case the probability of payout is 5 percent and the probability of a full payout is 1 percent.

Technical design based on aggregate values

In this case, first, the values per product are summed up to obtain national values, from which national losses (i.e., shortfall below average) are calculated¹⁶. Then, these values are compared to national attachment and exhaustion points (one per country) to calculate the payouts. The production value of each product is summed up to obtain a national value (Equation 2) from which the losses (shortfall below average) are calculated (Equation 7). The Attachment and Exhaustion probabilities are 5 percent and 1 percent, respectively, per country, which are used to establish attachment and exhaustion triggers for the losses per country to calculate the payouts (Equation 22). Then, payouts are aggregated at supranational level (Equation 25). Note that when the countries are pooled together and the supranational portfolio is considered, the probability of a payout (attachment) in the portfolio is higher than 5 percent while the probability of a full payout in the portfolio of countries (exhaustion) is lower than 1 percent.

Under this design, the total premium is EUR 150 million without diversification and EUR 131 million (-12.4 percent) when diversification among countries is considered, for a Limit of EUR 3,275 million (Table A.5). The individual premium rates per country are around 4.5 percent. These results are of the same order of magnitude as those presented in Table A.4, but the approach is different: in that case, losses were calculated per-product and then summed up to obtain a national loss, and here the value per-product is first summed up to obtain a national value and then the losses are calculated from it.

TABLE A.5 Rating based on Losses Per country and payout per country

	Triggers (EUR million)		Loss per country & Payout Per country ("cc")		
	Attachment loss	Exhaustion loss	Limit (EUR million)	Tech. Premium (EUR million)	Tech. Premium (% of million)
BG	513	767	253	11.54	4.55%
FR	4,279	6,298	2,020	92.37	4.57%
IT	1,691	2,488	797	36.54	4.58%
LV	148	230	82	3.72	4.53%
SK	237	360	123	5.62	4.56%
Total w/o diversification	N/A	N/A	3,275	149.79	4.57%
Total with diversification	N/A	N/A	3,275	131.21	4.01%

¹⁵ Note that correlations among all products were not considered, but only total national losses per country were correlated.

¹⁶ Per-product losses are not calculated in this case.

The final design, based on aggregate values, involves summing up all the values from all products and countries to define a supranational value, from which supranational losses (shortfall below average) are calculated. One attachment point and one exhaustion point for the supranational loss is used to calculate the payouts. In this case, the values are calculated product by product, then are added up across all products to obtain one national value for each country, which are further summed up to obtain a supranational value that considers diversification among countries¹⁷. In this case, there is only one attachment loss (EUR 5,589 million) and one exhaustion loss (EUR 8,116 million) for the supranational coverage, from which the Limit is calculated (EUR 2,527 million). Based on these parameters, the payout rule is applied, and the technical premium rate is around 4.5 percent or EUR 115.3 million. In this case, given that only one payout is calculated for the entire supranational portfolio (aggregation is done before, at value-level), the probability of payout is 5 percent and the probability of a full payout is 1 percent.

¹⁷ Note that correlations among all products were not considered, but only total national values per country were correlated.

APPENDIX 4

Actuarial analysis methodology

Objective and key concepts

This analysis aims to deliver a preliminary assessment of Contingent Liabilities (CLs) within the agricultural sector for each Member State. The analysis also involves reviewing the current Disaster Risk Financing (DRF) strategy, estimating the resulting financial gap, and proposing initial, cost-effective measures to narrow this gap. To achieve this, separate analyses were conducted for the crop and animal sectors, as summarized below in the next sections, which were ultimately integrated in an “agricultural portfolio”.

BOX A.1 Key concepts used in the actuarial analysis

Contingent Liabilities (CLs): A contingent liability is the amount that should be financed by the government(s) in case of materialization of a contingent negative event affecting the population and/or the economy. In the case of the agricultural sector, the events may include droughts, floods, diseases, etc. that could reduce production and consequently affect the livelihood of the farmers and food security of the whole population. The Agric-CL was estimated using actuarial techniques (see further details in the methodological section).

Disaster risk financing (DRF) strategy: Through an ex-ante disaster planning process, a DRF strategy is a portfolio of financial instruments with an established order of precedence, considering the frequency and severity (risk layers) of per event and annual aggregate losses. Its purpose is to reduce the fiscal cost of disasters and generate savings in public resources through a cost-efficient combination of risk retention instruments (e.g., emergency funds, budget reallocations, contingent loans, etc.) and risk transfer instruments (e.g., insurance, catastrophe bonds, etc.) to finance the contingent liability. It is a comprehensive plan that a government puts in place before a disaster strikes. The core purpose of a DRF strategy is to ensure that predictable, timely, and sufficient funding is available to respond to emergencies, while safeguarding the country’s long-term fiscal stability.

Disaster Risk Financing Core Principles:

- **Understanding and quantifying the risk:** Before developing any DRF strategy, a thorough and careful assessment of the underlying risks is essential. This involves identifying the hazards and quantifying the Contingent Liabilities (potential economic and fiscal impacts of the events).
- **Timeless of funding:** This principle emphasizes the importance of ensuring that financial resources are available promptly after a disaster. Speed is critical to minimize the economic and social impacts of disasters, but not all funds are needed immediately. A well-structured financial strategy ensures that resources are allocated efficiently across different phases of disaster response, from immediate relief to long-term recovery.
- **Risk layering:** this approach involves categorizing risks based on their frequency and severity, and then matching them with the most cost-effective financial instrument.
- **Disbursement of funds:** This principle focuses on the mechanisms for delivering financial resources to beneficiaries. It highlights that the effectiveness of disaster financing depends not only on where the money comes from but also on how it reaches those in need. Efficient, transparent, and accountable disbursement systems are essential to ensure that funds are used effectively and reach the intended recipients.

Average Annual Loss (AAL): The average loss per year over a long-time horizon. It is used as the basis for pricing some financial instruments.

Value at Risk with an exceedance probability of “ep” (VaR_{ep}): this is the minimum loss amount that will be exceeded with a given probability. It corresponds to a percentile of the probability distribution and must be reported together with its associated annual exceedance probability.

Loss Exceedance Curve: is the graphical representation of a set of ordered pairs consisting of the Annual Exceedance Probability (ep) and the associated VaR; i.e., (pe, VaR_{pe}). It shows the probability of a loss of a certain magnitude being exceeded. It is used as a metric to quantify the CLs.

Funding Gap: it is the difference between a given CL (VaR associated to an exceedance probability) with the instruments arranged ex-ante through a DRF strategy.

Yield Factor: A standardized metric that makes yields from different crops and years comparable by normalizing them to a common baseline.

Crop analysis

The work was structured in two phases: a data analysis phase followed by an actuarial analysis.

The initial data analysis phase focused on examining Eurostat datasets for Harvested Area (apro_cpsh1) and Production Value at Producer Prices (aact_eaa01, PVPP). This involved verifying the structure, variable definitions, units of measure, and completeness of the data. For each dataset, crop sub-categories were assessed for their materiality within the overall totals; categories with negligible contribution were excluded, considering area and value jointly (i.e., the Area-based selection also considered PVPP and, conversely, the PVPP-based selection also considered Area). Following this review, the two data sources were reconciled by mapping product codes across databases to create a unified and materially relevant set of crops – the “Final Portfolio”. This Portfolio established the scope for the subsequent actuarial analysis.

In the second phase, the actuarial analysis began by defining the risk sources and target variables. Agricultural production risk was modeled using two random variables: (a) Yield per hectare, which is influenced by weather, climate, seed type, others; and (b) market Price, which can offset or amplify volume outcomes). The Area was treated as a fixed, non-random variable determined by producer decisions.

For each crop, Yield and PVPP were detrended using a linear regression to remove structural trends. The parameters were estimated by maximum likelihood. For the risk assessment, we analyzed the residuals, defined as the difference between the observed yield and the yield estimated by the regression at each time point. We then built a detrended yield series by taking the model’s estimated yield for 2023 and adding the residual for each year - this “brings” past observations to today’s level. Finally, to enable comparison across crops, these detrended yields were expressed as a yield factor, calculated by dividing the detrended yield for each year by the model’s 2023 estimate. By construction, these factors were centered around 1, and any deviation below the trend was represented by a factor lower than 1 (e.g., a factor of 0.8 indicates a yield 20 percent below the trend).

Following the creation of the detrended yield factor, the statistical properties at the individual crop-country level were modeled. Several candidate fat-tail probability distributions were fitted and tested (including Normal, Lognormal, Gamma, Weibull, Pareto IV, and a left-heavy-tailed Pareto IV variant) to the historical data. The best distribution was selected based on a combination of goodness-of-fit tests (Kolmogorov-Smirnov, Cramér-von Mises, and Anderson-Darling), a comparison of theoretical mean, median, and standard deviation with those for actual data and a review of key percentiles. The distribution with the heaviest lower tail was selected to conservatively capture downside risk, unless the other diagnostics contradict that choice. Then summary statistics and cross-correlations for the detrended yield factors were calculated.

With the statistical models and the estimated correlation structure established, multivariate stochastic simulations were conducted to generate a 100,000 potential yield factor outcomes. These simulated factors were then converted to yields by multiplying them by an expected-yield baseline, for which a Linear-Trend estimate was adopted. “Yield loss” was defined as the shortfall of a simulated yield relative to the simulation’s mean. From these results, probability distributions of yields and the loss exceedance curve, and a summary chart of risk metrics were generated for each crop. The risk metrics included Value at Risk (VaR) and Tail Value at Risk (TVaR).

Finally, the simulated yields were then converted to production volume (Volume = Area x Yield), which in turn were translated into production value (PVPP) by multiplying the Volume by a Reference Price. For each crop, the following outputs for both the production volume and the production value were produced: (a) plot of the probability distribution; (b) loss exceedance curve; and (c) table of risk metrics (including expectation -average-, standard deviation and VaR).

The Crop Portfolio’s production value was jointly simulated using the selected per-crop models considering cross-crop correlations. These values were then aggregated to obtain the Crop Portfolio’s joint value distribution and its corresponding loss distribution. The losses were estimated, per crop, as any deviation below the expected value (average).

The loss-exceedance curves show the benefits of diversification, as the portfolio’s joint curve lies below the simple sum of stand-alone (per-crop) curves. The diversification benefit (reduction in risk) was then calculated as the difference between these two results.

As a primary output, this study computed the portfolio's average annual loss (AAL) and Value-at-Risk, two key metrics for understanding the financial impact of disasters. This was presented as an absolute monetary value, as percentage of the Expected Value (as proxy of the value exposed at risk).

Using the VaR as the basis for a comprehensive financing plan, a multi-layered strategy was analyzed. The first layer, designed to cover more frequent events, considered two risk retention options: a pre-allocated annual budget line and a multi-year reserve fund. These instruments were sized to cover losses that can be exceeded with a 5 percent annual probability (1-in-20). The second layer utilized a risk transfer instrument—specifically, parametric insurance—to protect against more severe, less frequent events. The insurance was designed per crop as an average nation-wide yield insurance, with an attachment probability of 5 percent and an exhaustion probability of 1 percent. The analysis concludes by quantifying the financing gap, which is the portion of potential losses that remains uncovered once the instruments are exhausted.

Livestock analysis

The study was structured in two phases: a data analysis phase followed by an actuarial analysis.

The first phase focused on a thorough review of three Eurostat datasets: Production Volume (apro_mk_cola), Bovine Population (apro_mt_lscatl) and Prices (apri_ap_anouta). This involved validating the structural integrity of the data, including variable definitions, units of measurement, and overall completeness. As part of this process, we compared an estimated Production Value calculated as Production Volume times Price (using the datasets referenced above) and the Production Value at Producer Prices dataset from Eurostat (aact_eaa01, PVPP). Although the two series do not match exactly, they exhibited broadly similar trends and levels, confirming a reasonable alignment. Finally, it was established a “Yield” metric, defined as the total tons of milk delivered to dairies divided by the number of cows, based on the latest available December headcount.

In the second phase, the actuarial analysis began by defining the Yield as the target variable (taking the number of cows as constant, at the latest December headcount) for the actuarial model. We fitted several candidate models to analyze the Yield, including Linear, second-degree Polynomial, ARIMA automatically selected, ARIMA manually tested, and Regression splines. After selecting the best-fitting selected model, the residuals were extracted, which represents the underlying risk factor. Subsequently, we then fitted and tested several probability distributions to these residuals to determine the best statistical representation of the risk. The candidate distributions included Normal, Lognormal, Gamma, Weibull, and two variants of the Pareto IV distribution. The final variant for each distribution was estimated using the minimum Anderson–Darling (AD) method, which minimizes the AD goodness-of-fit statistic to find the most accurate model.

Using the selected time-series model and fitted distribution, we ran stochastic simulations to generate yield, volume and production value.

- Yield was simulated directly from the selected model;
- Volume was computed by multiplying the simulated yield times the number of cows, which was held constant at the most recent observation); and
- Value was determined by multiplying the simulated production volume times the price.
- For each of these variables, a “loss” was defined as the non-negative shortfall from its simulation mean. This analysis facilitated the estimation of several key outputs to visualize and measure the risk:
- Probability Distributions were estimated based on the generation of produced plots, illustrating the full range of potential outcomes for yield, volume and value.
- Loss Exceedance Curves: These curves show the probability of losses exceeding specific thresholds, providing a clear picture of the tail risk.
- Risk Metrics were created, including loss thresholds such as Value at Risk (VaR) and Tail Value at

Risk (TVaR). These metrics help identify the level of capital required to cover losses up to a certain confidence level. We also computed conditional expectations computed on the left tail of the variables distributions (representing declines) and, equivalently, on the right tail of the loss distributions.

The Milk expected loss was incorporated into the Crop portfolio to calculate the total expected loss, which represents the amount requiring financing, and for the analysis of funding strategies. The financing strategy was structured in layers. First, for the layer of high-frequency events, two Risk Retention Instruments were considered for losses that can be exceeded with a 5 percent annual exceedance probability. These instruments were an Annual Budget Allocation (ex-ante) and a Reserve Fund, the latter of which capitalizes unused resources from one year to the next.

Second, for the mid-frequency layer, parametric insurance was proposed as a Risk Transfer Instrument. Lastly, the Financing Gap was computed. This gap represents the residual loss that remains to be covered after applying insurance (and any ex-ante resources, if considered).

Detailed country results

BULGARIA

The actuarial analysis conducted in this work is based on a representative portfolio of crops and animal outputs, selected for their contribution to total area and to production value at producers' prices (PVPP). It comprises six crops (that account for approximately 88 percent of total area and 80 percent of PVPP) and cow's milk (28 percent of animals' PVPP). While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the final portfolio represents about 3.8 percent of the national GDP.

The production reference value (RV) of the portfolio is almost EUR 3.6 billion and the Expected Loss (EL) is approximately EUR 160 million (4.4 percent of the RV). Table presents the RV and EL of each one of the products included in the portfolio, which comprises the three main categories presented in Figure 5 above (Cereals, Oilseeds and Milk). Note that grain maize represents about 20 percent of the value but 38 percent of the EL, which indicates an elevated risk for this crop. In turn, Milk accounts for 9 percent of the value but only 3.5 percent of the EL.

TABLE A.6 Expected production value and expected loss in Bulgaria

EUR million

Product	Value (EUR m)	% Value	EL (EUR m)	% EL	EL (% of Value)
Common wheat and spelt	1,321.86	36.73%	49.82	31.36%	1.38%
Barley	125.88	3.50%	4.89	3.08%	0.14%
Grain maize and corn-cob-mix	717.37	19.93%	60.44	38.05%	1.68%
Rape and turnip rape seeds	144.85	4.03%	7.40	4.66%	0.21%
Sunflower seed	900.93	25.04%	27.92	17.58%	0.78%
Tomatoes	58.45	1.62%	2.79	1.76%	0.08%
Milk	329.29	9.15%	5.60	3.52%	0.16%
Sum_Products	3,598.62	100.00%	158.87	100.00%	4.41%

Historical information of yields between 2000 and 2023 was used to estimate “yield factors”, which measure deviations from an estimated trend¹⁸. Figure A.1 exhibits the time series of these factors, whose baseline is one (i.e., 100 percent of the trend value). The graph shows that recent years affected by drought

18 Linear regression was used for crops and an ARIMA (0,2,0) model was used in milk.

and frost (2020, 2022 and 2023) exhibit most risk factors below the baseline (especially for common wheat and oilseeds, which tend to be the most affected crops by these types of events as noted above). Also, 2003 and 2007 were years in which most products presented negative deviation from their trend.

There are years in which certain events strike the whole sector but not in the same way. The correlation matrix of the risk factors presented in Figure A.2 shows the imperfect correlation among products; particularly, Tomatoes and Milk exhibited a low correlation with the other products, which contributed to the diversification in the portfolio.

FIGURE A.2 Time series of yield risk factors in Bulgaria

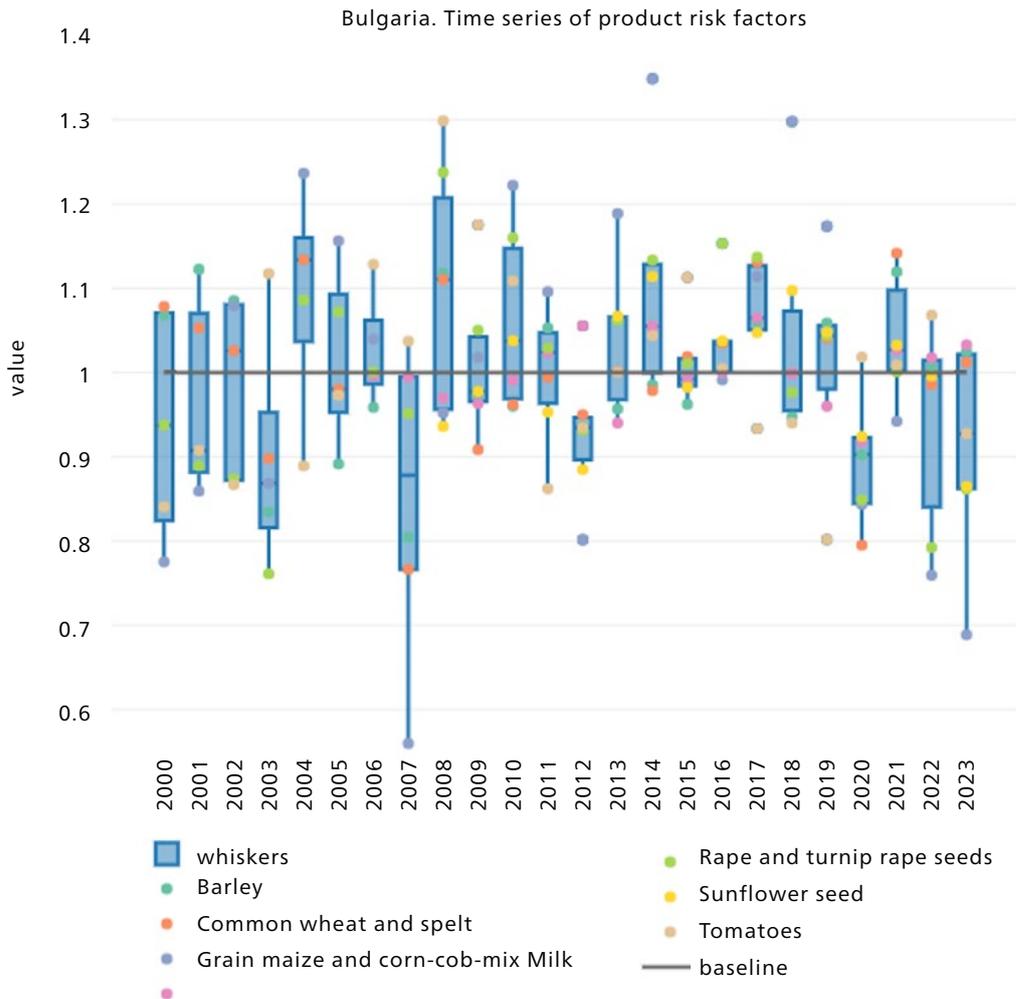
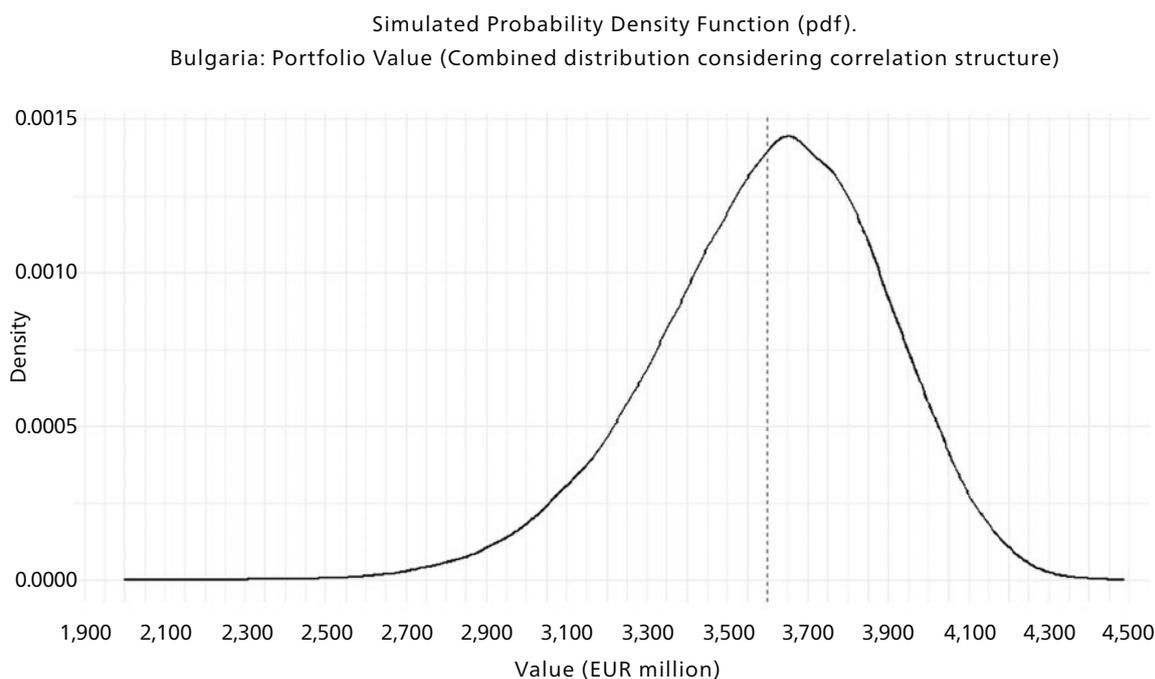
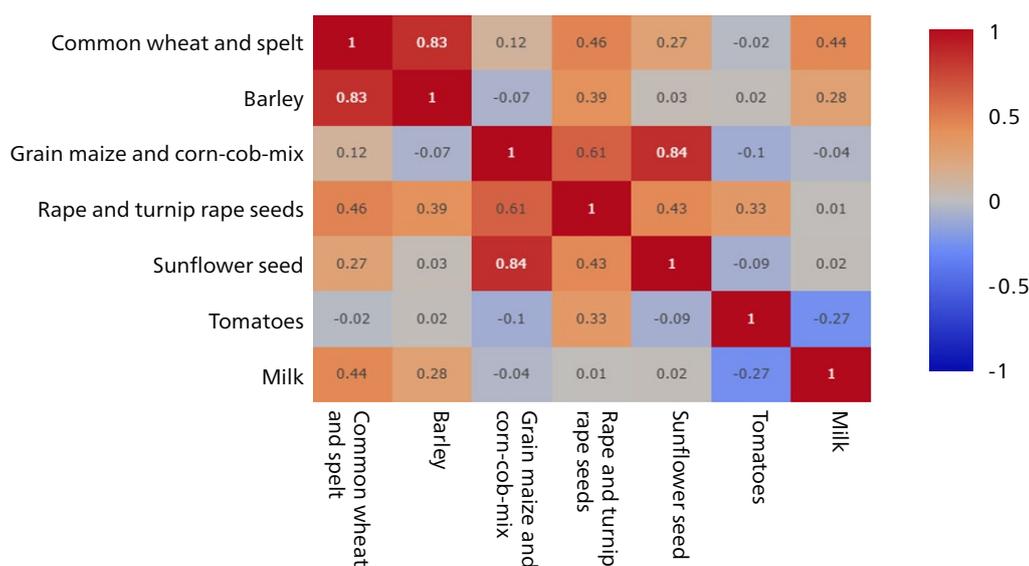


FIGURE A.3 Correlation matrix of yield risk factors in Bulgaria

The historical yield factors and the correlation matrix were used to simulate a multivariate sample of 100,000 yields scenarios per product. Probability distributions that best fit the historical data of product yield factors were selected¹⁹, and a multivariate random sample of 100,000 factors for each product was created using these distributions and the correlation matrix presented above. These simulated risk factors were used to simulate Yields per product, Volume of production based on an expected area, and the Value of the production based on a reference price²⁰. This approach enabled the assessment of the Joint Probability Distribution of the Portfolio Value.

FIGURE A.4 Probability Density Function of the Joint Portfolio Value in Bulgaria

EUR million



¹⁹ The reflected Pareto4 (with a heavy left tail) distribution best fits Rape and turnip rape seeds, while the Pareto4 best fits Grain maize, and the Log-Normal was selected for Tomatoes. Finally, Weibull was selected for the other four products in the portfolio.

²⁰ The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants.

The “Loss” in the portfolio, used to estimate the impact in the agricultural sector and the contingent liability of the government, is defined as any deviation below the average. Even though this might appear to be conservative, the estimation is based on nation-wide yields, and therefore it is possible that some producers suffer bigger losses, even below the 20% trigger of the current instruments. This is a caveat of the analysis, and it is recommended to perform a sub-national analysis at least based on Eurostat data at NUTS²¹ 2 level .

The Value-at-Risk (VaR) is used to estimate Contingent Liability (CL), and it measures the Loss that might be exceeded with a given annual probability. There is a 1 percent probability (1-in-100) that losses at portfolio level exceed EUR 777 million, or 21.6% of the reference value. Table shows the Contingent Liabilities for each product due to production losses, as measured by the Value at Risk (VaR).

The diversification, which arises from the no-perfect correlation among products, significantly reduces Contingent Liabilities. The CL without diversification is calculated as the sum of the VaR of each crop, a highly conservative estimate that implicitly assumes all products are perfectly positively correlated. In turn, the portfolio VaRs were estimated considering the diversification effect among products. When crops are not perfectly correlated, adverse events affecting one product are less likely to impact others to the same extent, resulting in lower overall risk for the portfolio. For example, at a 1 percent exceedance probability, the VaR without diversification is EUR 1,115 million, and therefore the diversification benefit is EUR 338 million²² (Table). This pattern holds across all exceedance probabilities, with the diversification benefit ranging from EUR 455 million EUR 33.7 million.

TABLE A.7 Contingent Liabilities (VaR) per Product and at portfolio level in Bulgaria

EUR million

Exc. Prob.	Common wheat and spelt	Barley	Grain maize and corn-cob-mix	Rape and turnip rape seeds	Sunflower seeds	Tomatoes	Milk	Sum of VaRs	Portfolio VaR	Portfolio VaR (%)	Diversification Benefit
0.20%	478.84	46.03	502.20	68.09	278.46	17.48	47.79	1,438.88	984.25	27.35%	454.63
0.40%	427.08	41.45	465.52	60.24	249.89	16.34	43.92	1,304.45	896.07	24.90%	408.38
0.50%	411.15	40.04	449.36	57.79	238.72	15.88	42.58	1,255.51	870.93	24.20%	384.58
1.00%	363.77	35.48	403.95	50.19	209.66	14.62	37.80	1,115.47	777.18	21.60%	338.28
2.00%	309.60	30.30	349.52	42.46	176.87	13.09	32.74	954.57	679.58	18.88%	274.99
4.00%	251.43	24.69	293.13	34.98	142.94	11.41	27.24	785.81	570.84	15.86%	214.97
5.00%	231.90	22.82	272.26	32.50	131.86	10.81	25.24	727.38	533.63	14.83%	193.76
10.00%	169.15	16.62	203.03	24.19	94.68	8.67	18.81	535.14	415.88	11.56%	119.26
20.00%	98.34	9.70	123.55	14.92	54.43	5.97	11.36	318.29	284.63	7.91%	33.66

The diversification among agricultural products strengthens resilience to shocks and cushions sector’s systemic risks. By considering diversification stakeholders can achieve more accurate risk estimates, reduce unnecessary capital reserves, and design tailored financial instruments that better match the true risk profile. Ultimately, this approach improves the efficiency and sustainability of risk management.

To mitigate the Contingent Liabilities arising from agricultural production shocks, we propose an illustrative example of a portfolio of financial potential instruments. This example demonstrates a layered DRF approach, strategically combining risk retention and risk transfer mechanisms to enhance fiscal resilience against adverse events. This portfolio is purely for illustrative purposes. To ensure cost-efficiency for the government, the interaction between the existing ARM instruments and the illustrative portfolio must be carefully studied in further stages.

²¹ Nomenclature des unités territoriales statistiques.

²² The difference between the portfolio VaR presented in the previous paragraph and the VaR without diversification.

The first layer of the illustrative strategy consists of pre-arranged, dedicated capital sources totaling EUR 535 million, around 16% of the Reference Value of the portfolio, and it is targeted to cover CLs with an annual probability of up-to 95%²³. This layer is composed of a dedicated annual budget of EUR 285 million and a supplementary reserve fund of EUR 250 million, with resources that carry over from one year to the next. The difference between the two instruments is that the first is an annual allocation in the budget to provide support to farmers, while the second would be a Fund whose proceedings are invested, earning interests, in high quality financial instruments and would be used in case of more severe events. The budget allocation is targeted to cover CLs up to an exceedance probability of 20 percent. When combined with the Fund, it is aimed to cover CLs up to a 5 percent of exceedance probability.

TABLE A.8 Risk retention instruments in Bulgaria

EUR million

Instrument	Amount (EUR m)	Exh. Prob. (cumulative)
Budget Allocation (ex-ante)	285	19.96%
Reserved Fund	250	4.97%

The Budget allocation is proposed to be allocated annually to cover the first layer of losses, and it would include compensations to the farmers through the state aid programs, while the additional Reserve Fund would be used for less frequent and more severe events. The state aid programs averaged around EUR 330 million in the last three years (Table 8, above), including insurance subsidies, the situation in Ukraine and COVID-19. It is important to stress that the illustrative instruments are targeted at the selected portfolio, whereas current programs are in principle intended for the whole universe of agricultural products. The illustrative strategy is targeted at covering only production risks, including events with relatively low frequency (i.e., up to 5% or 1-in-20 exceedance probability).

For more severe events that would deplete the retention layer, the proposed strategy includes risk transfer instruments. The insurance is designed as a nation-wide area-yield index insurance per product. The attachment point and exhaustion point are expressed in millions of euros, although the underlying risk is linked to production, because the yield is the only stochastic variable considered. The triggers are linked to attachment and exhaustion probabilities of 5 percent (on top of the risk retention layer) and 1 percent, respectively, further it is assumed that the full coverage is purchased. The Technical Premium (TP²⁴) is estimated as the Average Annual Loss (AAL) plus an uncertainty loading percentage of the Standard Deviation (SD) of $\alpha = 15.00\%$, calculated as $TP = AAL + \alpha \times SD$.

The total Limit of the illustrative risk transfer instruments is EUR 388 million²⁵, while the estimated Technical Premium is around EUR 17.7 million or 4.57% of the Limit (Table 12). This latter was rated on a per-product basis (i.e., it does not consider diversification) and does not include other loadings such as operational costs, shareholder profits, others. If a decision is made to incorporate this product into the DRF strategy of Bulgaria, the final pricing of the insurance will be different for several reasons: (1) companies will include additional loadings, (2) diversification among products in Bulgaria may reduce the uncertainty loading, (3) potential risk pooling among countries in the EU could provide additional diversification benefits. Furthermore, placing insurance at a national level might reduce costs and increase the government's negotiating power to obtain lower prices.

Bulgaria included an insurance premium support intervention in its CAP Strategic Plan for 2023–2027 (Article 76 of Regulation (EU) 2021/2115). The subsidy covers up to 70 percent of eligible premiums, with the remaining 30 percent covered by farmers. The allocated annual budget is EUR 10 million, which can subsidize up to EUR 14.3 million in eligible premiums at the 70 percent rate. The estimated technical premium of the illustrative risk transfer mechanism presented above carries a cost in line with this budget. However, it should be highlighted that the modeling calculates losses based on deviations from average

²³ There is a 5% probability that the losses exceed EUR 533 million, see Table 10.

²⁴ The application of the Standard Deviation Premium Principle is widely used for rate-making purposes, but the figures obtained must be tested with the (re)insurance market.

²⁵ This is the maximum potential payout that could be triggered. However, notice that the probability of a full payout is extremely small because of the diversification among products (e.g., in the 100,000 simulated scenarios, the maximum payout was EUR 1,127 million, only around 50% of the Limit).

on a national-level aggregates. On one hand, national aggregation may underestimate individual losses; on the other hand, in the absence of deductibles²⁶, the mechanism might overestimate payouts. An in-depth analysis of the current insurance scheme is beyond the scope of this report. The interaction of both risk transfer instruments should be studied in the future.

TABLE A.9 Insurance specifications in Bulgaria

Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP / Limit)	Leverage (Limit/TP = 1 / RoL)
Common wheat and spelt	231.90	363.77	131.87	3.36	2.54%	6.04	4.58%	21.85
Barley	22.82	35.48	12.66	0.32	2.54%	0.58	4.57%	21.88
Grain maize and corn-cob-mix	272.26	403.95	131.69	3.36	2.55%	6.02	4.57%	21.86
Rape and turnip rape seeds	32.50	50.19	17.69	0.44	2.50%	0.80	4.51%	22.17
Sunflower seed	131.86	209.66	77.81	1.96	2.52%	3.53	4.54%	22.03
Tomatoes	10.81	14.62	3.81	0.10	2.56%	0.18	4.60%	21.74
Milk	25.24	37.80	12.56	0.32	2.58%	0.58	4.63%	21.61

Stochastic modeling based on 100,000 simulations reveals that this combined DRF strategy has a 2.84 percent annual exceedance probability of being depleted. This represents the probability of a remaining Contingent Liability for the Government uncovered for the instruments pre-arranged. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities. While this strategy significantly enhances the country's capacity to manage shocks, a residual risk for catastrophic events remains.

The illustrative DRF strategy enhances the country's capacity to manage shocks; however, a residual risk for catastrophic events remains. Stochastic modeling based on 100,000 simulations reveals that this strategy has a 2.84 percent annual exceedance probability of being depleted. This represents the probability of a remaining Contingent Liability for the Government uncovered for the instruments pre-arranged. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities.

Figure A.5 presents a graphical representation of the funding gap analysis. The black line at the top of the plot shows the portfolio's Loss Exceedance Curve²⁷. Below this line, the financial instruments used to finance each potential loss are stacked. The graph of the stacked instruments exhibits a sawtooth pattern because not all coverages are activated simultaneously, as the risk transfer mechanism is structured on a per-product basis. Also note that, while the risk transfer is targeted to cover the highest layers, it is illustrated at the bottom in the gap analysis. This is because any payout from a triggering event will be used first, before using any risk retention instrument. Since premiums are paid up-front, any payout from a triggering event will be used by the government to compensate the farmers before expending money from other resources.

Table A.7 illustrates the gap analysis for some specific points of the Loss Exceedance Curve²⁸. The Financing Gap is non-monotonic (i.e., the higher the loss, the higher the gap) because of the sawtooth behavior of the insurance. For example, a loss associated with a 0.5 percent exceedance probability (EUR 871 million) triggered relatively higher risk transfer payouts (EUR 183 million), leading to a funding gap

²⁶ The trigger of the nation-wide risk transfer mechanism is set at the expected yield, while the current insurance payouts when individual yield deviates 20% below the average.

²⁷ Value-at-Risk in the y-axis vs Exceedance Probability in the x-axis. The results in Table 2, above, are selected points extracted from this curve.

²⁸ What is the "correct" annual probability to be taken? There is not a direct answer for that, is for the decision maker to make a choice. For example, some (re) insurance companies use a 1%, but others more conservative use 0.2% or even 0.1%

of about EUR 152.5 million. In contrast, a lower loss of EUR 777 million (at a 1 percent exceedance probability) generated a higher funding gap of EUR 186.6 million because the risk transfer payouts are relatively small due (EUR 55 million) to the per-product basis designed.

Finally, it should be remarked that the funding gap of the proposed strategy does not account for the subsidized insurance currently in place, as its evaluation was beyond the scope of this analysis. An actuarial analysis of the current scheme would require a significant effort that exceeded the objective of this report. Further investigation of the interactions between the current scheme and the proposed DRF strategy is required. For instance, the budget allocation of EUR 285 million could be reduced to EUR 275 million for compensations, and the remaining EUR 10 million might be used for subsidizing the current insurance scheme. However, a more in-depth analysis is required to provide well-founded recommendations regarding alternative strategies.

FIGURE A.5 Funding gap analysis for Bulgaria

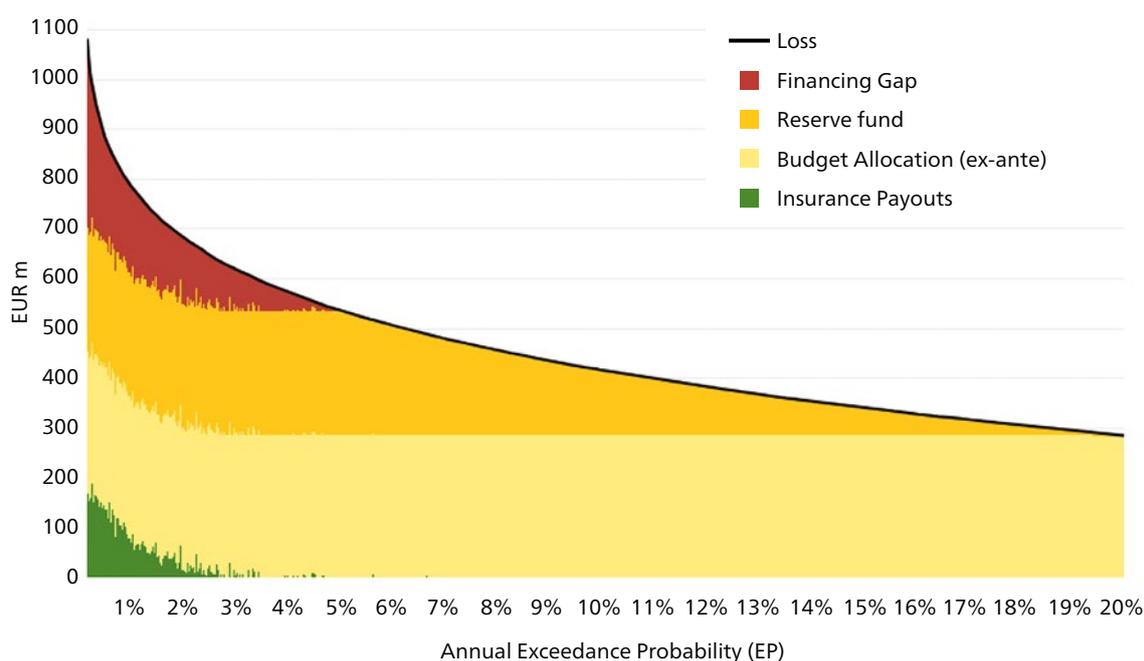


TABLE A.10 Funding gap analysis for selected exceedance probabilities in Bulgaria

EUR million

Exc. Prob.	Loss	Insurance Payouts	Retention	Budget Allocation (ex-ante)	Reserve fund	Financing Gap
0.20%	984.25	229.39	754.86	285.00	250.00	219.86
0.40%	896.07	160.96	735.11	285.00	250.00	200.11
0.50%	870.93	183.43	687.51	285.00	250.00	152.51
1.00%	777.18	55.54	721.64	285.00	250.00	186.64
2.00%	679.58	92.83	586.76	285.00	250.00	51.76
4.00%	570.84	70.17	500.67	285.00	215.67	0.00
5.00%	533.63	37.87	495.76	285.00	210.76	0.00
10.00%	415.88	0.00	415.88	285.00	130.88	0.00
20.00%	284.63	0.00	284.63	284.63	0.00	0.00

FRANCE

To complement the qualitative findings, we conducted an actuarial analysis for France based on a final portfolio that comprises twenty-six crops (that accounts for almost 90 percent of both total area and PVPP) and cow milk (36 percent of animals' PVPP). The selection of the portfolio in France is aligned with the key sectors presented above. While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the portfolio represents about 2.4 percent of the national GDP.

The production reference value (RV) of the portfolio is almost EUR 69 billion²⁹ and the Expected Loss (EL) is approximately EUR 2.2 billion (3.21 percent of the RV). Table A.8 presents the RV and the EL of each one of the products included in the portfolio. Grapes represent about 20 percent of the value but 24 percent of the EL, which indicates an elevated risk for this crop. In turn, Common wheat and spelts account for approximately 13 percent of expected value and 11 percent of expected loss of the portfolio. On the other hand, milk accounts for 17 percent of the value and only 3.5 percent of the EL.

TABLE A.11 Expected production value and expected loss in France

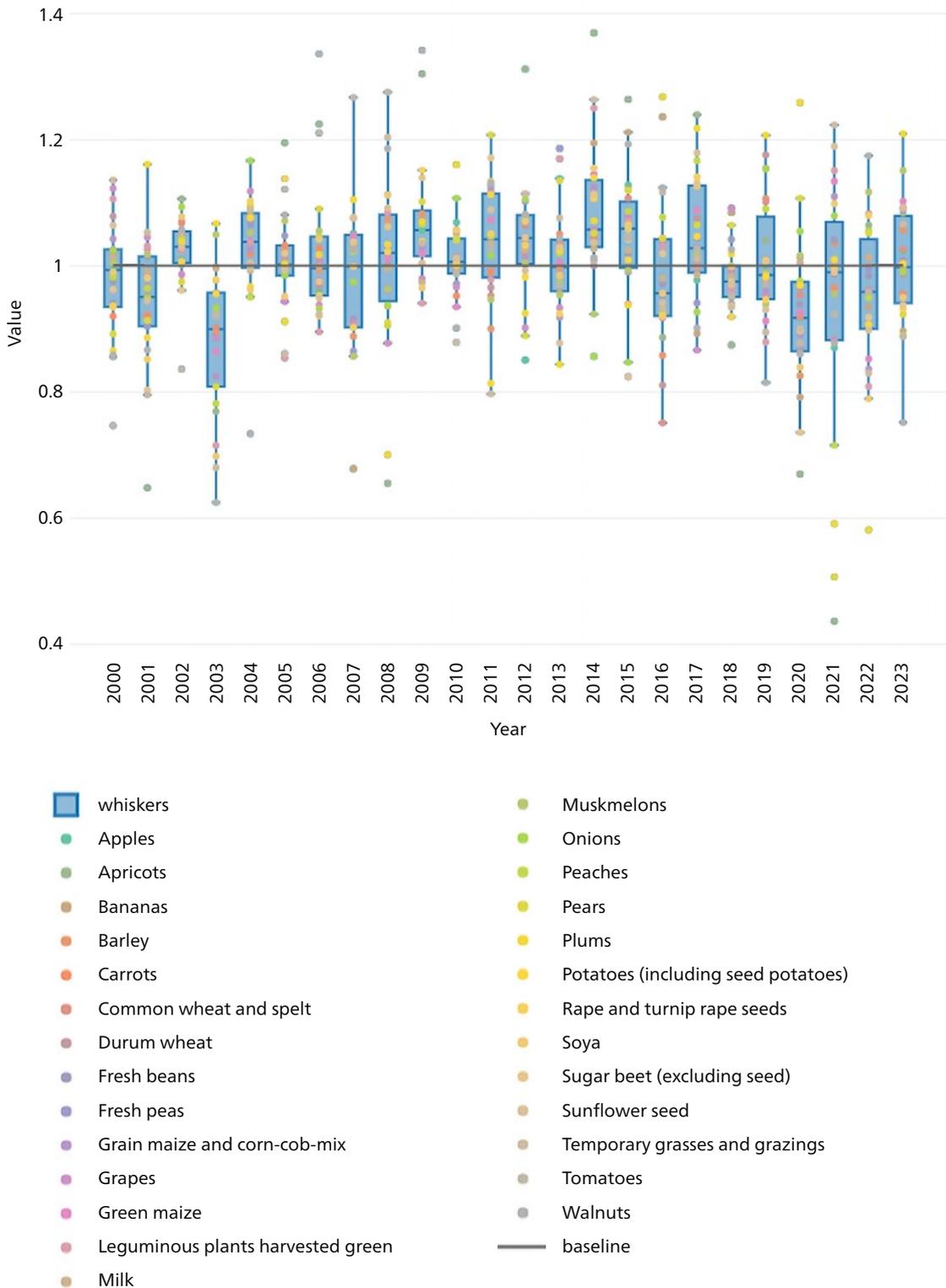
EUR million

Product	Value (EUR m)	% Value	EL (EUR m)	% EL	EL (% of Value)
Common wheat and spelt	9,008.40	13.06%	244.24	11.02%	0.35%
Durum wheat	455.00	0.66%	13.69	0.62%	0.02%
Barley	2,6677.87	3.8	87.08	3.93%	0.13%
Grain maize and corn-cob-mix	3,335.97	4.83%	120.88	5.45%	0.18%
Apples	1,436.17	2.08%	44.44	2.01%	0.06%
Pears	117.73	0.17%	5.77	0.26%	0.01%
Peaches	199.19	0.29%	7.65	0.35%	0.01%
Apricots	283.17	0.41%	27.75	1.25%	0.04%
Plums	271.76	0.39%	21.63	0.98%	0.03%
Bananas	287.18	0.42%	18.79	0.85%	0.03%
Walnuts	139.90	0.20%	10.99	0.50%	0.02%
Temporary grasses and grazings	4,390.44	6.36%	269.27	12.15%	0.39%
Leguminous plants harvested green	2,342.81	3.40%	118.88	5.36%	0.17%
Green maize	5,291.94	7.67%	182.69	8.24%	0.26%
Rape and turnip rape seeds	2,578.29	3.74%	105.55	4.76%	0.15%
Sunflower seeds	1,019.46	1.48%	37.85	1.71%	0.05%
Soya	235.83	0.34%	10.04	0.45%	0.01%
Potatoes (including seed potatoes)	3,291.35	4.77%	82.83	3.74%	0.12%
Sugar beet (excluding seed)	1,429.95	2.07%	54.43	2.46%	0.08%
Tomatoes	1,140.40	1.65%	60.89	2.75%	0.09%
Muskmelons	477.73	0.69%	14.21	0.64%	0.02%
Carrots	484.47	0.70%	9.75	0.44%	0.01%
Onions	436.79	0.63%	16.57	0.75%	0.02%
Fresh peas	672.24	0.97%	20.82	0.94%	0.03%
Fresh beans	1,195.53	1.73%	19.97	0.90%	0.03%
Grapes	13,770.45	19.96%	530.75	23.95%	0.77%
Milk	12,036.97	17.45%	78.53	3.54%	0.11%
Sum_Products	69,997.01	100.00%	2,215.94	100.00%	3.21%

²⁹ This represents roughly 70 percent of the total production value of crops and animals in France.

Historical information of yields between 2000 and 2023 was used to estimate “yield factors”, which measure deviations from an estimated trend³⁰. Figure A.6 displays the time series of these factors, for which the baseline is one (i.e., 100% of the trend value). The graph shows that 2003 was one of the worst years, exhibiting risk factors below the baseline for most of the products. Also, 2020 was a year in which many products presented negative deviation from their trend.

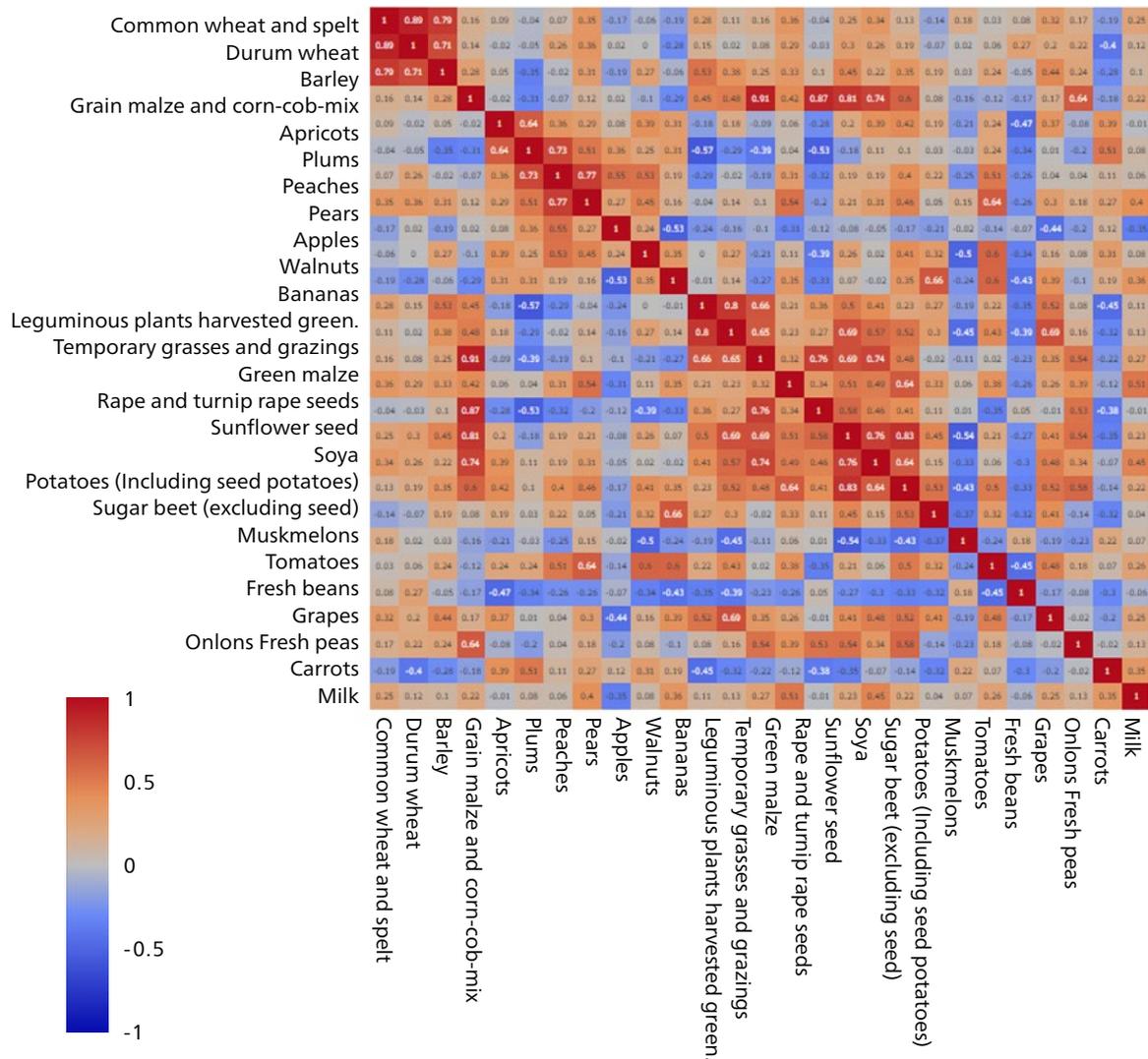
FIGURE A.6 Time series of yield risk factors in France



30 Linear regression was used for crops and an ARIMA(0,2,0) model was used in milk.

There are years in which certain events strike the whole sector but not in the same way. The correlation matrix of the risk factors presented in Figure A.7 shows the imperfect correlation among products; the blue values in the matrix exhibit negative correlations, which contribute to the diversification in the portfolio.

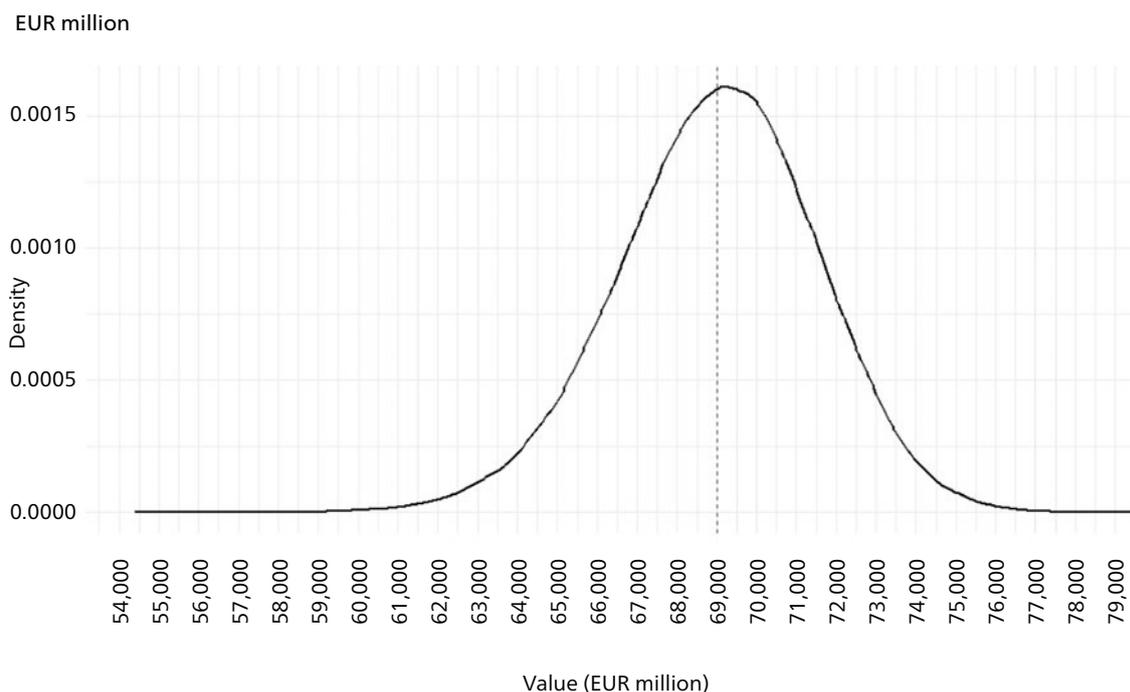
FIGURE A.7 Correlation matrix of yield risk factors in France



The historical yield factors and the correlation matrix were used to simulate a multivariate sample of 100,000 yields per product (i.e., 100,000 different potential scenarios). Probability distributions that best fit the historical data of product yield factors were selected³¹, and a multivariate random sample of 100,000 years for each product was created using these distributions and the correlation matrix presented above. These simulated risk factors were used to simulate Yields per product, Volume of production based on an expected area, and the Value of the production based on a reference price³². This approach enabled the assessment of the Joint Distribution of the Portfolio Value (Figure A.8).

31 The list of specific probability distributions that were fitted to each product is available upon request.

32 The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants. The expected yields are based on the detrending model used, the expected area was calculated as the average in the period 2021-2023 and the reference prices were estimated based on Eurostat and FAO data. The detailed information per product is available upon request.

FIGURE A.8 Probability Density Function of the Joint Portfolio Value

The “Loss” in the portfolio, used to estimate the impact in the agricultural sector and the contingent liability of the government, is defined as any deviation below the average. Even though this might appear to potentially overestimate losses, compared to the thresholds of 20% or 30% below average that are adopted in CAP ARM programs, it should be considered that the estimation carried out in this analysis is based on less variable national level yield references, and that nation-wide yield shortfalls below the average may be compatible with farm level losses of 20% or 30%. This is a feature of the current analysis and must be addressed in more depth in the future. As a first next step, it would be recommended to perform a sub-national analysis based on Eurostat data at NUTS2 level (*Nomenclature des unités territoriales statistiques*).

The Value-at-Risk (VaR) is used to estimate Contingent Liability (CL), and it quantifies a Loss that might be exceeded with a given annual probability. For instance, based on the actuarial analysis, there is a 1% probability (1-in-100) that losses at portfolio level exceed EUR 7.3 billion, or 10.6% of the reference value. Error! Reference source not found. shows the Contingent Liabilities for each product due to production losses, as measured by the Value at Risk (VaR).

The diversification effect, which arises from the non-perfect correlation among products, significantly reduces Contingent Liabilities. The portfolio CL without diversification is calculated as the sum of the VaR of each crop, a highly conservative estimate that implicitly assumes all products are perfectly positively correlated. In contrast, the portfolio VaRs were estimated considering the diversification effect among products. When crops are not perfectly correlated, adverse events affecting one product are less likely to impact others to the same extent, resulting in lower overall risk for the portfolio. For example, at a 1% exceedance probability (1-in-100), the VaR without diversification is EUR 15.6 billion, while with diversification, this figure drops to EUR 7.3 billion, and therefore the diversification benefit is EUR 8.3 billion. This pattern holds across all exceedance probabilities, with the diversification benefit ranging from EUR 11.7 billion to EUR 954 million (Table A.9).

TABLE A.12 Contingent liabilities (VaR) per product and at portfolio level in France

EUR million

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Common wheat and spelt	3,218.08	2,751.25	2,581.18	2,136.56	1,700.38	1,295.89	1,173.86	804.25	438.11
Common wheat	138.52	123.47	118.90	102.80	86.38	69.78	64.41	46.35	26.89

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Barley	862.58	764.49	735.80	643.54	549.70	439.44	404.95	295.21	171.48
Grain maize and corn-cob-mix	1,216.56	1,078.85	1,026.12	867.81	715.83	578.22	530.83	388.56	236.21
Apples	388.29	346.47	332.78	290.61	247.58	202.34	187.23	140.15	89.41
Pears	85.14	74.19	69.99	58.19	46.05	34.46	30.83	19.84	9.40
Peaches	118.87	100.91	94.51	77.21	60.62	44.78	39.82	25.86	12.33
Apricots	250.94	231.16	224.14	199.55	169.94	138.63	127.85	93.08	54.89
Plums	224.13	203.09	194.91	168.31	142.27	113.84	103.98	73.63	41.51
Bananas	157.94	145.05	140.72	125.84	109.87	91.17	84.62	63.18	38.43
Walnuts	87.97	80.82	78.20	71.04	62.36	52.12	48.54	36.66	22.88
Temporary grasses and grazings	2,304.20	2,111.71	2,040.92	1,821.28	1,580.24	1,301.74	1,214.86	909.36	550.44
Leguminous plants harvested green	1,316.03	1,149.67	1,098.42	932.83	767.69	607.26	553.77	394.03	224.38
Green maize	1,582.02	1,420.39	1,365.74	1,199.36	1,031.80	857.80	796.40	599.76	375.14
Rape and turnip rape seeds	635.80	595.44	580.14	533.29	477.59	412.67	390.89	314.94	220.71
Sunflower seed	250.70	233.79	228.33	207.77	185.66	160.31	151.40	119.72	80.98
Soya	146.78	121.78	115.52	93.47	74.16	55.43	49.65	32.98	17.26
Potatoes (including seed potatoes)	592.92	550.68	533.87	482.49	427.30	364.63	342.26	265.88	174.66
Sugar beet (excluding seed)	523.84	470.81	453.39	397.59	338.07	274.11	253.32	185.08	108.07
Tomatoes	419.42	380.23	367.91	329.18	289.33	248.16	234.12	185.11	127.46
Muskmelons	141.35	125.84	121.03	105.34	89.60	72.58	67.15	48.02	27.85
Carrots	100.73	90.08	86.15	75.23	62.84	50.53	46.35	33.05	18.89
Onions	102.66	94.61	92.29	84.30	75.66	66.02	62.65	50.61	35.38
Fresh peas	145.98	132.60	128.43	114.54	100.00	85.51	80.77	63.63	43.45
Fresh beans	213.57	190.65	180.93	156.37	129.91	104.00	95.44	67.76	38.39
Grapes	5,121.82	4,613.74	4,426.21	3,889.14	3,317.08	2,677.34	2,474.19	1,791.01	1,051.27
Milk	505.33	472.65	461.55	422.22	378.10	328.89	310.04	247.24	168.07
Sum of VaRs	20,852.16	18,654.41	17,878.07	15,585.85	13,215.99	10,727.64	9,920.18	7,294.95	4,403.94
Portfolio VaR	9,167.54	8,392.23	8,155.70	7,296.00	6,478.69	5,643.84	5,369.45	4,450.08	3,449.47
Portfolio VaR (%)	13.29%	12.16%	11.82%	10.57%	9.39%	8.18%	7.78%	6.45%	5.00%
Diversification Benefit	11,684.62	10,262.18	9,722.36	8,289.85	6,737.29	5,083.80	4,550.73	2,844.86	954.47

The diversification among agricultural products strengthens resilience to shocks and cushions sector's systemic risks. By considering diversification, stakeholders can achieve more accurate risk estimates, reduce unnecessary capital reserves, and design tailored financial instruments that better match the true risk profile. Ultimately, this approach improves the efficiency and sustainability of risk management.

To offset the Contingent Liabilities arising from agricultural production shocks, an example of a portfolio of potential financial instruments is presented. The portfolio example is developed purely for illustrative purposes with the objective of demonstrating how layered DRF approaches can strategically combine risk retention and risk transfer mechanisms to rationalize the use of fiscal resources for managing agricultural production risks.

The portfolio example does not identify the specific tools that need to be implemented to deliver compensations to farmers, nor it defines the level of the contribution that farmers need to make to the ARM tools embedded in the DRF strategy. However, it is acknowledged that the selection of the tools adopted to vehicle compensations to farmers is critical, as it influences the effectiveness of the delivery of support and defines the specific roles of the public and private sectors (e.g., direct public transfers vs micro-level farmer insurance). Separate dedicated analyses should be developed to discuss delivery approaches and the level of farmers' contribution to the ARM tools. It is expected that such analyses will in turn influence the definition of the specific DRF approach.

The first layer of the illustrative strategy consists of pre-arranged, dedicated budget resources totaling EUR 5,350 million, around 7.7% of the Reference Value of the portfolio, and it is targeted to cover CLs with a confidence level of 95%. This layer is composed of a dedicated annual budget of EUR 3,450 million and a supplementary reserve fund. The difference between the two instruments is that the first is an annual allocation in the budget, whereas the second could be composed of resources to be invested in high-quality interest-earning financial instruments to be mobilized in case of more severe events, with resources that carry over from one year to the next. For the specific case of high-income countries, this fund could be also conceived as an earmarked budget line within a larger DRF reserve fund managed by the Ministry of Finance/Treasury. The budget allocation is targeted to cover CLs up to an exceedance probability of 20 percent. When combined with the Fund, the two tools would cover CLs up to a 5 percent of exceedance probability.

TABLE A.13 Risk retention instruments in France

EUR million

Instrument	Amount (EUR m)	Exh. Prob. (cumulative)
Budget Allocation (ex-ante)	3,450	19.99%
Reserved Fund	1,900	5.08%

The Budget allocation is proposed to be assigned annually to cover the first layer of losses while funds from the additional Reserve Fund would be mobilized and used for less frequent and more severe events. As a general reference, for the case of France, the ex-ante Budget allocation could be used to finance the current ARM tools, such as farmer level insurance covers and exceptional annual budget subsidies. In the period 2014-2019, the average expenditure related to ARM state aid programs was around EUR 350 million (see Table 11, above). However, exceptional subsidies, which include Ukraine crisis, COVID-19 pandemic, expenditures of the *Fonds Solidarité Nationale*, tax rebates, etc., peaked at nearly EUR 1.2 billion in 2021. Such interventions are instructive examples of how unexpected events of significant magnitude can materialize. In the framework of this specific analysis, that is focused on production risks, it is useful to highlight that compensations for those unexpected events mainly targeted market constraints and input costs fluctuations, and not specifically production losses. Hence, these interventions would be more relevant in the context of an "income losses" analysis, which should be also carried out.

More detailed analysis of the amounts assigned to the different tools and the implementation of them are required. For instance, the MRC insurance scheme is a key element in the French ARM system, with subsidies expected to amount to about EUR 580 million annually³³. In turn, besides being a risk car-

³³ In recent years the subsidies were about EUR 350 million with a 30% uptake but it is possible to expect an increase up to 50%

rier, the insurance industry is a key stakeholder in the system, collaborating with other national programs as a loss adjuster to estimate compensations to farmers, even in non-insured areas.

For more severe events that would exhaust the retention layer, composed of the ex-ante Budget allocation and of the Reserve fund, the proposed strategy includes a risk transfer instrument. The instrument is designed as a nation-wide area-yield index insurance per product. The attachment point and exhaustion point are expressed in millions of euros, although the underlying risk is linked to production, because the yield is the only stochastic variable considered. The triggers are linked to attachment and exhaustion probabilities of 5% (on top of the risk retention layer) and 1%, respectively. The ceding percentage is 100% for all products. The Technical Premium (TP) is estimated as the Average Annual Loss (AAL) plus an uncertainty loading percentage of the Standard Deviation (SD) of $\alpha = 15.00\%$, calculated as $TP = AAL + \alpha \times SD$.

The total Limit of the illustrative risk transfer instruments is EUR 5,666 million³⁴, while the estimated Technical Premium is around EUR 256 million or 4.53% of the Limit (Error! Reference source not found). The Technical Premium was rated on a per-product basis (i.e., it does not consider diversification) and does not include other loadings such as operational costs, shareholder profits, etc. Should this insurance cover be included into the DRF strategy for Italy, the final pricing of the instrument will be different for several reasons: (1) risk takers (e.g., insurers) will include additional loadings, (2) diversification among products in Italy may reduce the uncertainty loading, (3) potential risk pooling among countries in the EU could provide additional diversification benefits. Furthermore, placing insurance at a national level might reduce costs and increase the government's negotiating power to obtain lower prices.

The illustrative risk transfer mechanism is structured at national level (i.e. a "macro-level" tool) and the payouts would be provided to the national administration and be used to increase the compensation capacity of the ex-ante Budget allocation. In the framework of the DRF strategy, it is important to distinguish between this risk transfer mechanism and the subsidized farm-level insurance programs. Although they should be conceived to be complementary for the government, the two instruments are separate and have different purposes. In particular, they differ with respect to the targeted risk levels and frequency of payouts, which are higher for the farm-level program and lower for the national-level product, which is designed to address only extreme events at an aggregate level.

TABLE A.14 Risk Transfer Specifications for France (nation-wide AYII)

Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP/Limit)	Leverage (Limit/TP = 1/RoL)
Common wheat and spelt	1,173.86	2,136.56	962.70	23.30	2.42%	42.32	4.40%	22.75
Durum wheat	64.41	102.80	38.39	0.96	2.50%	1.73	4.52%	22.14
Barley	404.95	643.53	238.59	6.07	2.54%	10.92	4.58%	21.85
Grain maize and corn-cob-mix	530.83	867.81	336.98	8.26	2.45%	14.94	4.43%	22.56
Apples	187.23	290.61	103.38	2.61	2.52%	4.69	4.54%	22.02
Pears	30.83	58.19	27.36	0.67	2.44%	1.21	4.42%	22.63
Peaches	39.82	77.21	37.38	0.92	2.46%	1.66	4.45%	22.46
Apricots	127.85	199.55	71.71	1.83	2.55%	3.29	4.59%	21.81
Plums	103.97	168.31	64.33	1.64	2.55%	2.95	4.58%	21.83
Bananas	84.62	125.84	41.22	1.07	2.59%	1.91	4.64%	21.54

³⁴ This is the maximum potential payout that could be triggered. However, notice that the probability of a full payout is extremely small because of the diversification among products (e.g., in the 100,000 simulated scenarios, the maximum payout was EUR 3,525 million, only around 62% of the Limit).

Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP/Limit)	Leverage (Limit/TP = 1/Rol)
Walnuts	48.54	71.04	22.50	0.58	2.59%	1.05	4.65%	21.53
Temporary grasses and grazings	1,214.85	1,821.28	606.42	15.47	2.55%	27.82	4.59%	21.80
Leguminous plants harvested green	553.77	932.83	379.06	9.38	2.47%	16.95	4.47%	22.37
Green maize	796.39	1,199.35	402.96	10.19	2.53%	18.31	4.54%	22.00
Rape and turnip rape seeds	390.89	533.29	142.40	3.66	2.57%	6.57	4.61%	21.68
Sunflower seed	151.40	207.77	56.37	1.46	2.58%	2.61	4.63%	21.60
Soya	49.65	93.47	43.82	1.08	2.45%	1.95	4.45%	22.48
Potatoes (including seed potatoes)	342.26	482.49	140.23	3.61	2.57%	6.47	4.61%	21.68
Sugar beet (excluding seed)	253.32	397.59	144.26	3.64	2.52%	6.56	4.55%	21.98
Tomatoes	234.12	329.18	95.06	2.40	2.52%	4.31	4.54%	22.04
Muskmelons	67.15	105.34	38.19	0.97	2.53%	1.74	4.55%	21.96
Carrots	46.35	75.23	28.89	0.72	2.49%	1.30	4.49%	22.26
Onions	62.65	84.30	21.65	0.55	2.56%	1.00	4.60%	21.74
Fresh peas	80.77	114.54	33.77	0.85	2.50%	1.52	4.51%	22.15
Fresh beans	95.44	156.37	60.93	1.51	2.48%	2.73	4.48%	22.30
Grapes	2,474.18	3,889.14	1,414.95	36.00	2.54%	64.75	4.58%	21.85
Milk	310.04	422.22	112.17	2.92	2.61%	5.23	4.66%	21.45

The illustrative DRF strategy enhances the country’s capacity to manage shocks; however, a residual risk for catastrophic events remains. Stochastic modeling based on 100,000 simulations reveals that this combined DRF strategy has a 2.47 percent annual exceedance probability of being depleted. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities.

Figure A.9 presents a graphical representation of the funding gap analysis for the illustrative DRF strategy. The black line at the top of the plot shows the portfolio’s Loss Exceedance Curve³⁵. Below this line, the instruments used to finance each potential loss are stacked. The boundaries of the stacked instruments exhibit a sawtooth pattern because not all coverages are activated simultaneously, as the insurance is structured on a per-product basis. Also note that, while the risk transfer tool targets high risk layers, in the graphical representation it is illustrated at the bottom, starting at the 0 level of the allocated amounts. This is because payouts provided by the risk transfer tool will be the first to be accessed, before using resources allocated to risk retention instruments.

Table A.12 illustrates the gap analysis for some specific points of the Loss Exceedance Curve. For instance, there is a 1% probability that the losses in the selected portfolio exceed EUR 7,296 million. The payouts from the risk transfer mechanism are estimated at EUR 1,044 million, and the risk retention instru-

³⁵ Value-at-Risk in the y-axis vs Exceedance Probability in the x-axis. The results in Table 2, above, are selected points extracted from this curve.

ments of EUR 5,350 million are fully depleted, resulting in a funding gap of around EUR 901 million. Note that the Financing Gap is non-monotonic (i.e., the higher the loss, the higher the gap) because of the sawtooth behavior of the risk transfer mechanism, which might be counterintuitive. For example, when comparing losses associated with a 0.4 and a 0.5 percent exceedance probability, it can be seen that while losses increased EUR 237 million (from EUR 8,156 million to EUR 8,392 million) the payouts increased EUR 280 million (from EUR 1,812 million to EUR 2,092 million), leading to a higher funding gap (EUR 993 million vs EUR 950 million) when the loss is lower. Moreover, for a loss of EUR 6,479 million (exceedance probability of 2 percent) the risk transfer payouts are EUR 1,179 million, while for a loss of EUR 7,296 million (exc. probability 1 percent) the payouts are only EUR 1,045 million.

FIGURE A.9 Funding gap analysis for France

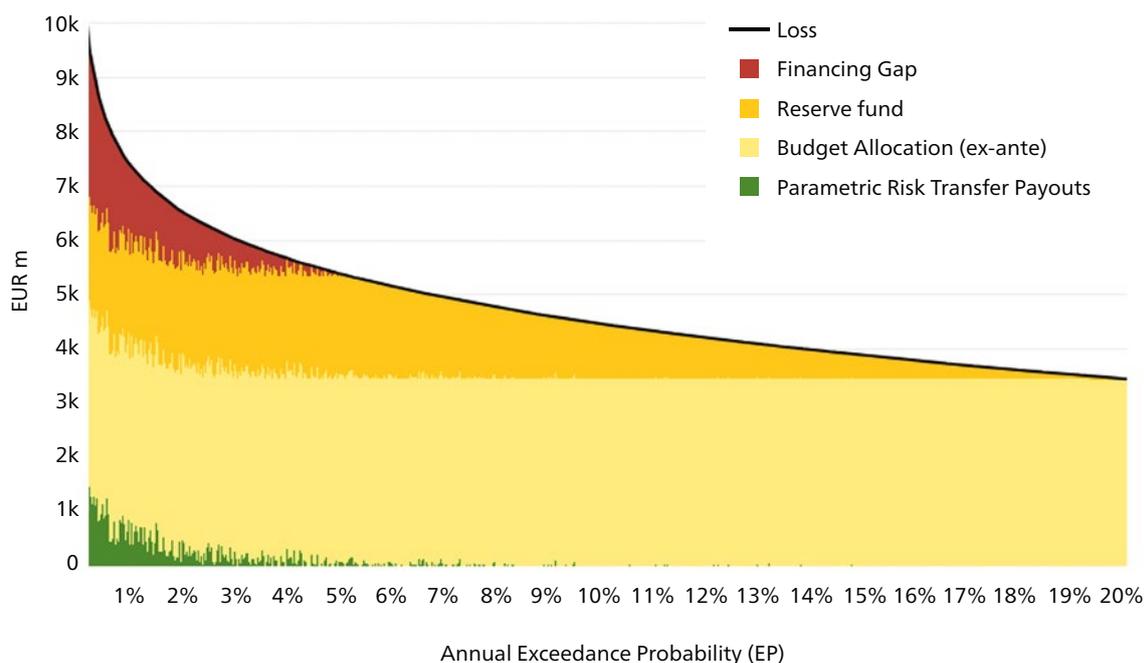


TABLE A.15 Funding gap analysis for selected exceedance probabilities in France

EUR million

Exc. Prob.	Loss	Insurance Payouts	Retention	Budget Allocation (ex-ante)	Reserve fund	Financing Gap
0.20%	9,167.54	2,197.83	6,969.71	3,450.00	1,900.00	1,619.71
0.40%	8,392.23	2,092.18	6,300.05	3,450.00	1,900.00	950.05
0.50%	8,155.70	1,812.37	6,343.33	3,450.00	1,900.00	993.33
1.00%	7,296.00	1,044.83	6,251.17	3,450.00	1,900.00	901.17
2.00%	6,478.69	1,179.38	5,299.31	3,450.00	1,849.31	0.00
4.00%	5,643.84	326.58	5,317.26	3,450.00	1,867.26	0.00
5.00%	5,369.45	529.18	4,840.27	3,450.00	1,390.27	0.00
10.00%	4,450.08	314.44	4,135.65	3,450.00	685.65	0.00
20.00%	3,449.47	394.45	3,055.03	3,055.03	0.00	0.00

ITALY

The actuarial analysis for Italy is based on a portfolio that comprises twenty-five crops (that accounts for approximately 61 percent of the total area and 66 percent of PVPP) and cow milk (33 percent of animals' PVPP). The selection of the portfolio in Italy is aligned with the key sectors presented above. While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the final portfolio represents about 1.5 percent of the national GDP.

The production reference value (RV) of the portfolio is almost EUR 31.4 billion³⁶ and the Expected Loss (EL) is approximately EUR 960 million (3 percent of the RV). Table A.12 presents the RV and the EL of each one of the products included in the portfolio. Note that Olives represent about 5 percent of the value but 13 percent of the EL, which indicates an elevated risk for this crop. In turn, Grapes accounts for approximately 15 percent of both RV and EL of the portfolio, while green maize accounts for 18 percent of the value and 14 percent of the EL. On the other hand, Milk accounts for 23 percent of the RV and 20 percent of the EL.

TABLE A.16 Expected Production Value and Expected Loss in Italy

EUR million

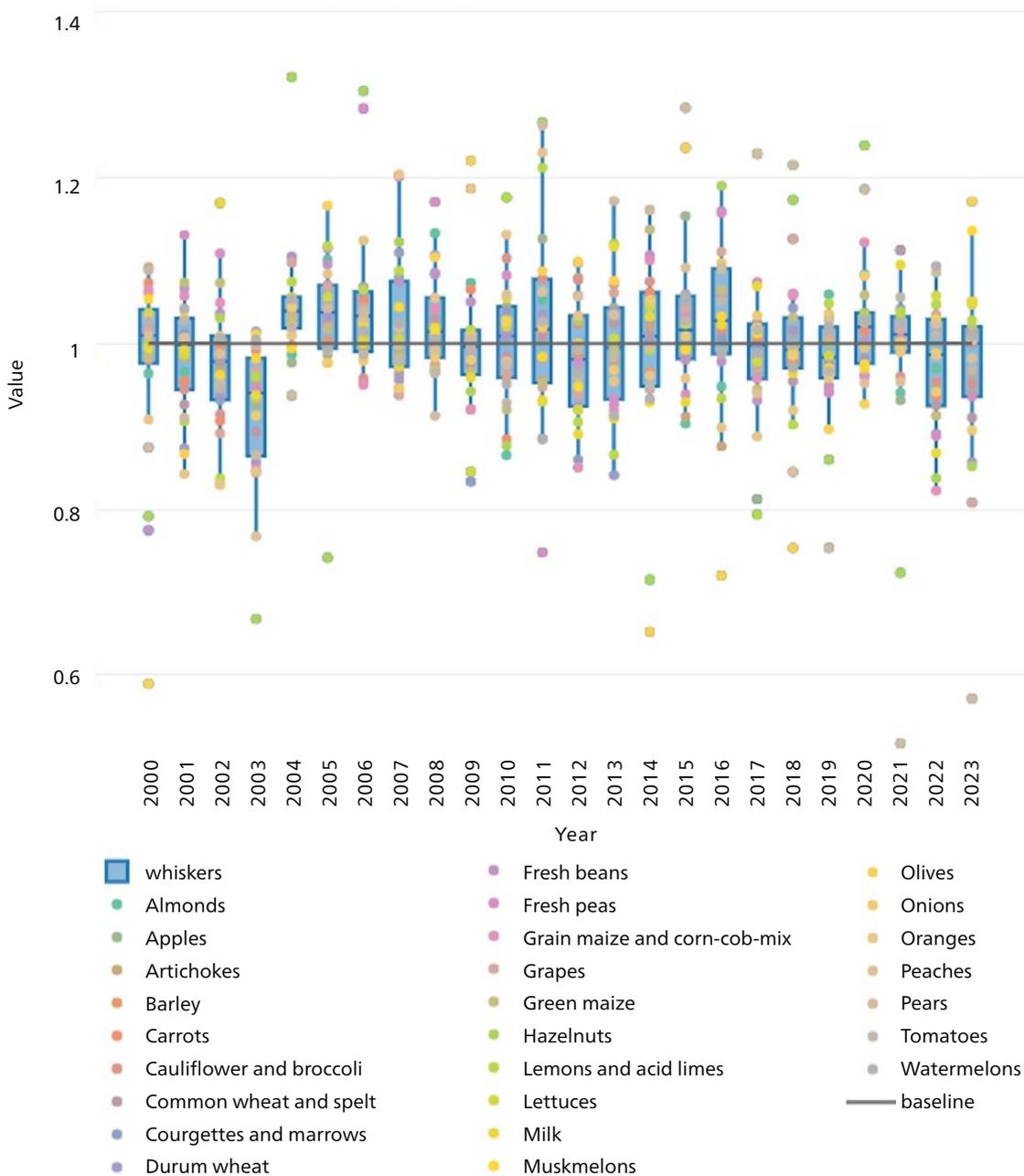
Product	Value (EUR m)	% Value	EL (EUR m)	% EL	EL (% of Value)
Common wheat and spelt	859.45	2.73%	21.20	2.21%	0.07%
Durum wheat	1,534.86	4.88%	46.06	4.80%	0.15%
Barley	278.02	0.88%	4.66	0.49%	0.01%
Grain maize and corn-cob-mix	1,125.84	3.58%	37.48	3.90%	0.12%
Apples	1,132.99	3.60%	40.11	4.18%	0.13%
Pears	299.85	0.95%	22.95	2.39%	0.07%
Peaches	414.13	1.32%	9.69	1.01%	0.03%
Hazelnuts	443.66	1.41%	40.05	4.17%	0.13%
Almonds	487.50	1.55%	14.21	1.48%	0.05%
Green maize	5,775.37	18.38%	133.08	13.87%	0.42%
Olives	1,600.96	5.09%	123.28	12.84%	0.39%
Oranges	564.76	1.80%	27.42	2.86%	0.09%
Lemons and acid limes	299.64	0.95%	12.32	1.28%	0.04%
Cauliflower and broccoli	292.11	0.93%	6.86	0.71%	0.02%
Lettuces	350.53	1.12%	6.01	0.63%	0.02%
Artichokes	304.50	0.97%	4.88	0.51%	0.02%
Tomatoes	1,948.69	6.20%	29.44	3.07%	0.09%
Courgettes and marrows	405.73	1.29%	11.50	1.20%	0.04%
Muskmelons	308.71	0.98%	6.02	0.63%	0.02%
Watermelons	248.15	0.79%	4.54	0.47%	0.01%
Carrots	186.93	0.59%	3.40	0.35%	0.01%
Onions	165.26	0.53%	3.47	0.36%	0.01%
Fresh peas	82.54	0.26%	4.84	0.50%	0.02%
Fresh beans	160.00	0.51%	4.26	0.44%	0.01%
Grapes	4,902.64	15.60%	145.82	15.19%	0.46%
Milk	7,255.74	23.09%	196.30	20.45%	0.62%
Sum_Products	31,428.55	100.00%	959.85	100.00%	3.05%

³⁶ This represents roughly 50% of the total production value of crops and animals in Italy

The actuarial analysis for Italy is based on a portfolio that comprises twenty-five crops (that accounts for approximately 61 percent of the total area and 66 percent of PVPP) and cow milk (33 percent of animals' PVPP). The selection of the portfolio in Italy is aligned with the key sectors presented in Error! Reference source not found., above. While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the final portfolio represents about 1.5 percent of the national GDP.

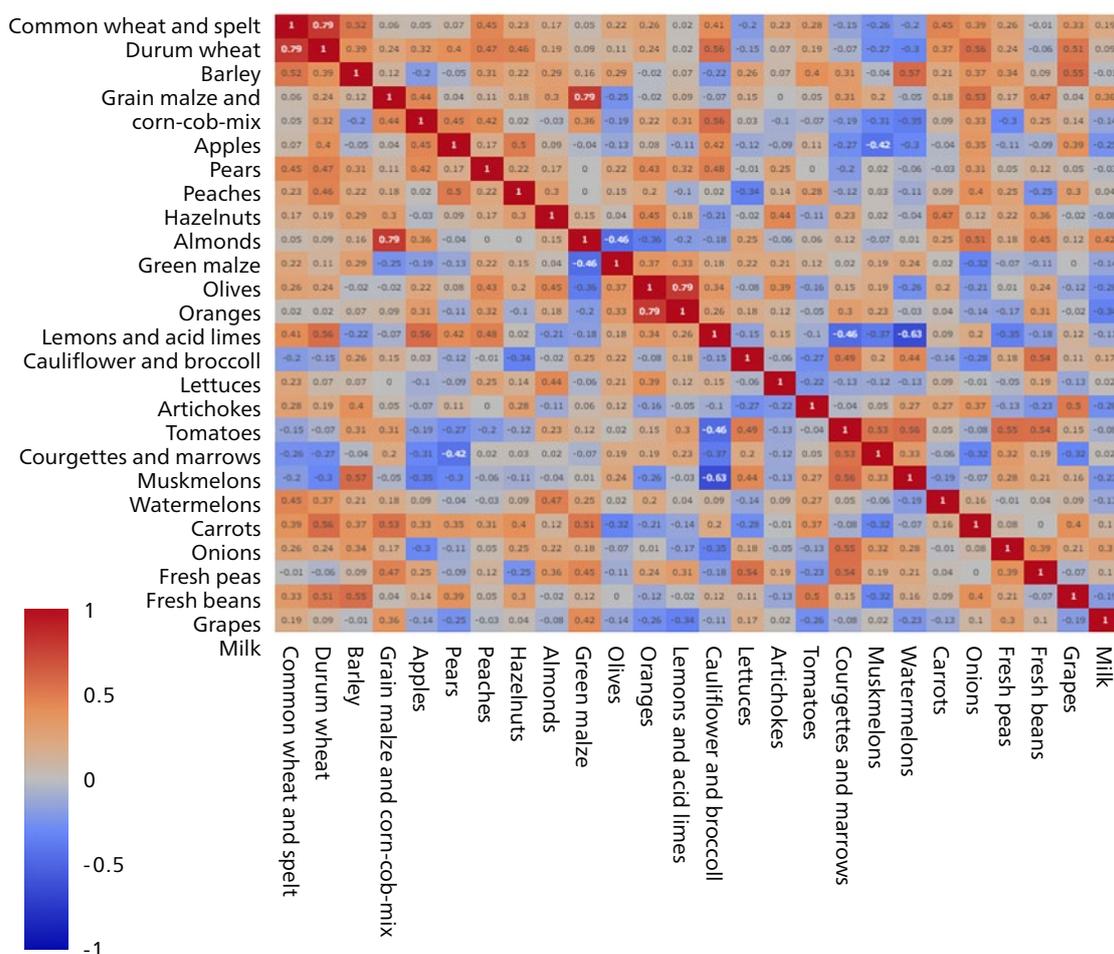
The production reference value (RV) of the portfolio is almost EUR 31.4 billion³⁷ and the Expected Loss (EL) is approximately EUR 960 million (3 percent of the RV). Table presents the RV and the EL of each one of the products included in the portfolio. Note that Olives represent about 5 percent of the value but 13 percent of the EL, which indicates an elevated risk for this crop. In turn, Grapes accounts for approximately 15 percent of both RV and EL of the portfolio, while green maize accounts for 18 percent of the value and 14 percent of the EL. On the other hand, Milk accounts for 23 percent of the RV and 20 percent of the EL.

FIGURE A.10 Time series of yield risk factors in Italy



37 This represents roughly 50% of the total production value of crops and animals in Italy.

FIGURE A.11 Correlation matrix of yield risk factors in Italy

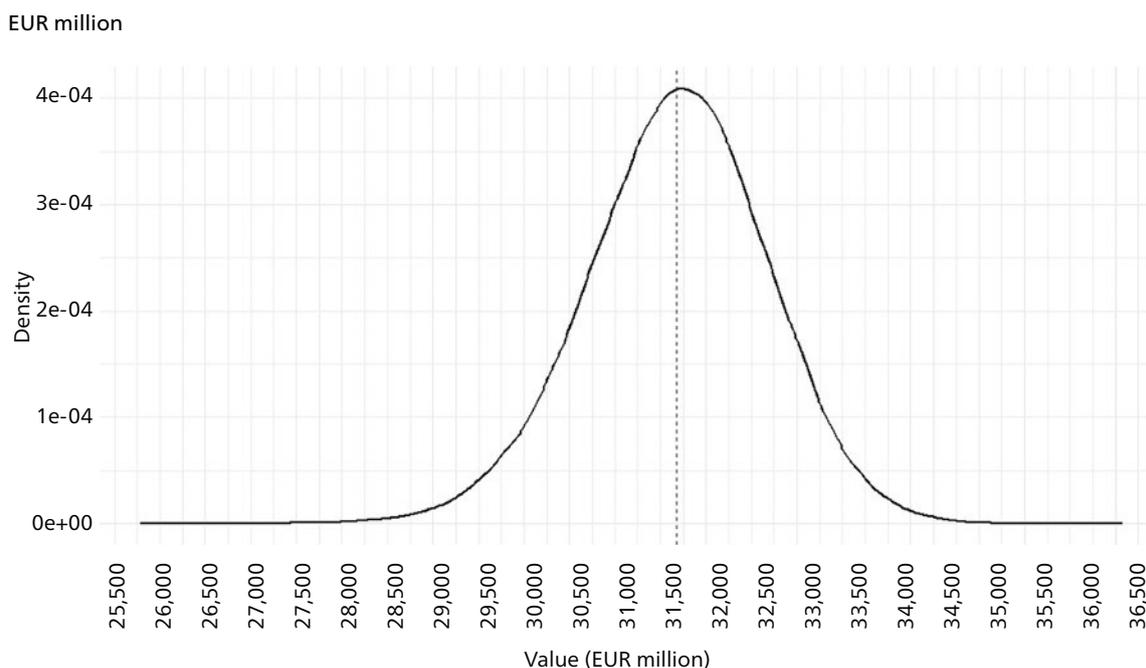


The historical yield factors and the correlation matrix were used to simulate a multivariate sample of 100,000 yields per product (i.e., 100,000 different potential scenarios). Probability distributions that best fit the historical data of product yield factors were selected³⁸, and a multivariate random sample of 100,000 years for each product was created using these distributions and the correlation matrix presented above. These simulated risk factors were used to simulate Yields per product, Volume of production based on an expected area, and the Value of the production based on a reference price³⁹. This approach enabled the assessment of the Joint Probability Distribution of the Crop Portfolio Value (Figure A.12)⁴⁰.

The “Loss” in the portfolio, used to estimate the impact in the agricultural sector and the contingent liability of the government, is defined as any deviation below the average. Even though this might appear to potentially overestimate losses, compared to the thresholds of 20% or 30% below average that are adopted in CAP ARM programs, it should be considered that the estimation carried out in this analysis is based on less variable national level yield references, and that nation-wide yield shortfalls below the average may be compatible with farm level losses of 20% or 30%. This is a feature of the current analysis and must be addressed in more depth in the future. As a first next-step, it would be recommended to perform a sub-national analysis based on Eurostat data at NUTS2 level (Nomenclature des unités territoriales statistiques).

The Value-at-Risk (VaR) is used to estimate the Contingent Liability (CL), and it quantifies a Loss that might be exceeded with a given annual probability. For instance, based on the actuarial analysis, there is a 1% probability (1-in-100) that losses at portfolio level exceed EUR 2,873 million, or 9.14% of the reference value. Table shows the Contingent Liabilities for each product due to production losses, as measured by the Value at Risk (VaR).

38 The list of specific probability distributions that were fitted to each product is available upon request.
 39 The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants. The expected yields are based on the detrending model used, the expected area was calculated as the average in the period 2021-2023 and the reference prices were estimated based on Eurostat and FAO data. The detailed information per product is available upon request.
 40 Note that the distribution is centered around the Reference Value presented above.

FIGURE A.12 Probability Density Function of the Joint Portfolio Value in Italy

The diversification effect, which arises from the non-perfect correlation among products, significantly reduces Contingent Liabilities. The portfolio CL without diversification is calculated as the sum of the VaR of each crop, a highly conservative estimate that implicitly assumes that all products are perfectly positively correlated. In contrast, the portfolio VaRs were estimated considering the diversification effect among products. When crops are not perfectly correlated, adverse events affecting one product are less likely to impact others to the same extent, resulting in lower overall risk for the portfolio. For example, at a 1% exceedance probability (1-in-100), the VaR without diversification is EUR 6,657 million, while with diversification, this figure drops to EUR 2,873 million, and therefore the diversification benefit is EUR 3,784 million. This pattern holds across all exceedance probabilities, with the diversification benefit ranging from EUR 5,402 million to EUR 462 million (Table A.17).

TABLE A.17 Contingent liabilities (VaR) per product and at portfolio level in Italy

EUR million

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Common wheat and spelt	157.40	143.11	138.77	124.73	108.81	91.66	85.98	67.14	44.55
Durum wheat	597.76	508.65	482.54	407.66	328.38	251.87	227.48	155.28	81.63
Barley	40.62	36.40	34.94	30.73	26.47	21.95	20.44	15.31	9.52
Grain maize and corn-cob-mix	668.34	560.98	524.27	409.49	315.54	228.12	202.84	126.27	55.87
Apples	386.35	348.38	335.30	294.40	249.97	202.11	186.49	136.06	79.48
Pears	249.36	223.16	214.29	182.97	149.55	118.32	107.46	75.64	43.58
Peaches	138.46	118.54	112.55	92.47	72.99	54.92	49.16	32.31	16.45
Hazelnuts	208.36	200.75	198.09	187.56	173.84	155.50	148.50	122.85	87.30
Almonds	115.28	102.35	98.86	87.40	75.15	62.42	58.47	45.07	29.27
Green maize	913.07	842.33	821.27	746.22	662.12	570.99	537.06	422.72	283.20
Olives	1,303.28	1,169.65	1,121.18	968.55	805.95	640.18	585.09	410.34	234.06

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Oranges	157.26	146.75	143.48	131.69	117.54	102.69	97.11	78.97	56.89
Lemons and acid limes	124.98	111.21	106.65	90.86	76.05	60.63	55.67	39.87	23.83
Cauliflower and broccoli	46.31	42.80	41.61	37.82	33.76	29.02	27.39	21.80	14.54
Lettuces	82.62	70.19	65.90	54.02	43.25	32.86	29.61	19.84	10.46
Artichokes	73.62	61.59	57.90	47.19	36.67	27.22	24.41	16.20	8.26
Tomatoes	238.16	210.58	201.81	178.01	153.34	127.41	119.32	92.05	60.54
Courgettes and marrows	192.86	162.28	151.50	121.26	93.93	69.46	61.58	38.50	17.76
Muskmelons	62.57	55.81	53.68	46.50	38.89	31.16	28.66	20.58	11.66
Watermelons	59.61	51.35	48.84	40.66	32.32	24.93	22.52	15.17	8.06
Carrots	40.35	34.43	32.57	27.24	22.10	17.20	15.73	11.08	6.35
Onions	36.21	32.16	30.99	26.79	22.48	17.99	16.55	11.81	6.68
Fresh peas	42.23	38.47	37.32	33.40	28.76	23.91	22.21	16.29	9.76
Fresh beans	53.99	45.01	42.60	34.62	28.34	21.85	19.95	13.84	7.86
Grapes	1,456.47	1,304.51	1,254.15	1,100.57	926.96	743.58	685.12	494.54	286.84
Milk	1,495.25	1,354.22	1,311.23	1,154.31	1,005.70	852.46	797.71	615.90	409.30
Sum of VaRs	8,940.78	7,975.67	7,662.28	6,657.12	5,628.85	4,580.40	4,232.51	3,115.44	1,903.72
Portfolio VaR	3,538.84	3,253.45	3,156.65	2,873.16	2,564.53	2,258.60	2,150.07	1,811.89	1,441.61
Portfolio VaR (%)	11.26%	10.35%	10.04%	9.14%	8.16%	7.19%	6.84%	5.77%	4.59%
Diversification Benefit	5,401.94	4,722.21	4,505.63	3,783.96	3,064.33	2,321.80	2,082.44	1,303.55	462.11

The diversification among agricultural products strengthens resilience to shocks and cushions the sector's systemic risks. By considering diversification, stakeholders can achieve more accurate risk estimates, reduce unnecessary capital reserves, and design tailored financial instruments that better match the true risk profile. Ultimately, this approach improves the efficiency and sustainability of risk management.

To offset the Contingent Liabilities arising from agricultural production shocks, an example of a portfolio of potential financial instruments is presented. The portfolio example is developed purely for illustrative purposes with the objective of demonstrating how layered DRF approaches can strategically combine risk retention and risk transfer mechanisms to rationalize the use of fiscal resources for managing agricultural production risks.

The portfolio example does not identify the specific tools that need to be implemented to deliver compensations to farmers, nor it defines the level of the contribution that farmers need to make to the ARM tools embedded in the DRF strategy. However, it is acknowledged that the selection of the tools adopted to vehicle compensations to farmers is critical, as it influences the effectiveness of the delivery of support and defines the specific roles of the public and private sectors (e.g., direct public transfers vs micro-level farmer insurance). Separate dedicated analyses should be developed to discuss delivery approaches and the level of farmers' contribution to the ARM tools. It is expected that such analyses will in turn influence the definition of the specific DRF approach.

The first layer of the illustrative strategy consists of pre-arranged, dedicated budget resources totaling EUR 2,150 million, around 6.8% of the Reference Value of the portfolio, and it is targeted to cover CLs with a confidence level of 95%⁴¹. This layer is composed of a dedicated annual budget of EUR 1,450 million

⁴¹ That is, there is a 5% probability that losses exceed this amount. See Table .

and a supplementary reserve fund of EUR 700 million. The difference between the two instruments is that the first is an annual allocation in the budget, whereas the second could be composed of resources to be invested in high-quality interest-earning financial instruments to be mobilized in case of more severe events, with resources that carry over from one year to the next. For the specific case of high-income countries, this fund could be also conceived as an earmarked budget line within a larger DRF reserve fund managed by the Ministry of Finance/Treasury. The budget allocation is targeted to cover CLs up to an exceedance probability of 20 percent. When combined with the Fund, the two tools would cover CLs up to a 5 percent of exceedance probability (Table A.18).

TABLE A.18 Risk retention instruments in Italy

EUR million

Instrument	Amount (EUR m)	Exh. Prob. (cumulative)
Budget Allocation (ex-ante)	1,450	19.72%
Reserved Fund	700	5.00%

The Budget allocation is proposed to be assigned annually to cover the first layer of losses while funds from the additional Reserve Fund would be mobilized and used for less frequent and more severe events. As a general reference, for the case of Italy, the ex-ante Budget allocation could be used to finance the current ARM tools, such as farmer level insurance covers, mutual funds for production risks and income stabilization, the AGRICAT national mutual fund, contributions to the reinsurance fund, and ex-post compensations; overall these tools combined absorb an amount of resources similar to the allocation foreseen in this example. The Reserve Fund would then be triggered for more severe events that exceed the average levels of expenditures, such as for example the severe flooding events of 2023 in the Emilia-Romagna and Marche regions that required a dedicated extraordinary allocation (Law 100 of 2023).

More detailed analysis of the amounts assigned to the different tools are required. For example, the average ex-post compensations provided in Italy through the National Solidarity Fund and national State-aid measures are roughly in the range of EU 350 million per year (Table 15, average of the 2022 – 2024 period). This is the amount that could be considered “structural” and does not include the compensations provided for the COVID-19 pandemic and the Ukraine crisis, which peaked at nearly EUR 2.3 billion annually. Such interventions are instructive examples of how unexpected events of significant magnitude can materialize. In the framework of this specific analysis, that is focused on production risks, it is useful to highlight that compensations for those events mainly targeted market constraints and input costs fluctuations, and not specifically production losses. Hence, these interventions would be more relevant in the context of an “income losses” analysis, which should be also carried out. Another important element to be considered is that the unitary levels of compensation provided for production losses are key parameters for obtaining reliable estimates of the resources required by a DRF strategy. For example, in Italy, compensations provided under the subsidized insurance programs are based on “Standard Values”, which are references for the values of production and are calculated by ISMEA for each crop, while AGRICAT compensations are based on different references known as “Index Values”, which cover only variable input costs (Box 4).

For more severe events that would exhaust the retention layer, composed of the ex-ante Budget allocation and of the Reserve fund, the proposed strategy includes a risk transfer instrument. The instrument is designed as a nation-wide area-yield index insurance per product. The attachment point and exhaustion point are expressed in millions of euros, although the underlying risk is linked to production, because the yield is the only stochastic variable considered. The triggers are linked to attachment and exhaustion probabilities of 5% (on top of the risk retention layer) and 1%, respectively. The ceding percentage is 100% for all products. The Technical Premium (TP) is estimated as the Average Annual Loss (AAL) plus an uncertainty loading percentage of the Standard Deviation (SD) of $\alpha = 15.00\%$. Calculated as $TP = AAL + \alpha \times SD$.

The total Limit of the illustrative risk transfer instruments is EUR 2,425 million⁴², while the estimated Technical Premium is around EUR 109 million or 4.51% of the Limit (Error! Reference source not found.). The Technical Premium was rated on a per-product basis (i.e., it does not consider diversification)

⁴² This is the maximum potential payout that could be triggered. However, notice that the probability of a full payout is extremely small because of the diversification among products (e.g., in the 100,000 simulated scenarios, the maximum payout was EUR 1,127 million, only around 50% of the Limit).

and does not include other loadings such as operational costs, shareholder profits, etc. Should this insurance cover be included into the DRF strategy for Italy, the final pricing of the instrument will be different for several reasons: (1) risk takers (e.g., insurers) will include additional loadings, (2) diversification among products in Italy may reduce the uncertainty loading, (3) potential risk pooling among countries in the EU could provide additional diversification benefits. Furthermore, placing insurance at a national level might reduce costs and increase the government's negotiating power to obtain lower prices.

The illustrative risk transfer mechanism is structured at national level (i.e. a “macro-level” tool) and the payouts would be provided to the national administration and be used to increase the compensation capacity of the ex-ante Budget allocation. In the framework of the DRF strategy, it is important to distinguish between this risk transfer mechanism and the subsidized farm-level insurance programs. Although they should be conceived to be complementary for the government, the two instruments are separate and have different purposes. In particular, they differ with respect to the targeted risk levels and frequency of payouts, which are higher for the farm-level program and lower for the national-level product, which is designed to address only extreme events at an aggregate level.

TABLE A.19 Risk Transfer Specifications for Italy (nation-wide AYII)

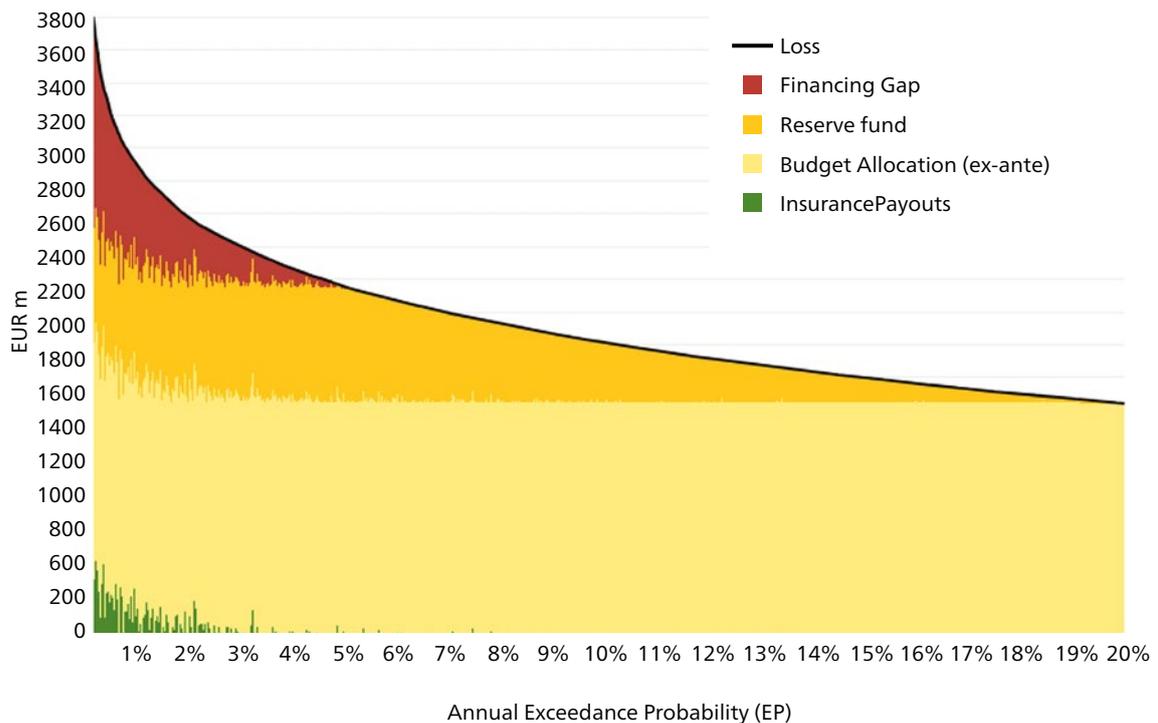
Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP/Limit)	Leverage (Limit/TP = 1/RoL)
Common wheat and spelt	85.98	124.73	38.75	0.98	2.52%	1.76	4.54%	22.03
Durum wheat	227.48	407.66	180.18	4.44	2.47%	8.03	4.46%	22.43
Barley	20.44	30.73	10.29	0.26	2.53%	0.47	4.55%	21.99
Grain maize and corn-cob-mix	202.84	409.49	206.64	5.01	2.42%	9.09	4.40%	22.73
Apples	186.49	294.40	107.91	2.73	2.53%	4.92	4.56%	21.94
Pears	107.46	182.97	75.51	1.87	2.48%	3.38	4.47%	22.36
Peaches	49.16	92.47	43.30	1.06	2.44%	1.92	4.43%	22.57
Hazelnuts	148.50	187.56	39.06	1.05	2.68%	1.86	4.77%	20.95
Almonds	58.47	87.40	28.93	0.72	2.50%	1.31	4.52%	22.14
Green maize	537.06	746.22	209.16	5.38	2.57%	9.64	4.61%	21.70
Olives	585.09	968.55	383.46	9.58	2.50%	17.28	4.51%	22.19
Oranges	97.11	131.69	34.58	0.89	2.57%	1.59	4.61%	21.69
Lemons and acid limes	55.67	90.86	35.19	0.88	2.50%	1.59	4.51%	22.16
Cauliflower and broccoli	27.39	37.82	10.43	0.27	2.58%	0.48	4.64%	21.57
Lettuces	29.61	54.02	24.41	0.60	2.45%	1.08	4.44%	22.51
Artichokes	24.41	47.19	22.78	0.55	2.40%	0.99	4.36%	22.92
Tomatoes	119.32	178.01	58.69	1.46	2.49%	2.64	4.50%	22.23
Courgettes and marrows	61.58	121.26	59.68	1.45	2.43%	2.63	4.41%	22.68
Muskmelons	28.66	46.50	17.83	0.44	2.49%	0.80	4.50%	22.23
Watermelons	22.52	40.66	18.14	0.44	2.42%	0.80	4.39%	22.76
Carrots	15.73	27.24	11.52	0.28	2.45%	0.51	4.44%	22.55
Onions	16.55	26.79	10.24	0.26	2.51%	0.46	4.53%	22.08
Fresh peas	22.21	33.40	11.19	0.28	2.54%	0.51	4.57%	21.89
Fresh beans	19.95	34.62	14.67	0.36	2.47%	0.66	4.47%	22.36
Grapes	685.12	1,100.57	415.45	10.40	2.50%	18.76	4.52%	22.14
Milk	797.71	1,154.31	356.60	9.07	2.54%	16.29	4.57%	21.89

The illustrative DRF strategy enhances the country's capacity to manage shocks; however, a residual risk for catastrophic events remains. Stochastic modeling based on 100,000 simulations reveals that this combined DRF strategy has a 2.46 percent annual exceedance probability of being depleted. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities.

Figure A.13 presents a graphical representation of the funding gap analysis for the illustrative DRF strategy. The black line at the top of the plot shows the portfolio's Loss Exceedance Curve.⁴³ Below this line, the financial instruments used to finance each potential loss are stacked. The boundaries of the stacked instruments exhibit a sawtooth pattern because not all coverages are activated simultaneously, as the risk transfer mechanism is structured on a per-product basis. Also note that, while the risk transfer tool targets high risk layers, in the graphical representation it is illustrated at the bottom, starting at the 0 level of the allocated amounts. This is because payouts provided by the risk transfer tool will be the first to be accessed, before using resources allocated to risk retention instruments.

Table illustrates the gap analysis for some specific points of the Loss Exceedance Curve. For instance, there is a 1% probability that the losses in the selected portfolio exceed EUR 2,873 million. The payouts from the risk transfer mechanism are estimated at EUR 376 million, and the risk retention instruments of EUR 2,150 million are fully depleted, resulting in a funding gap of around EUR 347 million.

FIGURE A.13. Funding gap analysis for Italy



⁴³ Value-at-Risk in the y-axis vs Exceedance Probability in the x-axis. The results in Table , above, are selected points extracted from this curve.

TABLE A.20 Funding gap analysis for selected exceedance probabilities in Italy

EUR million

Exc. Prob.	Loss	Insurance Payouts	Retention	Budget Allocation (ex-ante)	Reserve fund	Financing Gap
0.20%	3,538.84	647.09	2,891.75	1,450.00	700.00	741.75
0.40%	3,253.45	539.00	2,714.45	1,450.00	700.00	564.45
0.50%	3,156.65	639.47	2,517.18	1,450.00	700.00	367.18
1.00%	2,873.16	375.96	2,497.19	1,450.00	700.00	347.19
2.00%	2,564.53	226.63	2,337.90	1,450.00	700.00	187.90
4.00%	2,258.60	403.07	1,855.53	1,450.00	405.53	0.00
5.00%	2,150.07	129.91	2,020.16	1,450.00	570.16	0.00
10.00%	1,811.89	353.90	1,457.98	1,450.00	7.98	0.00
20.00%	1,441.61	263.25	1,178.35	1,178.35	0.00	0.00

LATVIA

The actuarial analysis is based on a representative portfolio of crops and animal outputs, selected for their contribution to total area and to production value at producers' prices (PVPP). It comprises five crops (that account for approximately 85 percent of total area and 83 percent of total PVPP) and cow milk (49 percent of animals' PVPP). While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the final portfolio represents about 2 percent of the national GDP.

In terms of the portfolio's risk exposure, the production Reference Value (RV) is around EUR 1.2 billion and the Expected Loss (EL) is almost EUR 41 million (3.55 percent of the RV). As presented in Table , the portfolio's risk is concentrated in two crops, which together account for approximately 78% of the EL: common wheat and spelt represent 45 percent of the value and are responsible for 52 percent of the EL). Similarly, rape and turnip rape seeds constitute 17 percent of the value and 26 percent of the EL. In contrast, milk accounts for a significant portion of the portfolio's value at 26 percent, but contributes a disproportionately low 7 percent of the overall EL.

TABLE A.21 Expected production value and expected loss in Latvia

EUR million

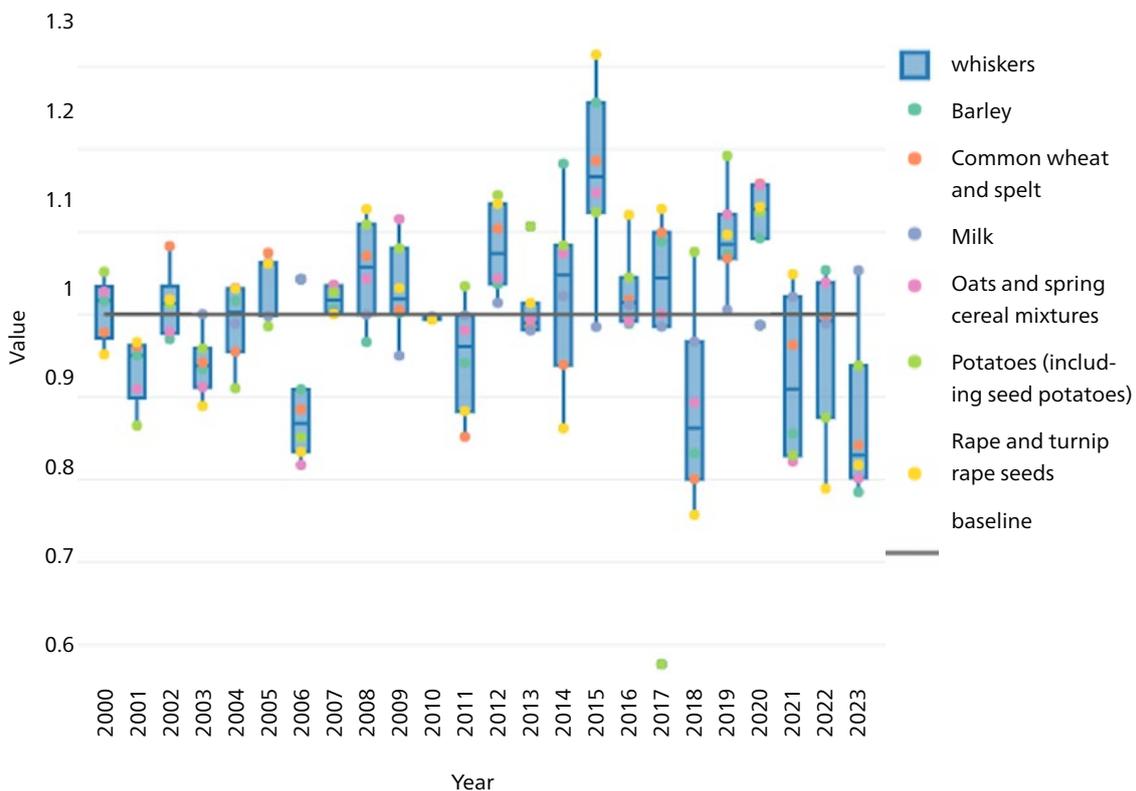
Product	Value (EUR m)	% Value	EL (EUR m)	% EL	EL (% of Value)
Common wheat and spelt	522.72	45.193%	21.27	51.86%	1.84%
Barley	48.16	4.164%	1.87	4.57%	0.16%
Oats and spring cereal mixtures (mixed grain other than maslin)	40.17	3.473%	1.72	4.19%	0.15%
Rape and turnip rape seeds	192.51	16.644%	10.54	25.70%	0.91%
Potatoes (including seed potatoes)	47.56	4.112%	2.66	6.48%	0.23%
Milk	305.51	26.414%	2.95	7.20%	0.28%
Sum_Products	1,156.62	100.00%	41.01	100.00%	3.55%

To analyze yield volatility, yield factors were calculated using yield data from 2000 to 2023 to measure deviations from an estimated trend.⁴⁴ These factors are indexed to a baseline of 1.0 (i.e., representing 100% of the trend value). The data shows that during the years with severe droughts, such as 2018, 2021, and 2023, the yield factors for grain crops – including common wheat and spelt, barley, and oats and spring cereal mixtures- fell significantly below the baseline. The years 2001, 2006 and 2018 also stand out as periods when most products presented negative deviation from their trend.

There are years in which certain events strike the whole sector but not in exactly the same way. The correlation matrix of risk factors presented in Figure A.14 shows the imperfect correlation among products; particularly, Milk exhibited a negative correlation with the crops, which contributes to the diversification benefit to the portfolio by offsetting some of the crop-related risks.

The historical yield factors and the correlation matrix were used to simulate a multivariate sample of 100,000 yields scenarios per product. Probability distributions that best fit the historical data of product yield factors were selected⁴⁵, and a multivariate random sample of 100,000 years was created using these distributions and the correlation matrix presented above. These simulated risk factors were used to derive the corresponding Yields per product, Volume of production based on an expected area, and the Value of the production based on a reference price⁴⁶. This approach ultimately enabled the assessment of the Joint Distribution of the Crop Portfolio Value.

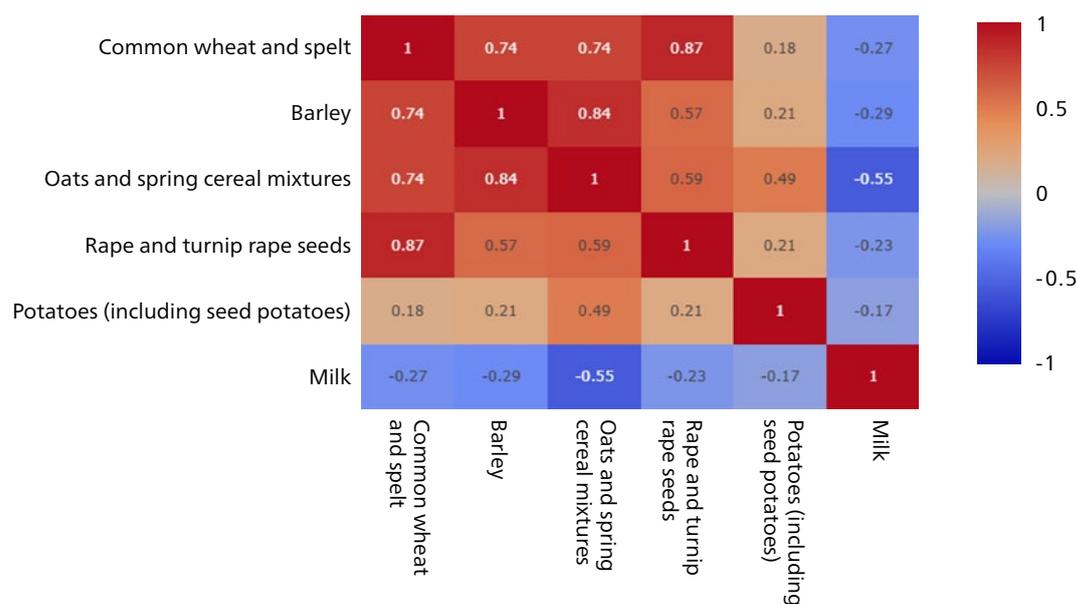
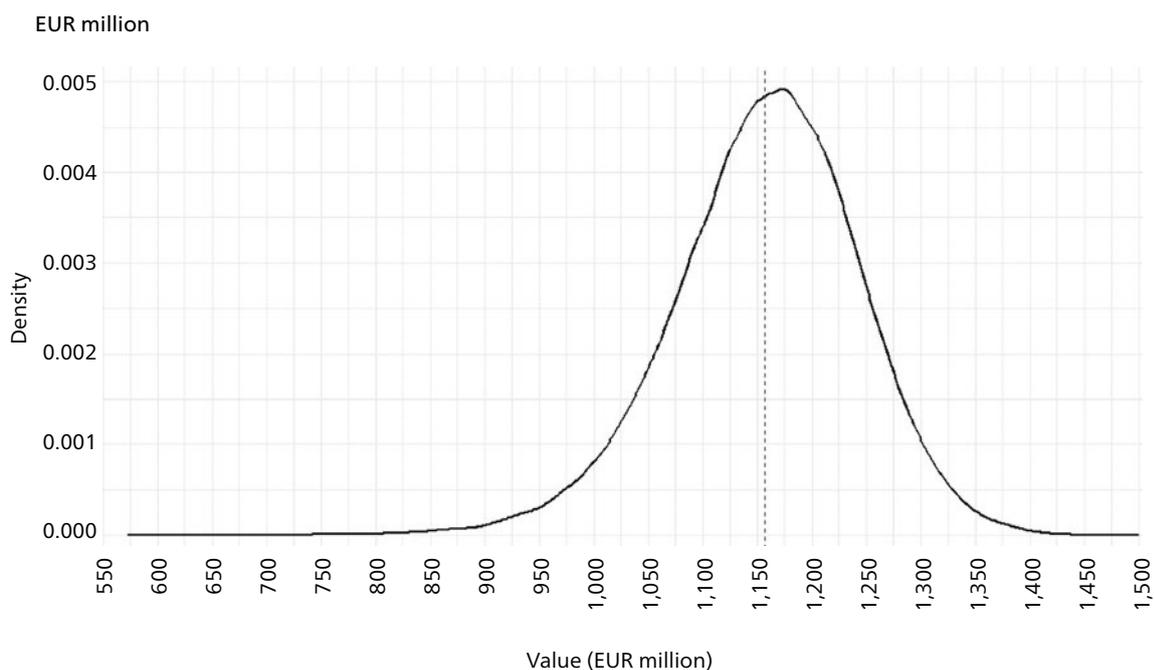
FIGURE A.14. Time series of yield risk factors in Latvia



⁴⁴ Linear regression was used for crops and an ARIMA (0,1,0) model was used in milk.

⁴⁵ The reflected Pareto4 (with a heavy left tail) distribution best fits all crops but Rape and turnip rape seeds the best fit is a Pareto4 distribution. For Milk a Weibull distribution was selected.

⁴⁶ The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants.

FIGURE A.15 Correlation matrix of yield risk factors in Latvia**FIGURE A.16** Probability density function of the joint portfolio value

For the purpose of this analysis, the “Loss” in the portfolio is defined as any negative deviation below the average. This metric is used to estimate both the financial impact on the agricultural sector and the corresponding Contingent Liability for the Government. While defining any deviation as a loss may seem conservative, the estimation is based on nation-wide yields, and therefore, it is possible that some producers suffer bigger losses, even below the 20% trigger of the current instruments. This is a caveat of the current analysis, and a more granular, a sub-national analysis using Eurostat data at NUTS-level⁴⁷ data is recommended for future work.

The Value-at-Risk (VaR) is used to estimate Contingent Liability (CL), and it measures the Loss that might be exceeded with a given annual probability. There is a 1 percent probability (1-in-100) that losses

⁴⁷ Nomenclature des unités territoriales statistiques.

at portfolio level exceed EUR 237 million, or 20.46% of the reference value. Table shows the Contingent Liabilities for each product due to production losses, as measured by the Value at Risk (VaR).

The diversification, which arises from the no-perfect correlation among products, significantly reduces Contingent Liabilities. The CL without diversification is calculated as the sum of the VaR of each crop, a highly conservative estimate that implicitly assumes all crops are perfectly positively correlated. In turn, the portfolio VaRs were estimated, considering the diversification effect among products. When crops are not perfectly correlated, adverse events affecting one product are less likely to impact others to the same extent, resulting in lower overall risk for the portfolio. For example, at a 1.0 percent exceedance probability, the VaR without diversification is EUR 294 million, and therefore the diversification benefit is EUR 57.6 million⁴⁸. This pattern holds across all exceedance probabilities, with the diversification benefit ranging from EUR 83.4 million to EUR 6.5 million.

TABLE A.22 Contingent liabilities per product and at portfolio level in Latvia

EUR million

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Common wheat and spelt	197.03	172.64	163.51	142.51	121.01	99.58	92.63	69.15	43.04
Barley	16.90	15.03	14.42	12.59	10.64	8.71	8.04	5.98	3.75
Oats and spring cereal mixtures (mixed grain other than maslin)	23.08	19.71	18.71	15.51	12.46	9.49	8.58	5.72	3.01
Rape and turnip rape seeds	104.80	91.42	87.75	75.84	63.22	51.11	47.29	34.59	20.77
Potatoes (including seed potatoes)	39.59	35.31	33.77	28.38	22.27	16.45	14.52	9.07	4.15
Milk	24.27	22.41	21.76	19.43	16.93	14.18	13.17	9.89	6.05
Sum of VaRs	405.67	356.52	339.93	294.26	246.53	199.51	184.21	134.40	80.77
Portfolio VaR	322.24	285.87	272.80	236.68	201.08	165.52	153.94	115.65	74.29
Portfolio VaR (%)	27.86%	24.72%	23.59%	20.46%	17.38%	14.31%	13.31%	10.00%	6.42%
Diversification Benefit	83.43	70.65	67.13	57.58	45.46	33.99	30.28	18.75	6.48

The diversification among agricultural products strengthens resilience to shocks and cushions sector's systemic risks. By considering diversification stakeholders can achieve more accurate risk estimates, reduce unnecessary capital reserves, and design tailored financial instruments that better match the true risk profile. Ultimately, this approach improves the efficiency and sustainability of risk management.

To mitigate the Contingent Liabilities arising from agricultural production shocks, the team is proposing illustrative examples of a portfolio of financial potential instruments. These examples demonstrate a layered approach to DRE, strategically combining risk retention and risk transfer mechanisms to enhance fiscal resilience against adverse events.

The first layer of the illustrative strategy consists of pre-arranged, dedicated capital sources totaling EUR 155 million, around 13% of the Reference Value of the portfolio, and it is targeted to cover CLs up to a 95%⁴⁹ annual probability. This layer is composed of a dedicated annual budget of EUR 75 million and a supplementary reserve fund of EUR 80 million, with resources that carry over from one year to the next. The difference between the two instruments is that the first is an annual allocation in the budget to provide support to farmers, whereas the second would be a Fund whose money is invested in high-quality financial instruments that earn interest and would be used in case of more severe events. The budget allocation is targeted to cover CLs up to an exceedance probability of 20 percent. When combined with the Fund, it is aimed to cover CLs up to a 5 percent of exceedance probability (Table A.22).

⁴⁸ The difference between the portfolio VaR presented in the previous paragraph and the VaR without diversification.

⁴⁹ There is a 5% probability that the losses exceed EUR 154 million, see Table 34.

TABLE A.23 Risk retention instruments in Latvia

EUR million

Instrument	Amount (EUR m)	Exh. Prob. (cumulative)
Budget Allocation (ex-ante)	75	19.78%
Reserved Fund	80	4.90%

For more severe events that would exhaust the retention layer, the illustrative strategy includes risk transfer instruments. The insurance is designed as a nation-wide area-yield index insurance per product. The underlying risk factors are used only to model the yield⁵⁰. The production value is therefore calculated as a “scaled yield”; hence, the attachment and exhaustion points will be expressed in million euros. These latter are linked to attachment and exhaustion probabilities of 5 percent and 1 percent, respectively, and the ceding percentage is 100 percent for all products. The Technical Premium (TP⁵¹) is estimated as the Average Annual Loss (AAL) plus a loading percentage of the Standard Deviation (SD) of $\alpha = 15.00\%$: $TP = AAL + \alpha \times SD$.

The total estimated Technical Premium is around EUR 4.93 million. This represents the pure cost of risk, calculated individually for each product, and excludes commercial loadings such as operational costs, shareholder margins. If there is a decision to incorporate this product into the DRF strategy of Latvia, the final pricing of the insurance will be different for several reasons: (1) companies will include additional loadings to cover their operational expenses and profit requirements, (2) diversification among products in Latvia may reduce the technical loading, (3) a potential risk pooling among countries in the EU might provide additional diversification benefits. Moreover, structuring the insurance program at a national level generate efficiencies, reducing costs and strengthening the government’s power of negotiation with insurance to secure more favorable prices.

Premium support is currently the main agricultural risk management tool in Latvia. The government reimburses a portion of farmers’ insurance premiums, which under the new 2023–2027 CAP, Latvia reduced to 50 percent, with the remaining 50 percent paid by farmers. Based on the technical premium of about EUR 4.93 million estimated in this analysis, a 50 percent CAP subsidy would require about EUR 2.5 million. Within the actuarial framework, insurance is modeled as the first layer of risk transfer, designed to pay out for losses before other instruments (e.g., reserve fund, budget allocation) are triggered. The technical premium is a theoretical benchmark; actual premiums may vary. The insurance mechanism is structured to cover a specific tranche of losses from extreme events, and is not intended to cover the entire financing gap. Moreover, the actuarial analysis uses national-level aggregate data. This approach may underestimate individual farm-level losses while potentially overestimating payouts, as the model does not incorporate deductibles or thresholds.

TABLE A.24. Insurance specifications in Latvia

Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP / Limit)	Leverage (Limit/TP = 1/RoL)
Common wheat and spelt	92.63	142.51	49.89	1.24	2.48%	2.24	4.48%	22.30
Barley	8.04	12.59	4.56	0.11	2.49%	0.20	4.50%	22.24
Oats and spring cereal mixtures (mixed grain other than maslin)	8.58	15.51	6.93	0.17	2.46%	0.31	4.46%	22.45
Rape and turnip rape seeds	47.29	75.84	28.56	0.70	2.46%	1.27	4.44%	22.51
Potatoes (including seed potatoes)	14.52	28.38	13.86	0.34	2.46%	0.62	4.46%	22.44
Milk	13.17	19.43	6.27	0.16	2.59%	0.29	4.64%	21.54

50 The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants.

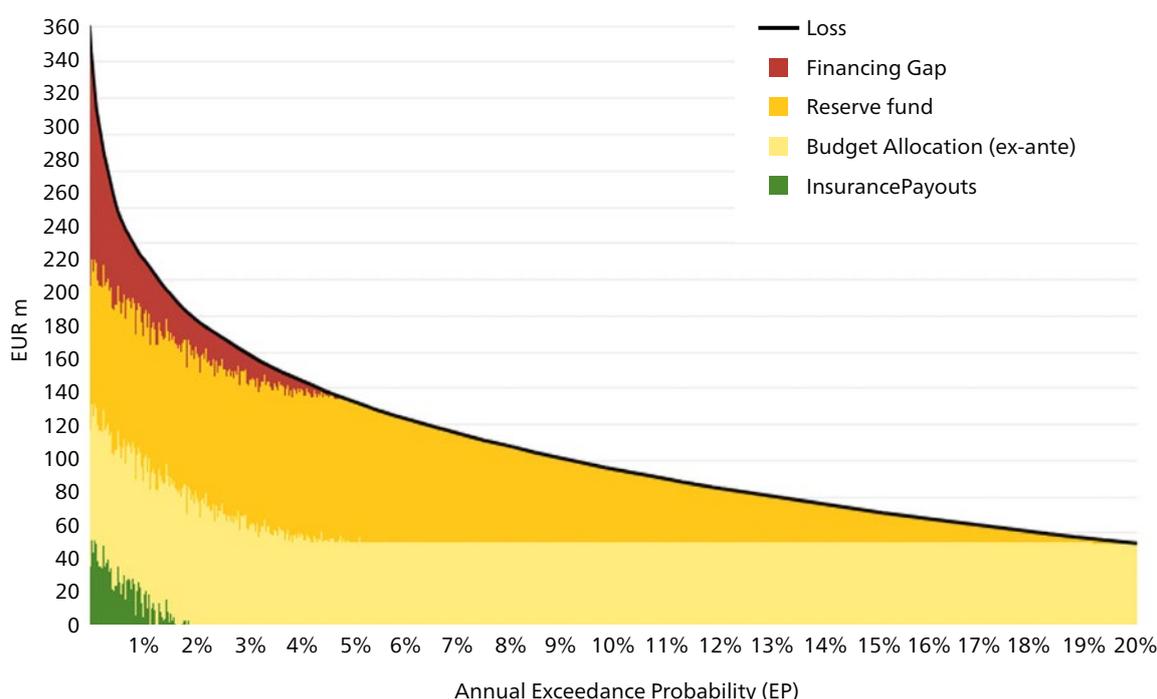
51 The application of the Standard Deviation Premium Principle is widely used for rate-making purposes, but the figures obtained must to be tested with the (re)insurance market.

The illustrative DRF strategy enhances the country's capacity to manage shocks; however, a residual risk for catastrophic events remains. Stochastic modeling based on 100,000 simulations reveals that this strategy has a 2.84 percent annual exceedance probability of being depleted. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities.

Figure A.17 presents a graphical representation of the funding gap analysis for the illustrative DRF strategy. The black line at the top of the plot shows the portfolio's Loss Exceedance Curve⁵². Below this line, the financial instruments used to finance each potential loss are stacked. The graph of the stacked instruments exhibits a sawtooth pattern because not all coverages are activated simultaneously, as the risk transfer mechanism is structured on a per-product basis. Also note that, while the risk transfer is targeted to cover the highest layers, it is illustrated at the bottom in the gap analysis. This is because any payout from a triggering event will be used first, before using any risk retention instrument. Since premiums are paid up-front, any payout from a triggering event will be used by the government to compensate the farmers before expending money from other resources.

Finally, Table A.25 illustrates the gap analysis for some specific points of the Loss Exceedance Curve⁵³. The Financing Gap is non-monotonic (i.e., the higher the loss, the higher the gap) because of the sawtooth behavior of the insurance. For example, a loss associated with a 0.5 percent exceedance probability (EUR 273 million) triggered more insurance policies, leading to a funding gap of only about EUR 28 million. In contrast, a lower loss of EUR 237 million (at a 1 percent exceedance probability) generated a lower funding gap of EUR 2 million.

FIGURE A.17 Funding gap analysis for Latvia



52 Value-at-Risk in the y-axis vs Exceedance Probability in the x-axis. The results in Table 2, above, are selected points extracted from this curve.

53 What is the "correct" annual probability to be taken? There is not a direct answer for that, is for the decision maker to make a choice. For example, some (re) insurance companies use a 1%, but others more conservative use 0.2% or even 0.1%.

TABLE A.25 Funding gap analysis for selected exceedance probabilities in Latvia

EUR million

Exc. Prob.	Loss	Insurance Payouts	Retention	Budget Allocation (ex-ante)	Reserve fund	Financing Gap
0.20%	322.24	84.66	237.58	75.00	80.00	82.58
0.40%	285.87	88.30	197.57	75.00	80.00	42.57
0.50%	272.80	89.93	182.88	75.00	80.00	27.88
1.00%	236.68	79.73	156.95	75.00	80.00	1.95
2.00%	201.08	37.00	164.07	75.00	80.00	9.07
4.00%	165.52	10.46	155.06	75.00	80.00	0.06
5.00%	153.94	28.56	125.38	75.00	50.38	0.00
10.00%	115.65	0.00	115.65	75.00	40.65	0.00
20.00%	74.29	0.00	74.29	74.29	0.00	0.00

SLOVAKIA

The actuarial analysis conducted is based on a representative portfolio of crops and animal outputs, selected for their contribution to total area and to production value at producers' prices (PVPP). It comprises seven crops (that account for approximately 80% of total area and 75 percent of total PVPP) and cow milk (40 percent of animals' PVPP). While this coverage is sufficient for the purposes of this analysis, it may lead to an underestimation of contingent liabilities. Notably, the production value of the final portfolio represents about 1.2 percent of the national GDP.

The production Reference Value (RV) is almost EUR 1.6 billion and the Expected Loss (EL) is almost EUR 70 million (4.5 percent of the RV). Table presents the RV and EL of each one of the products included in the portfolio, which comprises the four main categories presented in Error! Reference source not found. above (Cereals, Oilseeds, Forage plants and Milk). Risk is mostly concentrated in three crops: grain maize (15 percent of the value but 27 percent of the EL), common wheat and spelt (26 percent of the value and 27 percent of the EL), and rape and turnip rape seeds (14 percent of the value and 17 percent of the EL). In turn, milk has a low risk contribution as it accounts for 24 percent of the value but only 7 percent of the EL.

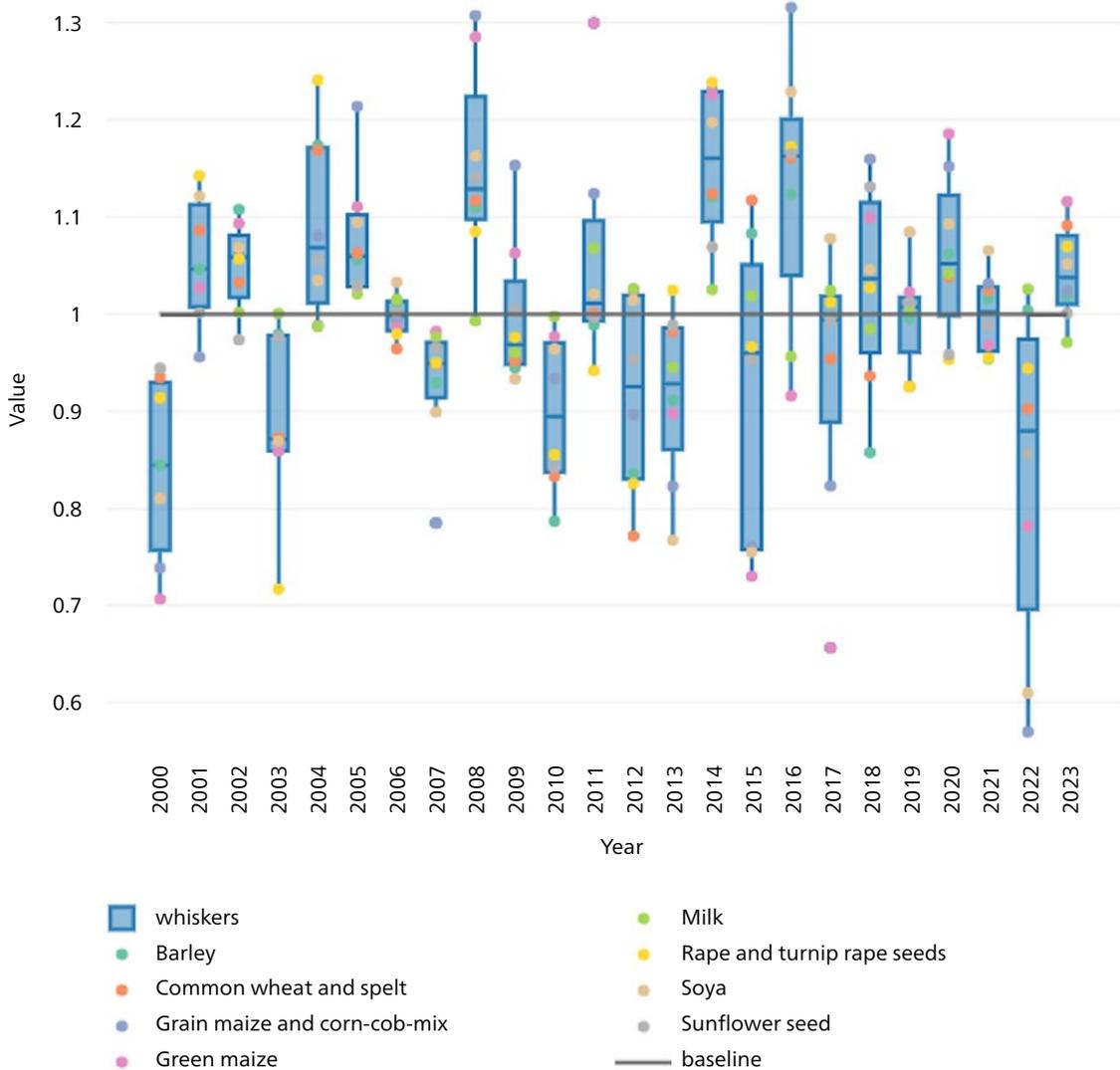
TABLE A.26 Expected production value and expected loss in Slovakia

Product	Value (EUR m)	% Value	EL (EUR m)	% EL	EL (% of Value)
Common wheat and spelt	406.32	26.12%	18.48	26.51%	1.19%
Barley	111.16	7.15%	4.78	6.85%	0.31%
Grain maize and corn-cob-mix	236.25	15.19%	18.79	26.96%	1.21%
Green maize	61.35	3.94%	4.25	6.10%	0.27%
Rape and turnip rape seeds	221.80	14.26%	11.93	17.11%	0.77%
Sunflower seed	78.51	5.05%	2.78	3.99%	0.18%
Soya	63.11	4.06%	3.70	5.31%	0.24%
Milk	376.93	24.23%	5.00	7.17%	0.32%
Sum_Products	1,555.43	100.00%	69.71	100.00%	4.48%

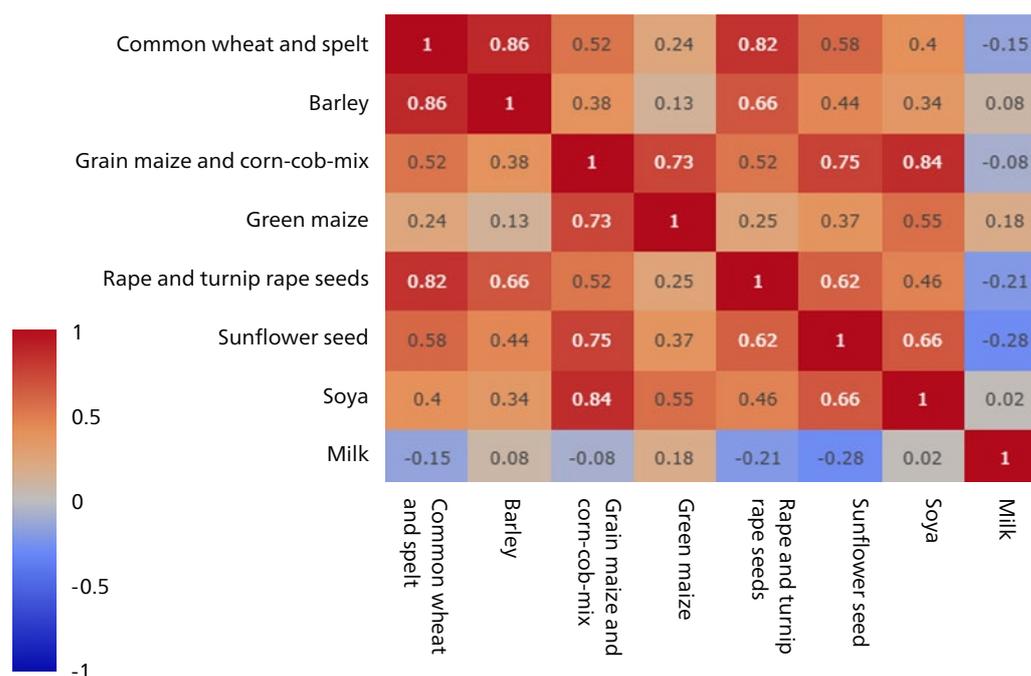
Historical information of yields between 2000 and 2023 was used to estimate “yield factors”, which measure deviations from an estimated trend⁵⁴. Figure A.18 exhibits the time series of these factors, whose baseline is one (i.e., 100% of the trend value). The graph shows that 2022, a year severely affected by drought, exhibits risk factors below the baseline for almost all products. In turn, the actuarial analysis also shows that 2000, 2003, 2007, 2010, 2012 and 2013 exhibited yields below the baseline.

There are years in which certain events strike the whole sector but not in the same way. The correlation matrix of the risk factors presented in Figure A.19 shows the imperfect correlation among products; particularly, Milk exhibited a negative or nil correlation with the crops, which contributes to the diversification in the portfolio.

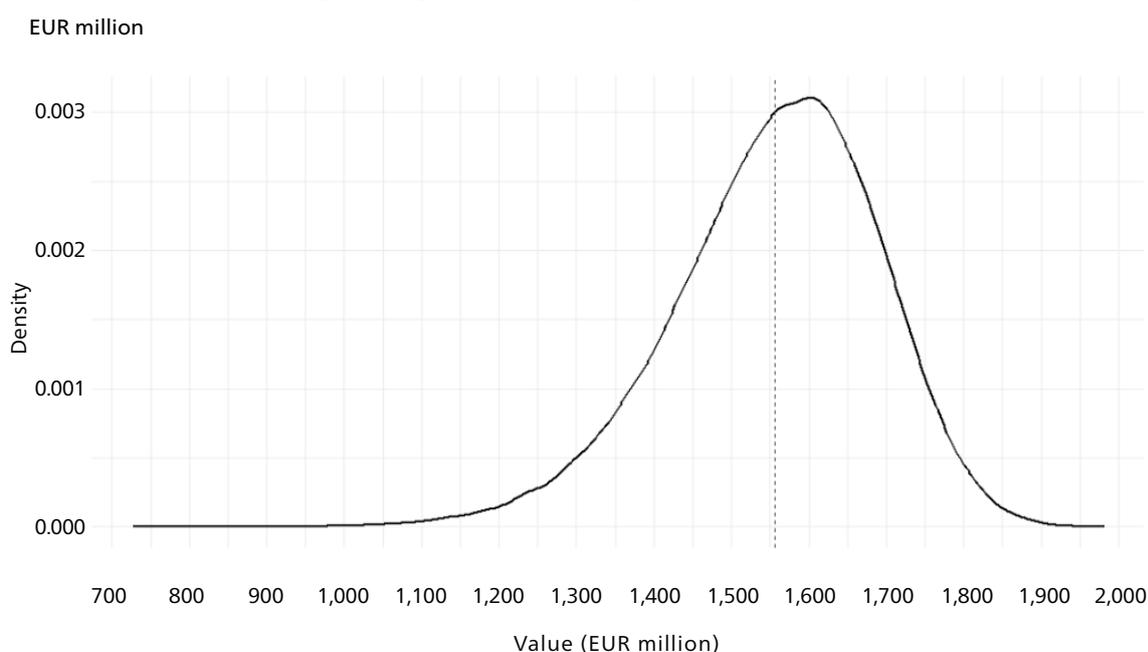
FIGURE A.18 Time series of yield risk factor in Slovakia



54 Linear regression was used for crops and an ARIMA (0,2,0) model was used in milk.

FIGURE A.19 Correlation matrix of yield risk factors in Slovakia

The historical yield factors and the correlation matrix were used to simulate a multivariate sample of 100,000 yields per product (i.e., 100k potential scenarios). Probability distributions that best fit the historical data of product yield factors were selected⁵⁵, and a multivariate random sample of 100,000 factor for each product was created using these distributions and the correlation matrix presented above. These simulated risk factors were used to simulate Yields per product, Volume of production based on an expected area, and the Value of the production based on a reference price⁵⁶. This approach enabled the assessment of the Joint Probability Distribution of the Portfolio Value.

FIGURE A.20 Probability density function of the joint portfolio value in Slovakia

⁵⁵ The Weibull distribution best fits wheat, maize, rape and sunflower; while the Pareto distribution is most appropriate for barley, green maize and soya. In turn, a Pareto with left heavy tail was selected for milk.

⁵⁶ The number of productive units (hectares or animals) and the price per ton are treated as fixed multiplicative constants.

The “Loss” in the portfolio, used to estimate the impact in the agricultural sector and the contingent liability of the government, is defined as any deviation below the average. Even though this might appear to be conservative, the estimation is based on nation-wide yields, and therefore it is possible that some producers suffer bigger losses, even below the 20% trigger of the current instruments. This is a caveat of the analysis, and it is recommended to perform a sub-national analysis based on Eurostat data at NUTS2 level (*Nomenclature des unités territoriales statistiques*).

The Value-at-Risk (VaR) is used to estimate Contingent Liability (CL), and it measures the Loss that might be exceeded with a given annual probability. There is a 1 percent probability (1-in-100) that losses at portfolio level exceed EUR 367 million, or 23.6% of the reference value. Table A.27 shows the Contingent Liabilities for each product due to production losses, as measured by the Value at Risk (VaR).

The diversification, which arises from the no-perfect correlation among products, significantly reduces Contingent Liabilities. The CL without diversification is calculated as the sum of the VaR of each crop, a highly conservative estimate that implicitly assumes all crops are perfectly positively correlated. In turn, the portfolio VaRs were estimated, considering the diversification effect among products. When crops are not perfectly correlated, adverse events affecting one product are less likely to impact others to the same extent, resulting in lower overall risk for the portfolio. For example, at a 1 percent exceedance probability, the VaR without diversification is EUR 505 million, and therefore the diversification benefit is EUR 138 million⁵⁷ (Table A.27). This pattern holds across all exceedance probabilities, with the diversification benefit ranging from EUR 197 million to EUR 14 million.

TABLE A.27. Contingent Liabilities (VaR) per product and at portfolio level

Exc. Prob.	0.20%	0.40%	0.50%	1.00%	2.00%	4.00%	5.00%	10.00%	20.00%
Common wheat and spelt	170.77	155.23	148.47	130.93	112.23	92.68	85.50	62.50	37.01
Barley	63.99	53.67	50.76	41.83	33.34	25.46	22.98	15.73	8.60
Grain maize and corn- cob-mix	148.11	137.88	134.41	120.73	105.50	89.10	83.08	62.99	38.98
Green maize	44.77	39.61	37.99	32.44	26.89	21.30	19.63	14.01	8.13
Rape and turnip rape seeds	105.24	96.50	93.51	82.54	71.70	58.93	54.62	40.42	24.10
Sunflower seed	27.13	24.33	23.34	20.44	17.37	14.09	13.01	9.42	5.47
Soya	54.03	47.71	45.56	37.86	29.76	22.28	19.79	12.58	5.95
Milk	55.75	48.23	46.01	38.27	31.47	25.01	22.85	16.20	9.57
Sum of VaRs	669.80	603.15	580.05	505.04	428.26	348.85	321.47	233.85	137.82
Portfolio VaR	472.76	429.82	415.38	367.00	318.16	263.43	245.13	186.57	123.55
Portfolio VaR (%)	30.39%	27.63%	26.71%	23.60%	20.45%	16.94%	15.76%	11.99%	7.94%
Diversification Benefit	197.04	173.33	164.67	138.04	110.10	85.42	76.35	47.28	14.28

The diversification among agricultural products strengthens resilience to shocks and cushions sector’s systemic risks. By considering diversification stakeholders can achieve more accurate risk estimates, reduce unnecessary capital reserves, and design tailored financial instruments that better match the true risk profile. Ultimately, this approach improves the efficiency and sustainability of risk management.

To mitigate the contingent liabilities arising from agricultural production shocks, we propose an illustrative example of portfolio of potential financial instruments. These examples demonstrate a layered DRF approach, strategically combining risk retention and risk transfer mechanisms to enhance

⁵⁷ The difference between the portfolio VaR presented in the previous paragraph and the VaR without diversification.

fiscal resilience against adverse events. This portfolio is purely for illustrative purposes. To ensure cost-efficiency for the government, the interaction between the existing ARM instruments and the illustrative portfolio must be carefully studied in further stages.

The first layer of the illustrative strategy consists of pre-arranged, dedicated capital sources totaling EUR 245 million, around 15% of the Reference Value of the portfolio, and it is targeted to cover CLs with a confidence level of 95%⁵⁸. This layer is composed of a dedicated annual budget of EUR 125 million and a supplementary reserve fund of EUR 120 million, with resources that carry over from one year to the next. The difference between the two instruments is that the first is an annual allocation in the budget to provide support to farmers, whereas the second would be a Fund whose money is invested in high-quality financial instruments that earn interest and would be used in case of more severe events. The budget allocation is targeted to cover CLs up to an exceedance probability of 20 percent. When combined with the Fund, it is aimed to cover CLs up to a 5 percent of exceedance probability.

TABLE A.28 Risk retention instruments in Slovakia

Instrument	Amount (EUR m)	Exh. Prob. (cumulative)
Budget Allocation (ex-ante)	125	19.67%
Reserved Fund	120	5.01%

The Budget allocation is proposed to be allocated annually to cover the first layer of losses, and it would include compensations to the farmers, while the additional Reserve Fund would be used for less frequent and more severe events. For example, the average ex-post compensations provided in Slovakia through national State-aid programs averaged around EUR 34 million from years 2021 to 2023 (Table 23, above), including insurance subsidies, Ukraine and COVID-19. It is important to stress that the illustrative instruments are targeted at the selected portfolio, whereas current programs are in principle intended for the whole universe of agricultural products. In addition, the illustrative strategy is targeted at covering only production risks, including events with relatively low frequency (i.e., up to 5% or 1-in-20 exceedance probability), whereas the aforementioned compensations were mainly targeted at market constraints.

For more severe events that would exhaust the retention layer, the proposed strategy incorporates risk transfer instruments. The instrument is designed as a nation-wide area yield index insurance per product. The attachment point and exhaustion point are expressed in millions of euros, although the underlying risk is linked to production, because the yield is the only stochastic variable considered. The triggers are linked to attachment and exhaustion probabilities of 5% (on top of the risk retention layer) and 1%, respectively. The ceding percentage is 100% for all products. The Technical Premium (TP) is estimated as the Average Annual Loss (AAL) plus an uncertainty loading percentage ($\alpha = 15.00\%$) of the Standard Deviation (SD): $TP = AAL + \alpha \times SD$ ⁵⁹. The total Limit of the illustrative risk transfer instruments is EUR 184 million⁶⁰, while the estimated Technical Premium is around EUR 8.35 million or 4.55% of the Limit (Error! Reference source not found.). This latter was rated on a per-product basis (i.e., it does not consider diversification) and does not include other loadings such as operational costs, shareholder profits, others. If a decision is made to incorporate this product into the DRF strategy of Slovakia, the final pricing of the risk transfer mechanism will be different for several reasons: (1) companies will include additional loadings, (2) diversification among products in Slovakia may reduce the uncertainty loading, (3) potential risk pooling among countries in the EU could provide additional diversification benefits. Furthermore, placing insurance at a national level might reduce costs and increase the government's negotiating power to obtain lower prices.

The illustrative risk transfer mechanism is structured at the national level and the payouts would be provided to the national government and used to increase the compensation capacity of the ex-ante budget allocation. The interaction between this risk transfer mechanism and the current scheme of insurance subsidies should be carefully studied. As noted above, Slovakia has provided premium subsidies over the past decade, though with interruptions. During this period, average claims paid for crops amounted to

⁵⁸ There is a 5% probability that the losses exceed EUR 245 million, see Table A.27.

⁵⁹ The application of the Standard Deviation Premium Principle is widely used for rate-making purposes, but the figures obtained must be tested with the (re)insurance market.

⁶⁰ This is the maximum potential payout that could be triggered. However, notice that the probability of a full payout is extremely small because of the diversification among products (e.g., in the 100,000 simulated scenarios, the maximum payout was EUR 1,127 million, only around 50% of the Limit).

EUR 3.21 million against an average premium of EUR 8.38 million, implying a loss ratio of 39%, which is relatively low (see Table 20, above). An in-depth actuarial review of the current insurance scheme with a focus on cost-efficiency is recommended. Within the 2023–27 CAP, Slovakia has implemented risk-management instruments and, in 2025, introduced EU-subsidized crop-insurance premiums for the first time, with subsidies of up to 65%. For 2023–27, Slovakia earmarked EUR 40 million for these insurance interventions, with an initial annual allocation of EUR 12 million for 2025. It should be highlighted that the risk transfer mechanism presented in the actuarial analysis, with an estimated Technical Premium of around EUR 8.35 million, is based on the selected portfolio of agricultural products and is structured to address extreme, aggregate losses with a low expected payout frequency; it does not aim to close the entire financing gap. In contrast, the subsidized farm-level insurance programs are intended to cover more frequent, individual losses with a higher payout frequency.

TABLE A.29 Risk Transfer Specifications in Slovakia

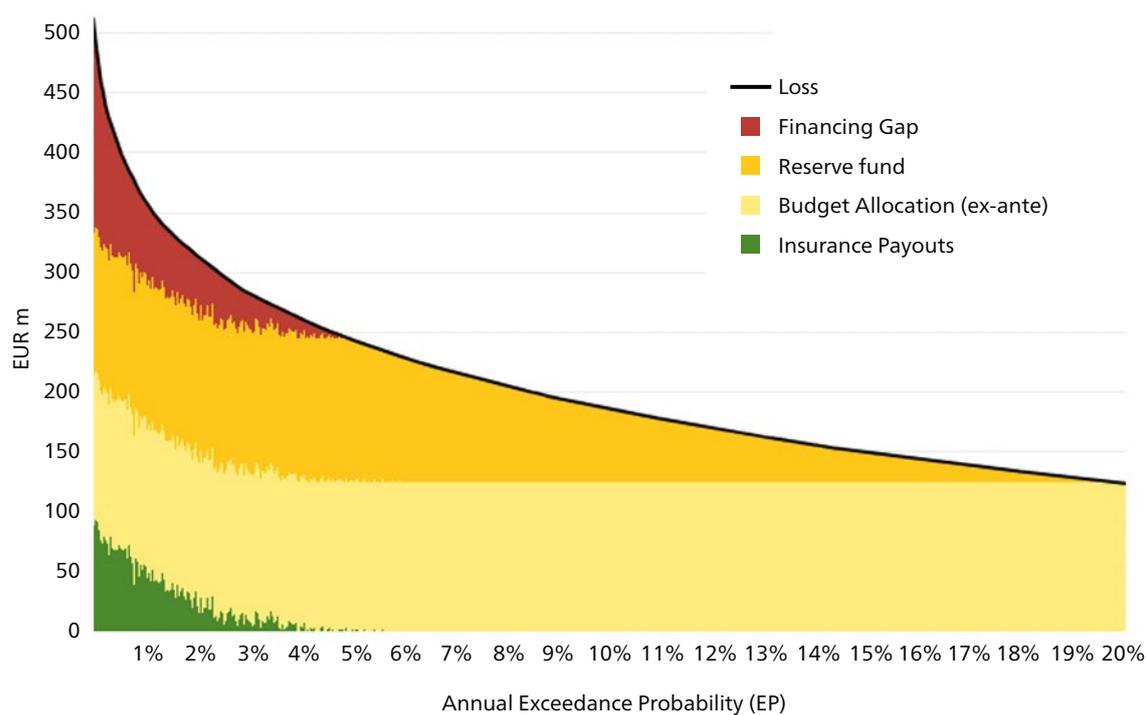
Product	Attachment (EUR m)	Exhaustion (EUR m)	Limit (EUR m)	AAL (EUR m)	AAL rate (% of Limit)	Technical Premium (TP, EUR m)	TP Rate (ROL = TP/Limit)	Leverage (Limit/TP = 1/ROL)
Common wheat and spelt	85.50	130.93	45.43	1.16	2.56%	2.08	4.59%	21.80
Barley	22.98	41.83	18.86	0.46	2.44%	0.84	4.43%	22.57
Grain maize and corn-cob-mix	83.08	120.73	37.64	0.97	2.57%	1.73	4.61%	21.71
Green maize	19.63	32.44	12.81	0.32	2.46%	0.57	4.46%	22.41
Rape and turnip rape seeds	54.62	82.54	27.91	0.72	2.58%	1.29	4.63%	21.61
Sunflower seed	13.01	20.44	7.43	0.19	2.53%	0.34	4.56%	21.93
Soya	19.79	37.86	18.07	0.45	2.46%	0.81	4.46%	22.44
Milk	22.85	38.27	15.42	0.38	2.48%	0.69	4.47%	22.35

The illustrative DRF strategy enhances the country's capacity to manage shocks; however, a residual risk for catastrophic events remains. Stochastic modeling based on 100,000 simulations reveals that this strategy has a 3.17 percent annual exceedance probability of being depleted, i.e. remaining Contingent Liability for the Government uncovered for the instruments pre-arranged. Beyond this point, any further losses would create an unfunded financing gap, exerting significant pressure on public finances and jeopardizing critical national priorities.

Error! Reference source not found. A.21 presents a graphical representation of the funding gap analysis for the illustrative DRF strategy. The black line at the top of the plot shows the portfolio's Loss Exceedance Curve⁶¹. Below this line, the financial instruments used to finance each potential loss are stacked. The graph of the stacked instruments exhibits a sawtooth pattern because not all coverages are activated simultaneously, as the risk transfer mechanism is structured on a per-product basis. Also note that, while the risk transfer is targeted to cover the highest layers, it is illustrated at the bottom in the gap analysis. This is because any payout from a triggering event will be used first, before using any risk retention instrument. Since premiums are paid up-front, any payout from a triggering event will be used by the government to compensate the farmers before expending money from other resources.

Table A.30 illustrates the gap analysis for some specific points of the Loss Exceedance Curve. The Financing Gap is non-monotonic (i.e., higher losses do not always imply higher gaps) because of the sawtooth behavior of the insurance. For instance, there is a 1% probability that the losses in the selected portfolio exceed EUR 367 million. The payouts from the risk transfer mechanism are estimated at EUR 68.7 million, and the risk retention instruments of EUR 245 million are fully depleted, resulting in a funding gap of around EUR 53 million.

⁶¹ Value-at-Risk in the y-axis vs Exceedance Probability in the x-axis. The results in Table A.29, above, are selected points extracted from this curve.

FIGURE A.21 Funding Gap Analysis in Slovakia**TABLE A.30** Funding gap analysis for selected exceedance probabilities in Slovakia

Exc. Prob.	Loss	Insurance Payouts	Retention	Budget Allocation (ex-ante)	Reserve fund	Financing Gap
0.20%	472.76	128.30	344.46	125.00	120.00	99.46
0.40%	429.82	83.76	346.06	125.00	120.00	101.06
0.50%	415.38	77.68	337.70	125.00	120.00	92.70
1.00%	367.00	68.74	298.27	125.00	120.00	53.27
2.00%	318.16	35.81	282.35	125.00	120.00	37.35
4.00%	263.43	22.50	240.93	125.00	115.93	0.00
5.00%	245.13	26.81	218.32	125.00	93.32	0.00
10.00%	186.57	10.08	176.49	125.00	51.49	0.00
20.00%	123.55	0.00	123.55	123.55	0.00	0.00

